Ala Moana Wastewater Pump Station
Emergency Generator upgrade

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
DIVISION OF ENGINEERING AND CONSTRUCTION
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

FELIX B. LIMTIACO
DIRECTOR

JAMES K. HONKE
CHIEF

WEP 96-132

March 13, 1996

Mr. Gary Gill, Director
Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

RECEIVED
'96 MAR 13 P1:35
OFC. OF ENVIRONMENTAL QUALITY CONTROL

Dear Mr. Gill:

Subject: Ala Moana Wastewater Pump Station
Emergency Generator Upgrade

The Department of Wastewater Management (WWM), City and County of Honolulu, has reviewed the draft environmental assessment for the Ala Moana Wastewater Pump Station Emergency Generator Upgrade. The agency has determined that this project will not have significant environmental effect and anticipates a negative declaration. Please publish this notice in the March 23, 1996 Environmental Notice.

We have enclosed a completed OEQC Bulletin Publication Form and four copies of the draft Environmental Assessment. The point of contact at WWM is Dennis Kaneshiro at 527-5848. M&E Pacific is the consultant to WWM on this project. The point of contact at M&E is Wes Geertsema at 529-7226.

Very truly yours,

James K. Honke

JAMES K. HONKE
Chief

Enclosures

33

1996-5-23-OA-FEA-Emerg Emergency Generator Upgrade - Ala Moana Wash with Pump Station

M & E Pacific, Inc.
Consulting Engineers

1996-5-23-OA-FEA-Emergency Emergency Generator Upgrade - Hig Hiram Brock with Pump Station

M & E Pacific, Inc.
Consulting Engineers

Final
Environmental Assessment

EMERGENCY GENERATOR UPGRADE
ALA MOANA WASTEWATER PUMP STATION
TMK: 2-1-15: 23

Prepared for

City and County of Honolulu
Department of Wastewater Management

Responsible Official:

Felix B. Limtiaco, Director

May 1996

Prepared by

M&E Pacific, Inc.
1001 Bishop Street,
500 Pauahi Tower
Honolulu, Hawaii

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
530 SOUTH KING STREET
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

FELIX B. LIMTIACO, P.E.
DIRECTOR

CHERYL K. OKUMA-SEPE, ESQ.
DEPUTY DIRECTOR

WEP 96-277

May 13, 1996

Mr. Gary Gill, Director
Office of Environmental Quality Control
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Gill:

Subject: Notice of Determination Negative Declaration
Ala Moana Wastewater Pump Station Emergency Generator Upgrade
TMK: 2-1-15:23

The Department of Wastewater Management (WWM), City and County of Honolulu is the proposing and accepting agency for the above referenced project. The WWM has reviewed and responded to comments related to the draft environmental assessment for the project. The 30-day review period began on March 23, 1996. The WWM has determined that implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a negative declaration. Please publish this notice in the May 23, 1996 Environmental Notice. We have enclosed a completed OEQC Bulletin Publication Form and four copies of the final EA.

Identification of Proposing Agency
The Department of Wastewater Management, City and County of Honolulu

Identification of Accepting Agency
The Department of Wastewater Management, City and County of Honolulu

Brief Description of Proposed Action
The proposed project involves upgrades to the Ala Moana Wastewater Pump Station (WWPS). Upgrades include addition of a new 2000 kilowatt diesel engine driven emergency generator and building expansion to accommodate the generator and electrical control equipment. These improvements are necessary to meet future sewage pumping requirements at the Ala Moana WWPS and are consistent with the East Mamala Bay Wastewater Facilities Plan. The project lies within the Kakaako Makai Special Management Area (SMA).

The project specifically involve providing a new 2000 KW diesel engine driven generator; providing ventilation, architectural, and structural changes needed for the installation of the generator and to attenuate the noise from the unit; extending the existing generator

room to reduce noise impacts; providing positive air pressure relative to the adjacent wet well; providing new switchgear; extending the existing electrical room and provide architectural and structural changes needed to accommodate the new switchgear; and providing air conditioning.

Determination
Negative Declaration

Reasons Supporting Determination
This determination is based on the significance criteria listed in 11-200-12 of the Environmental Impact Statement Rules. Specifically, these significance criteria are addressed below:

1. The proposed project will not result in an adverse commitment, loss, or destruction of any natural or cultural resources. The proposed site has already been developed and is currently in use.

2. The range of beneficial uses of the environment will not be curtailed.

3. The project will not conflict with the state's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court orders or executive orders. The project conforms with the 1993 East Mamala Bay Wastewater Facilities Plan and the 1989 Kakaako Makai Area Plan and Rules.

4. The proposed project will not adversely affect the economic or social welfare of the community or state.

5. The project will not adversely affect public health. The project will improve public health by increasing the pumping capacity during power outages, and increasing the flexibility and reliability of the Ala Moana WWPS.

6. The project will not involve substantial adverse secondary impacts, such as population changes or effects on public facilities. The proposed project responds to current population trends.

7. The project will not involve a substantial degradation of environmental quality.

8. The project does not involve a commitment for larger actions and will not result in significant cumulative effects upon the environment. The proposed actions are consistent with the East Mamala Bay Wastewater Facilities Plan and EIS.

9. The project will not substantially affect a rare, threatened or endangered species , or its habitat.

10. The project will not detrimentally affect air or water quality or ambient noise levels. Sound attenuation equipment is included in the project design. Short-term impacts will occur during the construction phase.

11. The project will not affect an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

12. The project will not affect scenic vistas and viewplanes.

13. The project will not require substantial energy consumption. The generator provides backup power.

Contact Persons for Further Information

Proposing agency: Mr. Dennis Kaneshiro
Department of Wastewater Management
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813
(808) 527-5848

Consultant: Mr. Wes Geertsema
M&E Pacific, Inc.
1001 Bishop Street
Suite 500, Pauahi Tower
Honolulu, Hawaii 96813
(808) 521-3051

Very truly yours,

Cheryl K. Okuma-Soon for

FELIX B.LIMTIACO
Director

Enclosures

TABLE OF CONTENTS

LIST OF FIGURES

1.0 APPLICANT

The applicant for the proposed Ala Moana Wastewater Pump Station Emergency Generator Upgrade (project) is the Department of Wastewater Management (WWM), City and County of Honolulu (CCH). This Environmental Assessment (EA) was prepared in accordance with Section 343, Hawaii Revised Statutes (HRS) and Chapter 200 of Title 11, Hawaii Administrative Rules (HAR). This Environmental Assessment is required due to the use of State land and County funds within a Special Management Area.

2.0 APPROVING AGENCY

The approving agency for a determination of significance for this Environmental Assessment is the CCH WWM.

3.0 CONSULTATION LIST

The following parties were contacted during the preparation of the draft environmental assessment. The parties with an asterisk (*) commented on the draft document, and responses are provided in Appendix B.

United States Government
- Department of the Interior
  - Fish and Wildlife Service

State of Hawaii:
- *Department of Land and Natural Resources:
  - Historic Preservation Division
  - Forestry and Wildlife Division
- *Department of Health:
  - Clean Air Branch
  - Clean Water Branch
  - Office of Environmental Quality Control
- *Department of Transportation:
  - Harbors Division
- *Hawaii Community Development Authority
- *Office of Hawaiian Affairs
- *Office of State Planning

City and County of Honolulu:
- *Department of Public Works:
  - Storm Water Quality
- *Department of Planning
- *Department of Land Utilization
- *Department of Transportation Services

*Building Department:
Permit Section
Neighborhood Board Commission
Ala Moana/Kakaako Neighborhood Board Number 11

Others:
Hawaiian Electric Company (HECO)

4.0 PROJECT OBJECTIVE AND NEED

The proposed project involves upgrades to the Ala Moana Wastewater Pump Station (WWPS). Upgrades include addition of a new 2000 kilowatt (KW) diesel engine driven emergency generator and building expansion to accommodate the engine generator, electrical switchgear, motor control center and electrical control equipment. These improvements are consistent with the East Mamala Bay Wastewater Facilities Plan (Belt Collins, 1993a) and were included in the Environmental Impact Statement for the plan (Belt Collins, 1993b).

The new emergency engine generator is necessary to provide reliable power to existing sewage pumps and to meet future sewage pumping requirements at the Ala Moana WWPS. The WWPS receives sewage from all other pump stations in the Ala Moana sub-district (see Figure 3) and discharges the sewage to the Sand Island Wastewater Treatment Plant (SIWWTP). It is the largest pump station in East Mamala Bay with four pumps and a peak pumping capacity of 101.5 million gallons per day (mgd). However, according to the East Mamala Bay Final Wastewater Facilities Plan, the WWPS does not have adequate capacity to convey future design peak flows for the year 2015 (166 mgd and 143 mgd, based on land use and population models respectively). In addition, future expansion of the SIWWTP will create higher hydraulic head requirements for the pump stations upstream. In order to meet future sewage pumping requirements, the WWM plans to upgrade the Ala Moana WWPS by adding a fifth pump and increasing the size of existing motors in the near future. Volume I, Section 36.2 of the WWM Design Standards (July, 1993) states that pump stations shall be equipped with standby diesel powered engine generators to provide electric power to pump the peak flow. Currently, one standby 800 KW Combustion Turbine (CT) generator is available on-site to provide backup power. However, the existing generator can only power two pumps simultaneously. The new generator is required to provide backup power to all pumps (four pumps are required to pump the peak wet weather flow).

The proposed project also includes the addition of air conditioning to increase the reliability and extend the service life of sensitive electrical equipment.

5.0 PROJECT DESCRIPTION

The improvements to the Ala Moana WWPS are described as follows:

1. Provide a new 2000 KW diesel engine driven generator to augment the existing 800 KW CT generator. Provide ventilation, architectural, and structural changes needed for the installation of the diesel engine driven generator and to attenuate the noise from the unit. The existing generator room will be extended to accommodate the duct silencers needed to reduce noise impacts.

2. Install supply air fans to improve ventilation. Provide positive air pressure relative to the adjacent wet well to comply with NFPA 820. A new motor control center (MCC) will be provided for the fans.

3. Provide new switchgear to interface between all incoming power sources and dual feeds to existing electrical switchgear. New switchgear shall also include new pump motor starters, and the electrical controls and logic for operating the entire station.

4. Provide space for the generator switchgear and air conditioning units. The existing WWPS building will be expanded to accommodate the new equipment. The new and existing electrical rooms will be enclosed and a split-type air conditioning system of air-cooled condensing units and air handlers will be provided. The location for the new building expansion needed for the electrical equipment is shown on Figures 5 and 6.

5. Replace existing Hawaiian Electric Company (HECO) electrical transformers with larger HECO transformers to handle future pump and motor upgrades consistent with the East Mamala Bay Wastewater Facilities Plan.

5.1 Final Design

Several design alternatives were presented in the draft EA based upon the September, 1995 preliminary Engineering Design Report (EDR) for the project (M&E Pacific, 1995). The final design included here shares the same design concept with Alternative 3B, except that the building interior layout has been revised.

Figures 5 and 6 show the site plan which relocates the office, locker, janitor room and bathroom to the north of the existing electrical equipment room. Air conditioning units will be placed in a new equipment room next to the locker, and the condensing units will be installed on the roof. New electrical equipment will be located where the office area is currently located. The existing generator room will be extended to accommodate the duct silencers needed to reduce noise impacts. There are five new roof exhaust fans above the pump station as shown. The HECO transformer will be relocated to the north of the new

office area, but within the subject property. To reduce noise impacts from the transformer at the property boundary, a 12-feet high sound deflection wall will be constructed along the northwest fenceline. No reconfiguration of site boundaries is required.

5.2 Cost

The preliminary cost estimate for construction is $1,500,000 - $2,000,000.

6.0 SUMMARY OF AFFECTED ENVIRONMENT

6.1 Location and Access

Figure 1 shows the regional location of the Ala Moana WWPS on Keawe Street in Kakaako, within the Honolulu judicial district. The site is identified as the 30,390 square feet (0.7 acre) parcel Tax Map Key (TMK) 2-1-15:23, and the owner is identified as the State of Hawaii (Figure 2). The site is seaward of Ala Moana Boulevard, and access to the site is obtained through a gate located on Keawe Street, near the intersection of Ilalo Street.

6.2 Future Projects at the Ala Moana WWPS

As stated in Section 4.0, the proposed project is consistent with the East Mamala Bay Wastewater Facilities Plan and Environmental Impact Statement (Belt Collins, 1993a: 1993b). Design and construction of the proposed project will be coordinated with future projects planned for the Ala Moana WWPS.

Specifically, the proposed project is related to the *Ala Moana WWPS Modification* project, currently in the planning stage. The *Ala Moana WWPS Modification* project will result in the following improvements to the WWPS: upgrade the pumps to meet increased upstream and downstream demands (described in Section 4.0), maximize operator flexibility, meet accessibility requirements, and meet odor control needs. Implementation of the *Ala Moana WWPS Modification* project will require expansion of the property boundaries. Approximately 0.4 acres will be required from the northwest side of the WWPS boundaries. Additional land would be obtained from parcel 9 or 43 of TMK 2-1-15, owned by the State of Hawaii.

6.3 Topography and Climate

The project site is in the leeward coastal lowland area of Oahu. It is virtually flat with an elevation of approximately 8 feet. The climate in the general area is similar to that of other coastal areas in Honolulu. It is characterized by long southern exposures; temperatures ranging from 55 degree Fahrenheit to 90 degree Fahrenheit; persistent

northeasterly trade winds, ranging from 8 to 18 miles per hour; and an average mean rainfall of less than 30 inches (Aloha Tower Associates, 1990; WWM, 1985).

6.4 Infrastructure

Power for the Ala Moana WWPS is provided by Hawaiian Electric Company's (HECO) Downtown and Kakaako systems (Belt Collins, 1993b). There are two transformers at the WWPS, and each is powered by a separate substation. Each transformer supplies power to half of the switchgear. If one feeder line fails, the breaker will automatically close and supply power to all of the switchgear. The standby emergency generator on-site can operate two pumps simultaneously during a power outage. Fuel for the generator is provided by a 10,000 gallon diesel underground storage tank located on the subject property. The existing generator does not have the capacity to support peak pumping or motor upgrades. Also, the generator has been reported to be prone to failure (Belt Collins, 1993b).

Telephone, water and sewer services are currently available at the project site.

6.5 Land Use Zoning

The project is within the Kakaako Community Development District, and land use at the project site is under jurisdiction by the Hawaii Community Development Authority (HCDA). The project lies within the Kakaako Makai Special Management Area (SMA). The subject property is zoned for public use, according to the Kakaako Makai Area Plan (HCDA, 1990). Surrounding land uses are planned for commercial development with parks located seaward of the subject property.

The site is currently designated as Public and Quasi-Public on the Primary Urban Center Development Plan Land Use Map. A Development Plan Public Facilities Map amendment to the Primary Urban Center for a publicly funded wastewater pump station/modification symbol was approved by the Honolulu City Council under Ordinance 93-040.

6.6 Soils

The project area lies on land classified by the U.S. Soil Conservation Service (USDA, 1972), as Fill land, mixed (FL). This land type occurs mostly adjacent to the ocean, consists of areas filled with material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources. Approximately 5 to 10 feet of coral fill underlie the site. Beneath the coral fill are soft mixtures of sand, silt and clay, and a coral layer exists between 5 and 20 feet below mean sea level (HCDA, 1990).

6.7 Water Quality

Groundwater underlying the project site is located at approximately sea level, with some tidal fluctuation. The site is located seaward of the underground injection control line, and therefore groundwater underlying the site is not considered a source of drinking water. The project will be designed with pile cap footings above the water level for construction, and dewatering is not anticipated.

Honolulu Harbor and Kewalo Basin are classified as Class "A" embayments, designated for recreational uses, aesthetic enjoyment, and propagation of marine life (HCDA, 1990). Also, the Kakaako Makai Area Plan includes future development of 17 acres of inland waterways. The project does not involve discharge into these nearshore waters. All sewage is pumped directly to the SIWWTP.

6.8 Natural Hazards

The project site is near the Honolulu Harbor, which is subject to coastal flood hazards such as tsunamis, hurricane wave-induced coastal inundation. During Hurricane Iwa in 1982, Kewalo peninsula and the Fort Armstrong area in the region were flooded However, like most of Kakaako Makai area, the project parcel is in Zone X, designated for areas outside of the 500-year flood plain (HCDA, 1990). There are no surface water bodies in the Kakaako Makai area, although the Kakaako Makai Area Plan includes future development of 17 acres for inland waterways.

Island of Oahu is in seismic Zone 1 as determined in the 1988 edition of Uniform Building Code. The intensity of earthquake effects are classified as intensity VI, able to break glassware and shake books off of shelves.

6.9 Archaeological and Historic Sites

The proposed area of construction is shown on Figure 4. The Kakaako Makai area is highly developed, and there are no known archaeological sites on or adjacent to the project site. However, should evidence of archeological sites be uncovered during excavation, all construction work will cease and the State Historic Preservation Office shall be notified immediately to allow for a field investigation.

Two historic sites are located northeast (mauka) of the Ala Moana WWPS. Both sites are historic buildings previously used as wastewater pumping stations. The original Hering Station (1900), and the old Ala Moana Station (1940) are on the Hawaii and National Register of Historic Places (site no. 80-14-9710) and considered to have "high" preservation potential and historic significance. The proposed construction will not impact the two stations.

6.10 Biological Resources

Generally, the project site and the surrounding areas are in a highly altered urban environment, providing little or no habitat for any terrestrial flora and fauna. Non-paved ground surface at the project site is covered with introduced turf grass and scattered papaya trees. It is unlikely that the site is a habitat for native Hawaiian or endangered species.

6.11 Noise

An acoustical engineering study was performed for this project and is included in Appendix A. Existing background ambient noise levels were measured on October 7, 1994 at and near the station perimeter fenceline (Y. Ebisu, 1994). Noise levels were measured at the same locations with the 800 KW combustion turbine generator operating along with a temporary 900 KW diesel engine generator.

The results indicated that background ambient noise levels around the station are between 55 and 62 dBA. Major noise sources at the project site include traffic along Ala Moana Boulevard. Currently, State Department of Health (DOH) noise limits for commercial and apartment properties on Oahu are 60 dBA and 50 dBA for daytime and nighttime periods, respectively.

6.12 Air Resources

Air quality standards are provided in Hawaii Administrative Rules, Title 11, Chapter 59. A variety of air emission sources are located in or near Kakaako. Air monitoring results from downtown Honolulu indicate compliance with State and Federal standards for ambient air (HCDA, 1990).

6.13 Traffic

Ala Moana WWPS is accessible via Keawe Street, near the intersection with Ilalo Street. Keawe Street is one of several streets that convey north to south traffic flow in the Kakaako area (See Figure 1). Ala Moana Boulevard, which is an important link between the airport area, downtown and Waikiki, is located approximately 500 feet to the northeast.

Currently, traffic conditions within the Kakaako Makai area are being evaluated by the HCDA. Preliminary plans have been developed to realign and expand Keawe Street and to extend Ilalo Street in the immediate vicinity of the proposed project site (HCDA, 1990). The proposed project is consistent with the Kakaako Makai Area Plan by leaving the western part of the subject property available for the Ilalo road extension. A temporary electrical transformer (described in Alternate 3A Option 2) may be located in this area in order to phase construction so that operation of the Ala Moana WWPS is not

disrupted. The temporary structure would be removed once permanent electrical transformers are operational.

7.0 RELATIONSHIP OF THE PROJECT TO CZM PROGRAM

The project lies within the Kakaako Makai Special Management Area (SMA). As such, the project is consistent with the policies and objectives of the coastal zone management (CZM) program. The relationship of the project to the CZM program is described below:

1. Recreational resources. The project will not adversely affect coastal recreational opportunities accessible to the public.

2. Historic resources. Two historic buildings considered to have "high" preservation potential and historic significance are located northeast (mauka) of the Ala Moana WWPS. The proposed construction will not impact the two stations.

3. Scenic and open space resources. The project will be compatible with the existing visual environment and will not impact shoreline open space areas.

4. Coastal ecosystems. The project will not disrupt, degrade or have other adverse impact on coastal ecosystems.

5. Economic uses. The project will not adversely impact the development potential of neighboring parcels within the Kakaako Community Development District.

6. Coastal hazards. The project will reduce the hazard to life and property from wastewater pollution by upgrading the Ala Moana WWPS. The new emergency engine generator is necessary to provide reliable power to existing sewage pumps and to meet future sewage pumping requirements at the Ala Moana WWPS, the largest sewage pumping station in East Mamala Bay.

7. Managing development. The project will not adversely impact the management of coastal resources and hazards.

8. Public participation. Public review and comment was solicited during the environmental assessment process. A presentation of the project was given during the February 27 meeting of the Ala Moana/Kakaako Neighborhood Board.

9. Beach protection. The project will not facilitate beach erosion nor adversely impact public use of beach areas.

10. Marine resources. The project will not adversely impact marine resources.

8.0 PROBABLE IMPACTS AND MITIGATION MEASURES

8.1 Short-term Construction Related Impacts

All proposed construction activities will be performed within or adjacent to existing pump station property boundaries. There is no major earth moving operations associated with this project, except for footing excavations for the MCC generator room extension and AC rooms. Therefore, the fugitive dust and hydrocarbon emission from heavy vehicles are temporary and not anticipated to be a major concern. Other short term impacts, such as the increase in traffic, dust and noises, are expected to be insignificant since the scale of construction is small and the construction site is located away from residential areas. Dewatering is not anticipated for construction.

A Phase I Environmental Site Assessment (ASTM practice E1527) of the subject property will be performed to determine if any hazardous substance contamination exists that may affect construction.

8.2 Noise

Engine generators can create a noise nuisance without engineering and operational controls. Background noise levels were measured at the project site and compared with readings obtained while the 800 KW combustion turbine generator was operating and with readings obtained using a temporary 900 KW diesel engine generator to simulate noise created by the new generator. The results indicate a high noise level requiring mitigation (see Appendix A).

The proposed project includes equipment and engineering measures to attenuate sound from the new generator. The measures were designed to reduce the noise level to 60 dBA or less at the project's property lines which adjoin the Mixed-Use / Commercial Zones, and to approximately 50 dBA at the closest Mixed-Use / Residential Zone. A description of the proposed noise-reduction measures are included in Appendix A. They include sound-treating the existing generator building and adding intake air silencers and exhaust mufflers to the generator air discharge.

The new HECO transformer will be located closer to the northwest property fenceline as compared to the existing HECO transformer. To reduce noise impacts from the new transformer at the property boundary, a 12-feet high sound deflection wall will be constructed along the northwest fenceline.

8.3 Air Resources

Regulations for air pollution control are provided in Hawaii Administrative Rules, Title 11, Chapter 60. The new 2000 KW emergency generator is considered a significant emission source if operated continuously at full load for the entire year. However, the

generator is normally operating only during routine testing. An initial non-covered permit must be obtained from the DOH Clean Air Branch to operate the generator. In order to qualify for non-covered permit status, restrictions will be placed on operation of the new generator. Fuel usage of the new generator will be limited to keep nitrogen emissions less than 40 tons per year. Using AP42 emission factors for large stationary diesel engines, fuel usage will be limited to less than 180,000 gallons per year. The proposed project includes installation of a separate fuel meter to track fuel consumed by the new generator.

No restrictions will be placed on the existing generator, since emission rates are not significant, even if operated at full load for the entire year.

9.0 ALTERNATIVES TO THE PROPOSED ACTION

9.1 No Action

Implementation of this project will enable the City to increase the capacity of the existing Ala Moana WWPS to handle projected peak flowrates during emergency occurrences of power outage. Without this project, insufficient pumping capacity would increase the risk of potential wastewater spills in the tributary areas. Wastewater spills pose a threat to human health. The project is also considered beneficial by maintaining current sewer services for the people of Honolulu.

9.2 Alternative Site

An alternative site is not considered a viable option. An alternative site further away may involve costly land purchases as well as access difficulties. Piping and system control may also be inefficient from an engineering standpoint. The proposed project expands the existing Ala Moana WWPS. The vacant space in the generator room was designed to house a future generator (although an eight foot extension is required for the proposed project). The proposed MCC room and air structures are intended to be integral parts of the existing buildings.

10.0 LIST OF PERMITS

The following permits and clearances will be required as part of this project:

State of Hawaii:
Special Management Area Use Permit (Office of State Planning)
Kakaako Base Zone Development Permit (Hawaii Community Development Authority)
Initial Noncovered Source Permit (DOH Clean Air Branch)
Construction Dewatering Permit (DOH Clean Water Branch), not anticipated

City and County of Honolulu:
Grading Permit (Department of Public Works)
Building Permit (Building Department)
Construction Dewatering Permit to Discharge into City & County of Honolulu Storm Drainage System (if necessary, not anticipated)

Other:
Concurrence with Hawaiian Electric Company regarding transformer relocation

11.0 DETERMINATION

In accordance with Chapter 343, Hawaii Revised Statutes, this Environmental Assessment has characterized the technical and environmental issues of the Emergency Generator Upgrade at Ala Moana WWSP project, identified potential impacts and their significance. It is anticipated that the proposed project will not significantly impact the environment. Therefore, a Negative Declaration is anticipated, and an Environmental Impact Statement is not required for this project. This determination is based on the significance criteria listed in §11-200-12 of the Environmental Impact Statement Rules. Specifically, these significance criteria are addressed below:

1. The proposed project will not result in an adverse commitment, loss, or destruction of any natural or cultural resources. The proposed site has already been developed and is currently in use.

2. The range of beneficial uses of the environment will not be curtailed.

3. The project will not conflict with the state's long-term environmental policies or goals and guidelines as expressed in chapter 344, HRS, and any revisions thereof and amendments thereto, court orders or executive orders. The project conforms with the 1993 East Mamala Bay Wastewater Facilities Plan and the 1989 Kakaako Makai Area Plan and Rules.

4. The proposed project will not substantially adversely affect the economic or social welfare of the community or state.

5. The project will not substantially adversely affect public health. The project will improve public health by increasing the pumping capacity during power outages, and increasing the flexibility and reliability of the Ala Moana WWPS.

6. The project will not involve substantial adverse secondary impacts, such as population changes or effects on public facilities. The proposed project responds to current population trends.

7. The project will not involve a substantial degradation of environmental quality.

8. The project does not involve a commitment for larger actions and will not result in significant cumulative effects upon the environment. The proposed actions are consistent with the East Mamala Bay Facilities Plan and EIS.

9. The project will not substantially affect a rare, threatened or endangered species, or its habitat.

10. The project will not detrimentally affect air or water quality or ambient noise levels. Sound attenuation equipment is included in the project design. Short-term impacts will occur during the construction phase.

11. The project will not affect an environmentally sensitive area such as a flood plain, tsunami zone, erosion-prone area, geological hazardous land, estuary, fresh water, or coastal waters.

12. The project does not affect identified scenic vistas or view planes.

13. The project does not require substantial energy consumption. The generator provides backup power.

12.0 REFERENCES

Documents reviewed during preparation of this Environmental Assessment:

Aloha Tower Associates and Wilson, Okamoto & Associates, Inc., December 1990. Final Environmental Impact Statement for the Waterfront at Aloha Tower.

Belt Collins Hawaii, December, 1993a. East Mamala Bay Final Wastewater Facilities Plan, Volume I-A & II.

Belt Collins Hawaii, December, 1993b. East Mamala Bay Final Wastewater Facilities Plan Final Environmental impact Statement.

Department of Wastewater Management (WWM), City and County of Honolulu, July, 1993. Design Standards.

Department of Wastewater Management (WWM), City and County of Honolulu, April, 1985. Notice of negative Declaration for Ala Moana Reconstructed Sewer.

Hawaii Community Development Authority (HCDA), May 1985. Final Supplement Environmental Impact Statement for the Kakaako Community Development District Plan An Addendum to Final Environmental Impact Statement 82-5F(FS).

Hawaii Community Development Authority (HCDA), January, 1990. Kakaako Makai Area Plan Final Supplement Environmental Impact Statement.

M&E Pacific, Inc., September 1995. Engineering Design Report for Emergency Generator Upgrade at Ala Moana Wastewater Pump Station.

U.S. Department of Agriculture, Soil Conservation Service in Cooperation with the University of Hawaii Agricultural Experiment Station, August 1972. Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii.

Wilson, Okamoto & Associates, Inc., November 1975. Final Environmental Impact Statement for the New Ala Moana Sewage Force Main.

Y. Ebisu & Associates, October 1994. Initial Acoustical Recommendations for 2000 KW Emergency Generator; Upgrade Emergency Generator, Ala Moana Wastewater Pump Station.

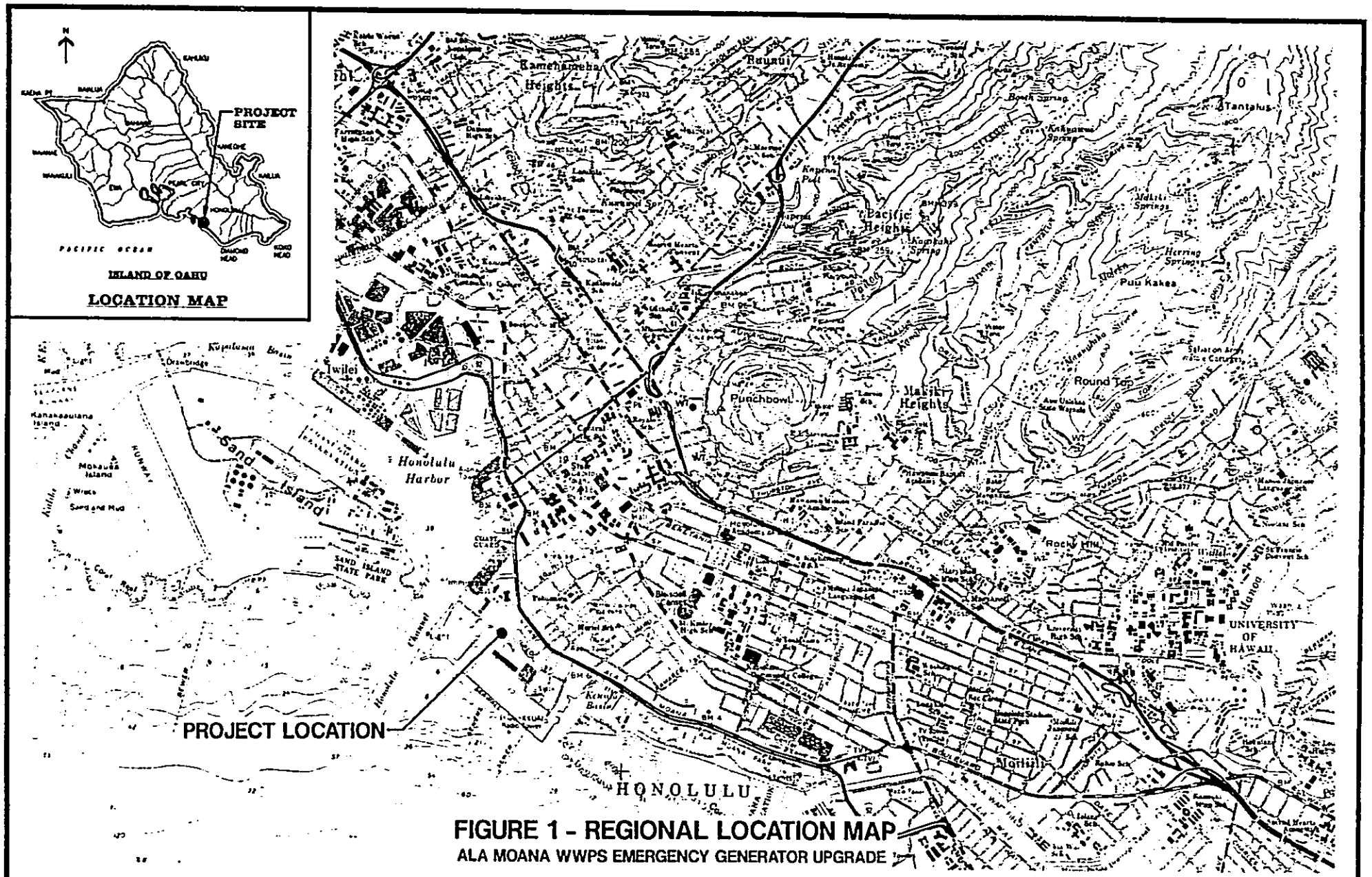


FIGURE 1 - REGIONAL LOCATION MAP

ALA MOANA WWPS EMERGENCY GENERATOR UPGRADE

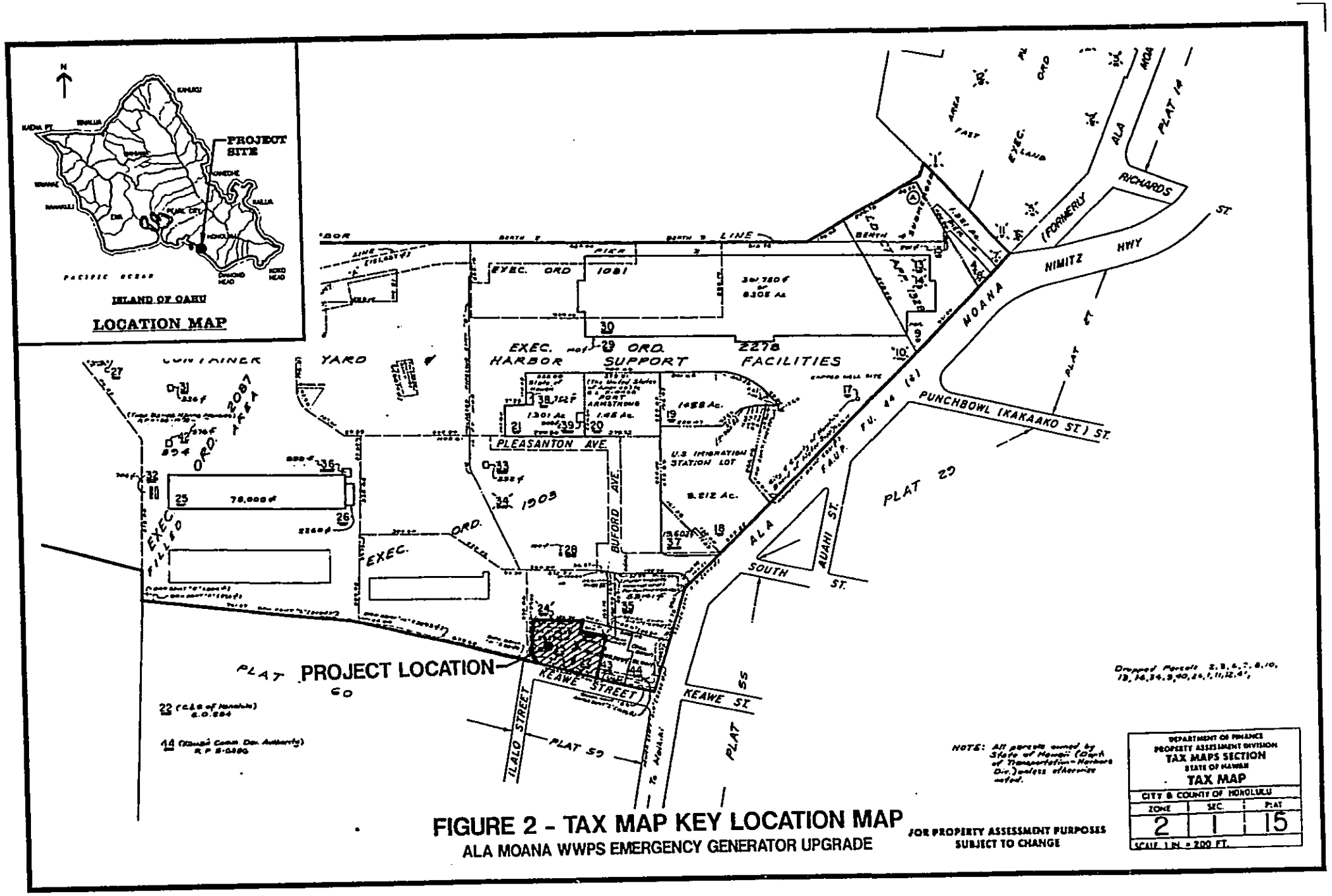
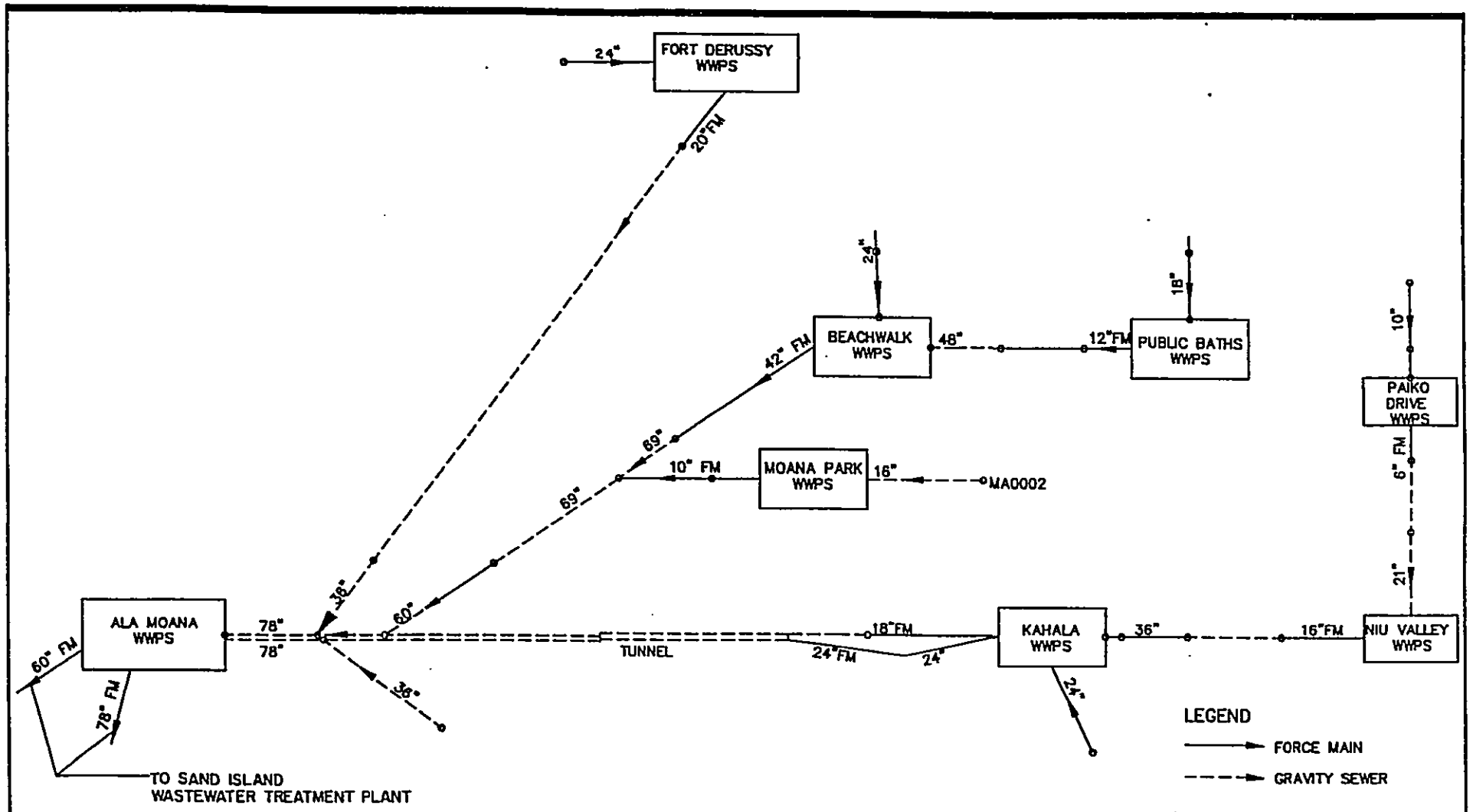


FIGURE 2 – TAX MAP KEY LOCATION MAP
ALA MOANA WWPS EMERGENCY GENERATOR UPGRADE

FOR PROPERTY ASSESSMENT PURPOSES
SUBJECT TO CHANGE



REFERENCE:

EAST MAMALA BAY WASTEWATER FACILITIES PLAN BELT COLLINS HAWAII • DECEMBER 1993	Not to Scale	**FIGURE 3 - ALA MOANA SUB DISTRICT WASTEWATER SYSTEM** ALA MOANA WWPS EMERGENCY GENERATOR UPGRADE

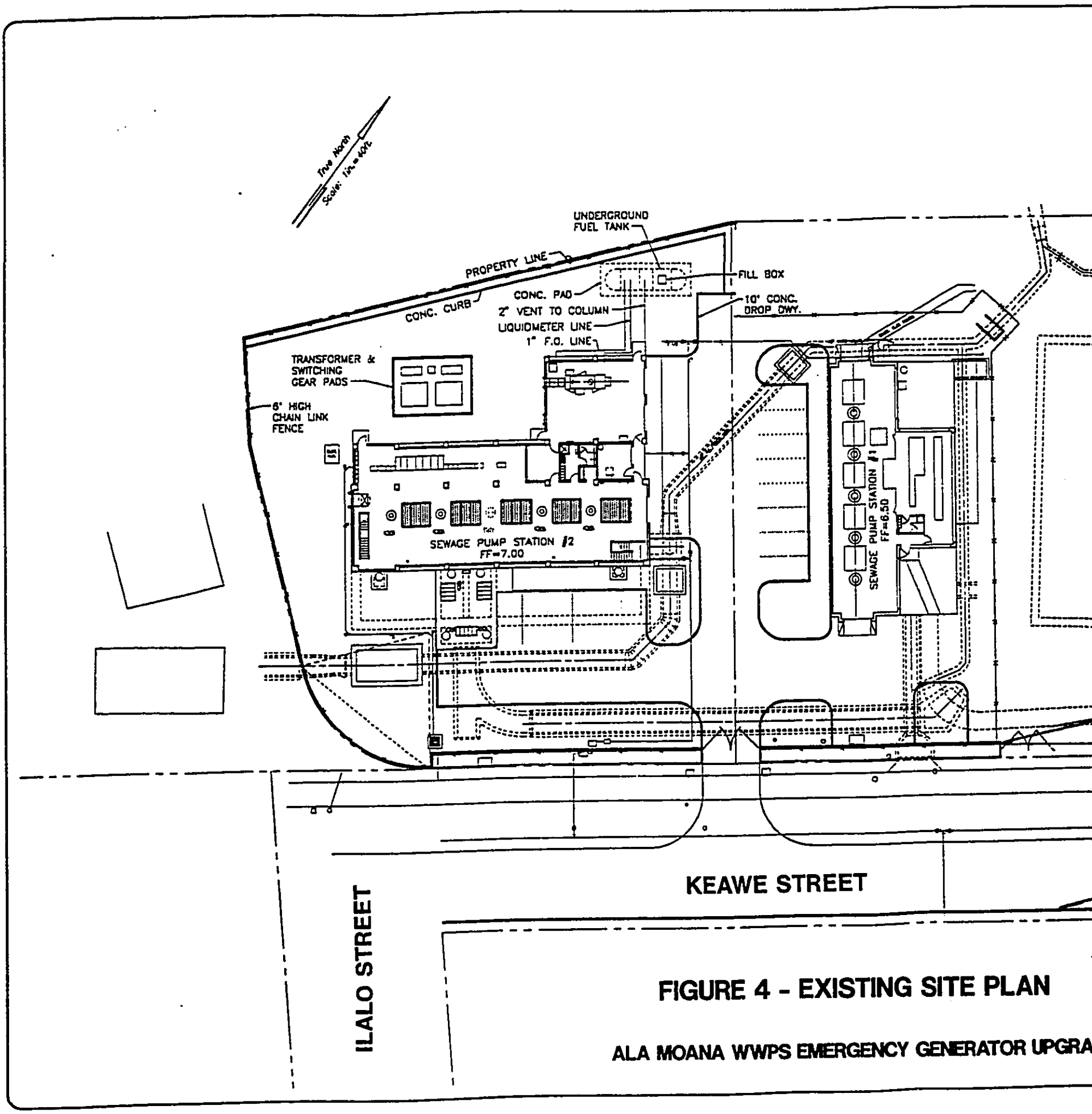
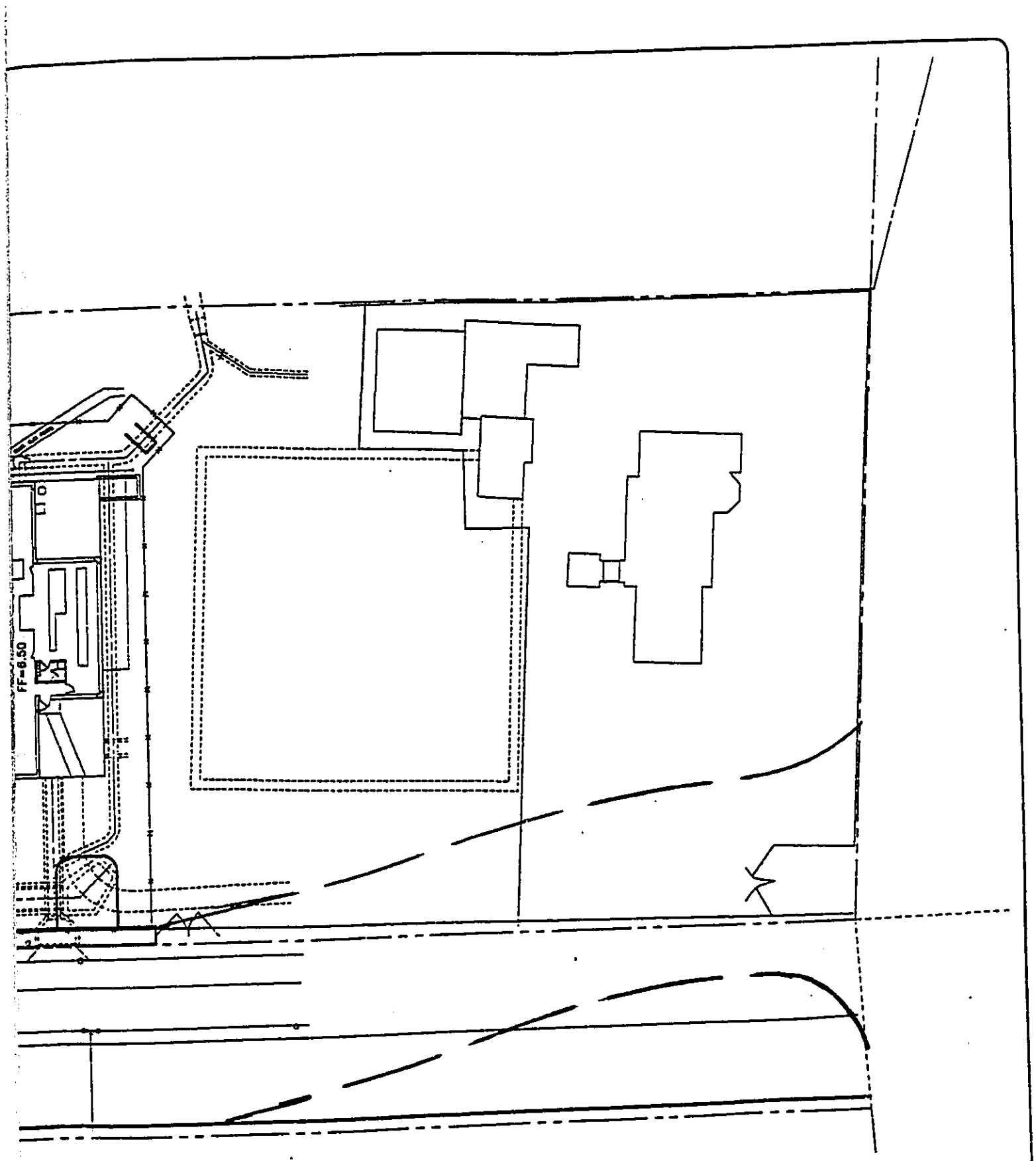


FIGURE 4 - EXISTING SITE PLAN

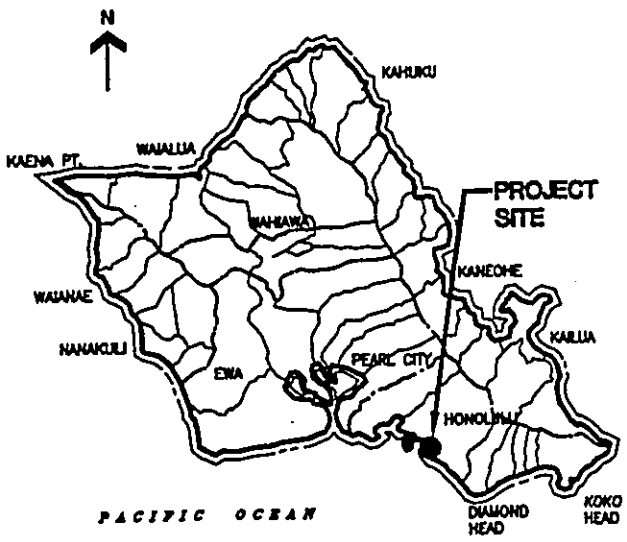
ALA MOANA WWPS EMERGENCY GENERATOR UPGRA



NG SITE PLAN

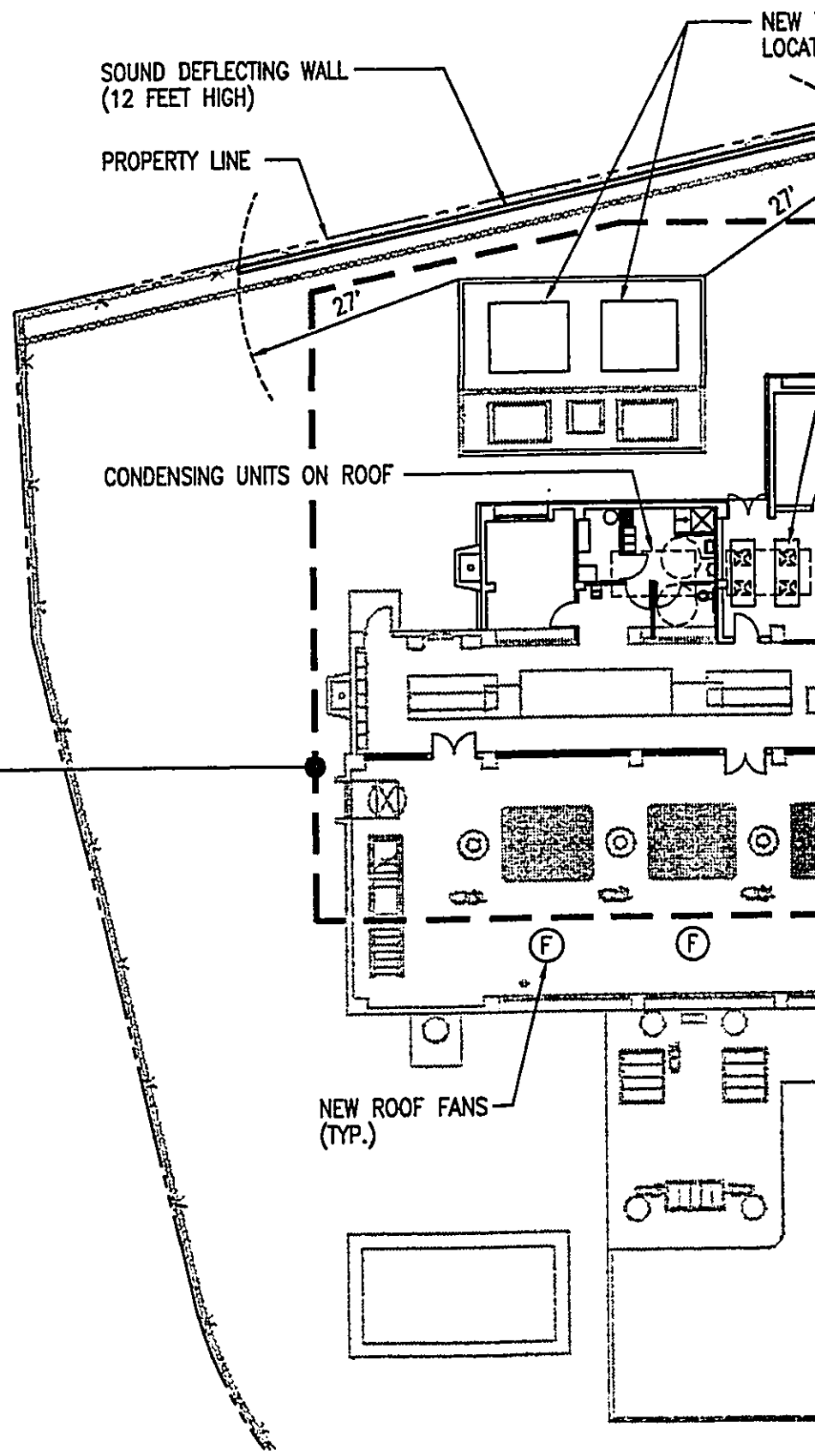
ICY GENERATOR UPGRADE

M&E Pacific, Inc.



ISLAND OF OAHU

LOCATION MAP

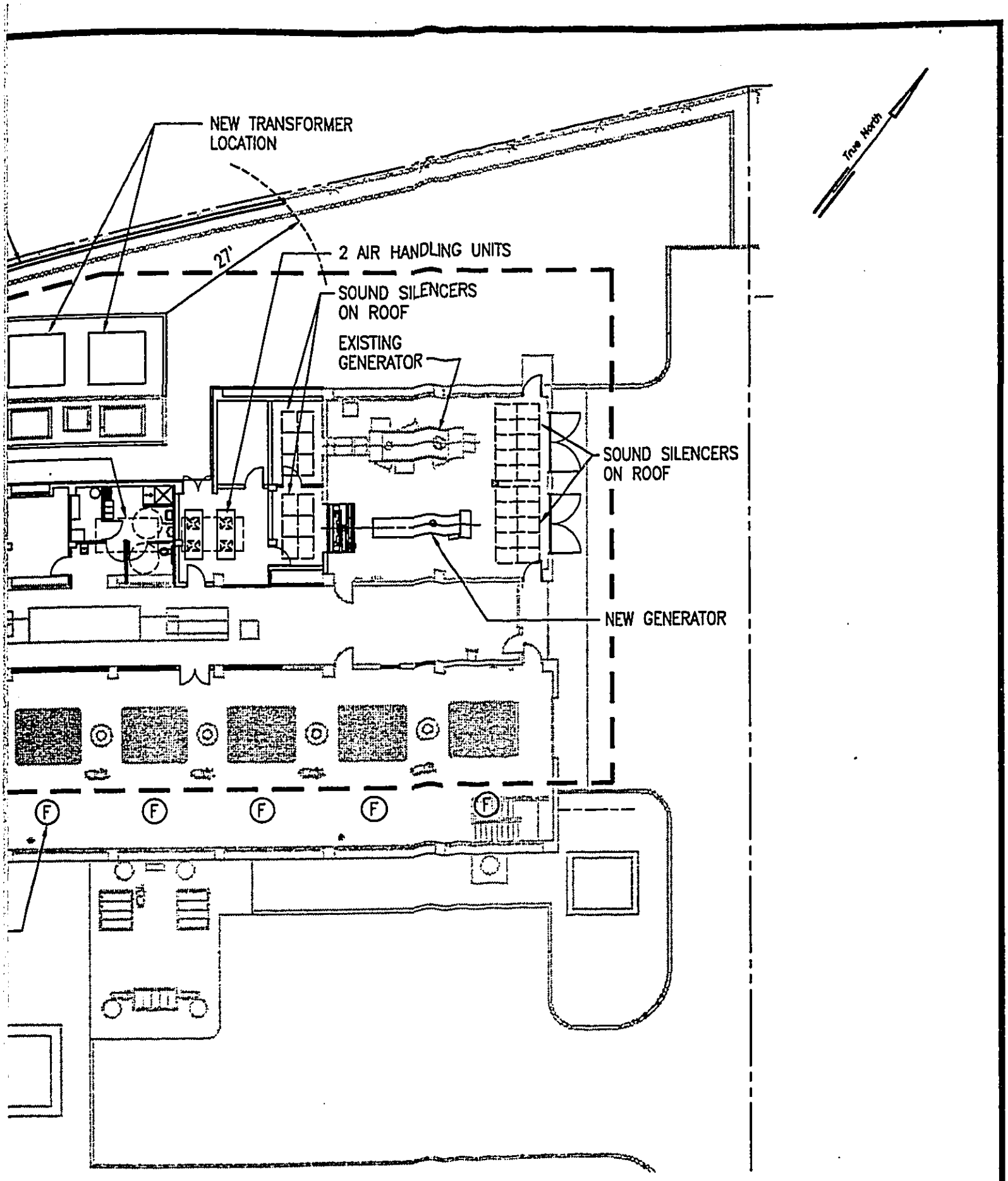


SEE FIGURE 6

FIGURE 5 - PROPO

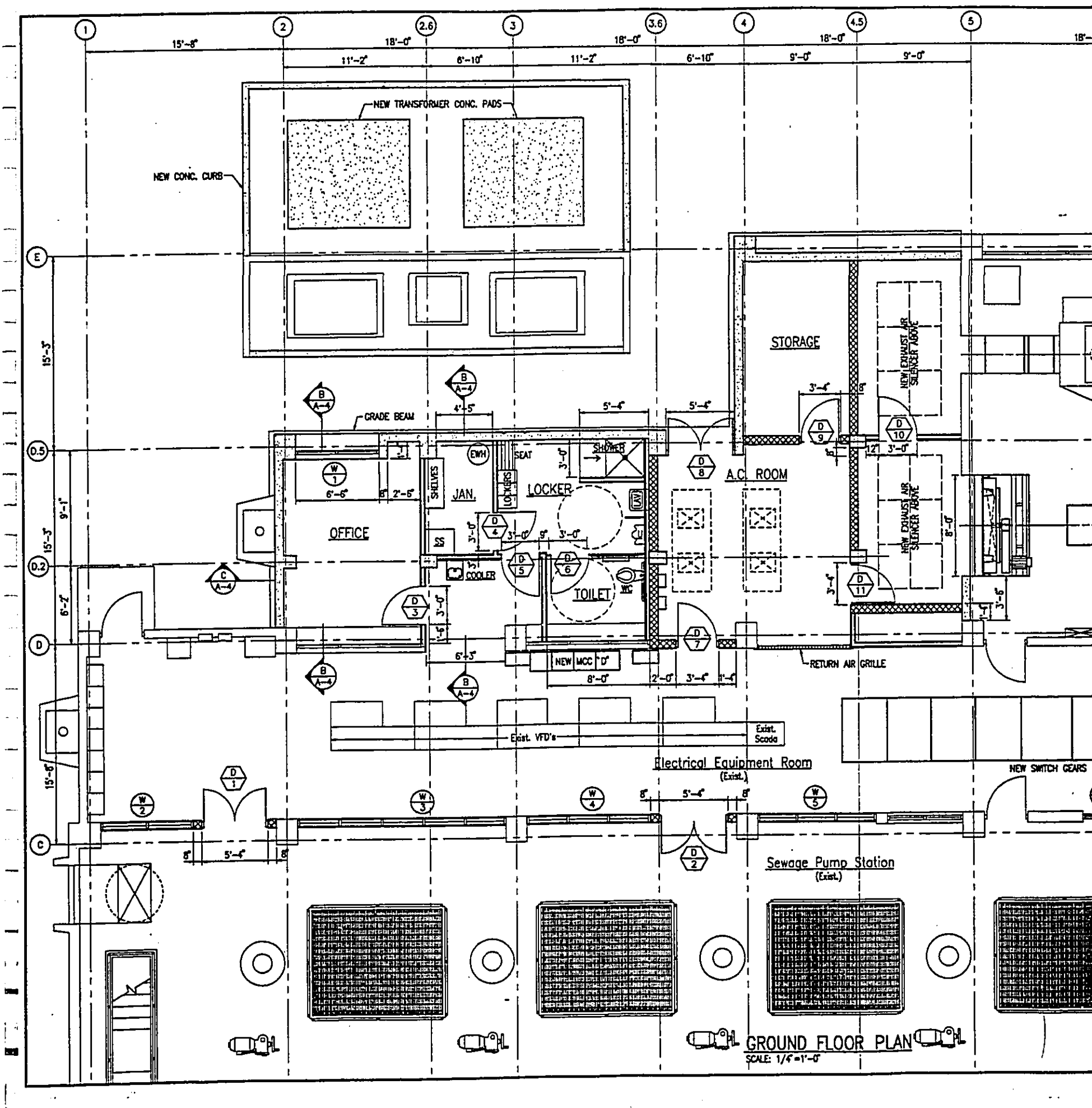
ALA MOANA WWPS EMERGEN

(RA)N:\AMWWPSUG\FIGURES\PLOT2 May 13, 1996 1:00PM



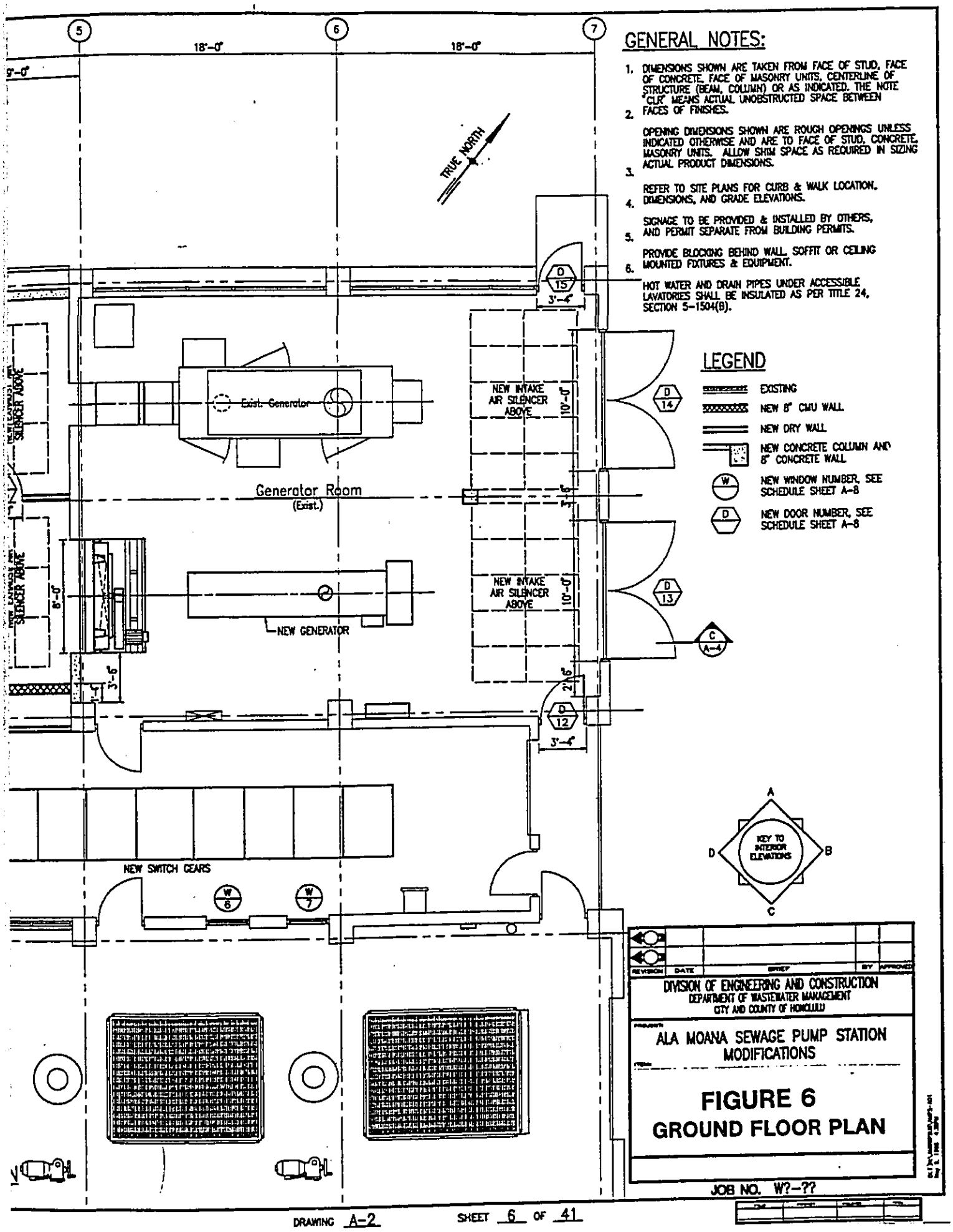
IRE 5 - PROPOSED SITE PLAN

ANA WWPS EMERGENCY GENERATOR UPGRADE



GROUND FLOOR PLAN

SCALE: 1/4"=1'-0"



GENERAL NOTES:

1. DIMENSIONS SHOWN ARE TAKEN FROM FACE OF STUD, FACE OF CONCRETE, FACE OF MASONRY UNITS, CENTERLINE OF STRUCTURE (BEAM, COLUMN) OR AS INDICATED. THE NOTE "CLR" MEANS ACTUAL UNOBSTRUCTED SPACE BETWEEN FACES OF FINISHES.
2. OPENING DIMENSIONS SHOWN ARE ROUGH OPENINGS UNLESS INDICATED OTHERWISE AND ARE TO FACE OF STUD, CONCRETE, MASONRY UNITS. ALLOW SHIM SPACE AS REQUIRED IN SIZING ACTUAL PRODUCT DIMENSIONS.
3. REFER TO SITE PLANS FOR CURB & WALK LOCATION, DIMENSIONS, AND GRADE ELEVATIONS.
4. SIGNAGE TO BE PROVIDED & INSTALLED BY OTHERS, AND PERMIT SEPARATE FROM BUILDING PERMITS.
5. PROVIDE BLOCKING BEHIND WALL, SOFFIT OR CEILING MOUNTED FIXTURES & EQUIPMENT.
6. HOT WATER AND DRAIN PIPES UNDER ACCESSIBLE LAVATORIES SHALL BE INSULATED AS PER TITLE 24, SECTION 5-1504(B).

LEGEND

- EXISTING
- NEW 8" CMU WALL
- NEW DRY WALL
- NEW CONCRETE COLUMN AND 8" CONCRETE WALL
- (W) NEW WINDOW NUMBER, SEE SCHEDULE SHEET A-8
- (D) NEW DOOR NUMBER, SEE SCHEDULE SHEET A-8

REVISION	DATE	BRIEF	BY	APPROVED

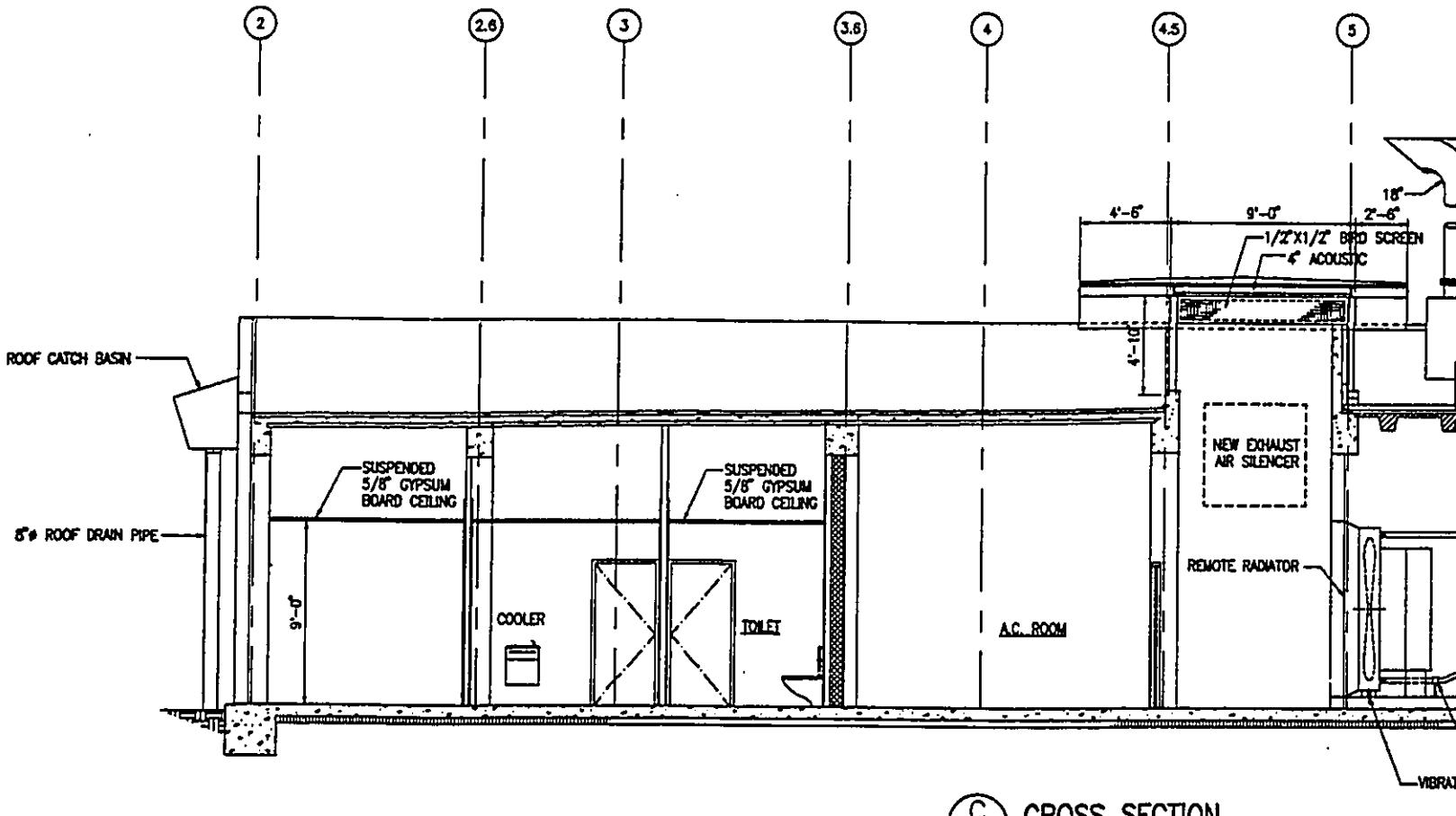
DIVISION OF ENGINEERING AND CONSTRUCTION
DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU

ALA MOANA SEWAGE PUMP STATION MODIFICATIONS

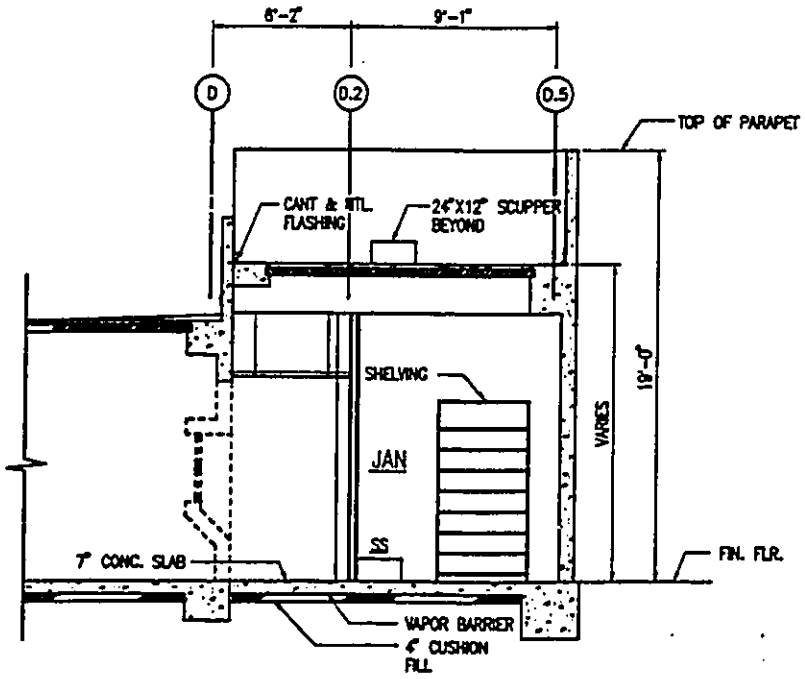
FIGURE 6
GROUND FLOOR PLAN

JOB NO. W?-??

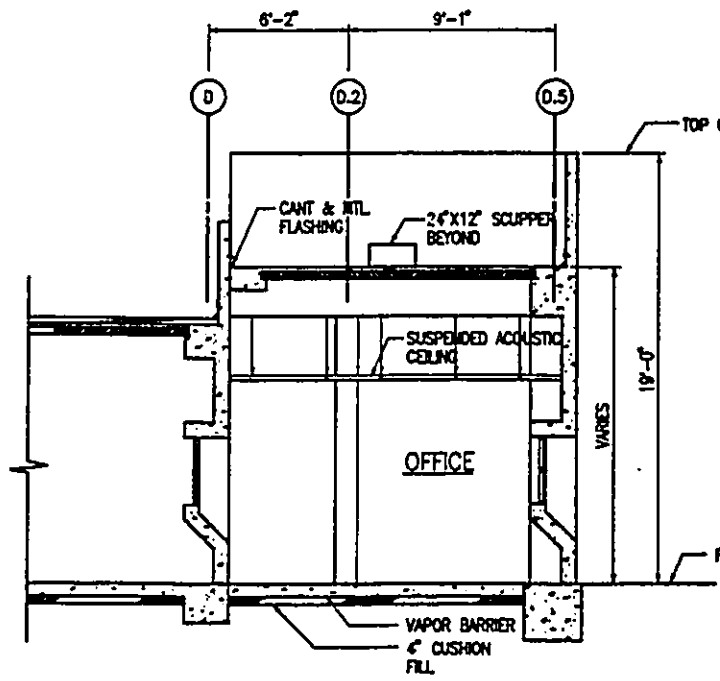
DRAWING A-2 SHEET 6 OF 41



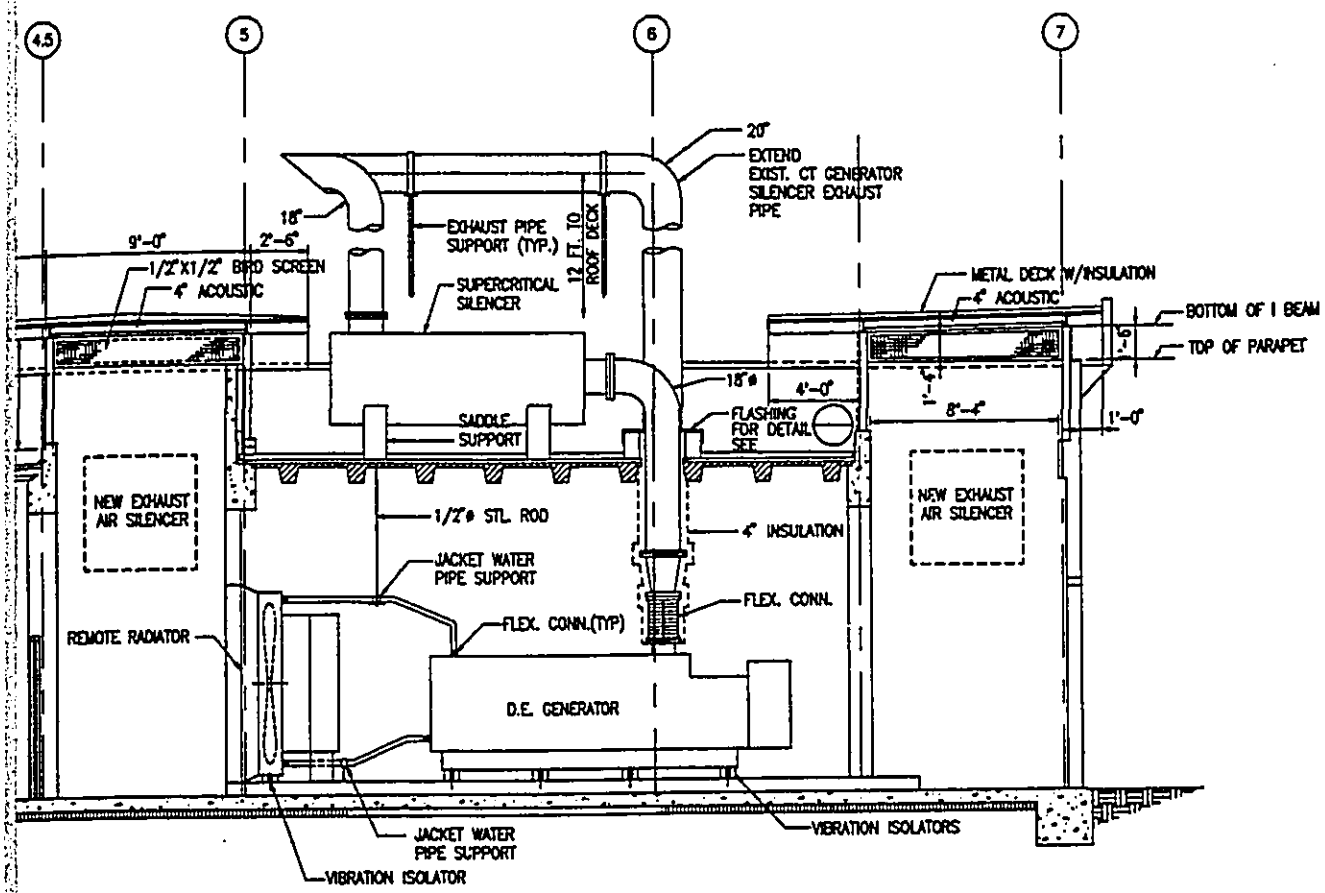
C/A-4 CROSS SECTION
SCALE: 1/4" = 1'-0"



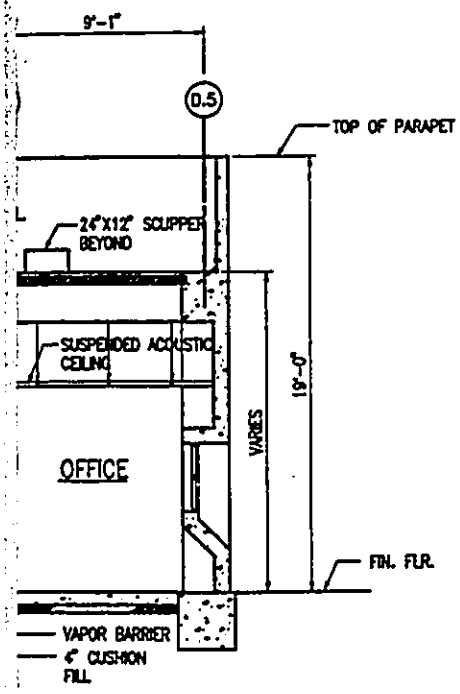
A/A-4 CROSS SECTION
SCALE: 1/4" = 1'-0"



B/A-4 CROSS SECTION
SCALE: 1/4" = 1'-0"



ECTION
1/4" = 1'-0"



SS SECTION
1/4" = 1'-0"

REVISION	DATE	BY	APPROVED

DIVISION OF ENGINEERING AND CONSTRUCTION
DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU

ALA MOANA SEWAGE PUMP STATION MODIFICATIONS

SECTIONS

FIGURE 7

JOB NO. W?-??

DRAWING ___ SHEET ___ OF 41

Appendix A

Initial Acoustical Recommendations for 2000 KW Emergency Generator; Upgrade Emergency Generator, Ala Moana Wastewater Pump Station

Y. Ebisu & Associates letter to M&E Pacific, Inc., October 14, 1994.

Y. Ebisu & Associates
Acoustical and Electronic Engineers

1126 12th Avenue
Room 305
Honolulu, Hawaii 96816
(808) 735-1634

Job #32.028
October 14, 1994

M&E Pacific, Inc.
Suite 500, Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813-3497

Attention: Mr. Jerry M.H. Loo, P.E.
Project Manager

Subject: Initial Acoustical Recommendations for 2000 KW Emergency Generator; Upgrade Emergency Generator, Ala Moana Wastewater Pump Station

Dear Mr. Loo:

The following letter report delineates my assumptions, acoustical design goals, and initial acoustical recommendations for the 2000 KW Emergency Generator installation.

A. ACOUSTICAL ASSUMPTIONS:

1. **2000 KW Generator:** Free-field total noise level of approximately 91 dBA at 50 FT distance.

2. **Radiator Fan Airflow Required:** Approximately 72,000 CFM.

3. **Radiator Fan Noise Level:** 80 dBA @ 25 FT distance.

4. **Maximum static pressure drop of exhaust air duct silencers:** 0.1 (inches of water).

5. **Minimum size of discharge air opening:** 80 SF.

6. **Inlet Airflow Required:** Approximately 77,760 CFM.

7. **Maximum static pressure drop of inlet air duct silencers:** 0.11 (inches of water).

8. **Minimum size of inlet air opening:** 82 SF.

9. **Exhaust pipe noise level with Super Critical Grade (40 dBA) Muffler:** 54 dBA at 35 FT distance.

B. ACOUSTICAL DESIGN GOAL:

The acoustical design goal selected for this project was to reduce generator noise to 60 dBA or less at the project's property

lines which adjoin the Mixed-Use/Commercial Zones, and to approximately 50 dBA at the closest Mixed-Use/Residential Zone, if possible. Currently, State Department of Health (DOH) noise limits for commercial and apartment properties on Oahu are 60 dBA and 50 dBA for the daytime and nighttime periods, respectively.

C. RESULTS OF NOISE MEASUREMENTS AT THE STATION:

Existing background ambient noise levels at the Ala Moana Station were obtained during the morning of October 7, 1994 at or near the perimeter fence of the station. The locations where the noise measurements were obtained are shown in **ENCLOSURE 1**. In addition, noise measurements were obtained at the same locations with both the 900 kw diesel engine generator and the 800 kw combustion turbine generator operating separately. In **ENCLOSURE 1**, the three sound levels shown at each location represent the following: background ambient noise level in dBA / noise level in dBA with 900 kw diesel generator ON / noise level in dBA with 800 kw combustion turbine generator ON. The "NA" designates "not audible" at the measurement location.

The results of the noise measurements indicate that it will be very difficult to quiet the 900 kw diesel engine generator to meet the 60 dBA design goal at Locations "A" and "B" without major modifications to its existing portable configuration. The noise measurements also indicate that the 800 kw CT is nearly in compliance with the 60 dBA design goal, and could probably be brought into compliance if the existing openings of the Generator Room are closed or sound-treated.

D. INITIAL ACOUSTICAL RECOMMENDATIONS:

a. Plan on using IAC 5Ms duct silencers in the inlet and discharge air openings to the Generator Room. These duct silencers will be more than sufficient to attenuate any radiated noise components from the existing combustion turbine (CT) enclosure.

b. Plan on using a super-critical exhaust muffler similar to the Nelson Super Critical Grade (35-45 dBA) Muffler. If possible, locate the open end of the exhaust pipe at least 35 FT from the nearest station property line.

c. In-fill the existing glass and louver surfaces on the Ewa wall of the Generator Building with dense concrete or solid-grouted CMU. Also in-fill all existing roof openings with dense concrete.

d. Increase the thickness of the wall and ceiling insulation located behind the perforated metal panels from 2" to 4"

using an additional 2" thick layer of Owens Corning Type 703 semirigid insulation panels.

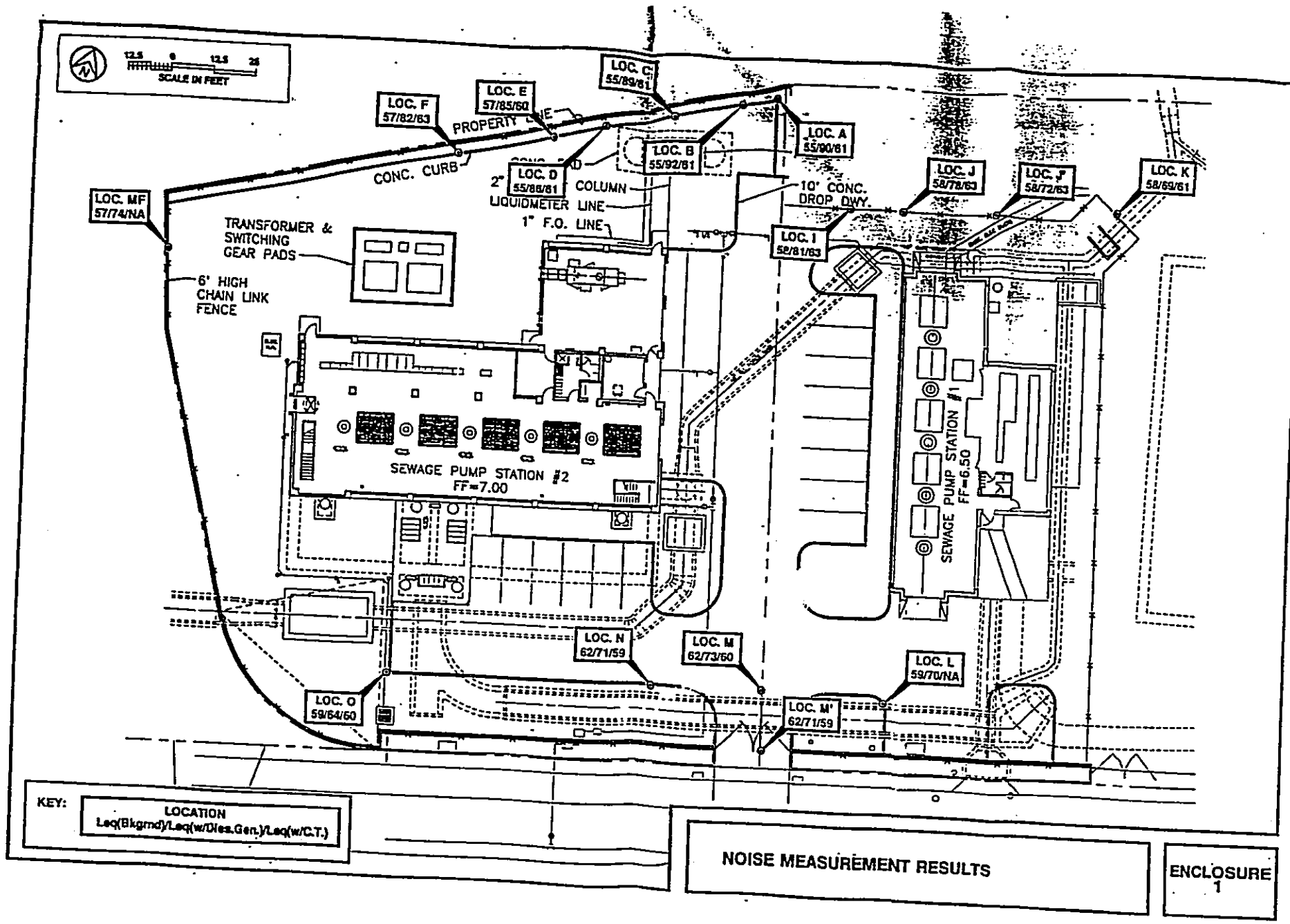
e. Plan on replacing the existing roll-up and single swinging doors with sound-rated doors with STC 45 to 50 ratings.

Let me know if you have any concerns regarding these initial recommendations for the Generator Room. Hiroshi and the Electrical Engineer may adjust the operating parameters which I assumed for my initial analysis.

Sincerely,

Yoichi Ebisu, P.E.

encl.


SCALE IN FEET
LOC. C
55/89/61
LOC. E
57/85/60
LOC. F
57/82/63
PROPERTY LINE
CONC. CURB
LOC. A
55/90/61
LOC. B
55/92/61
LOC. D
55/88/61
2" LIQUIDMETER LINE
COLUMN
1" F.O. LINE
10' CONC. DROP DWY.
LOC. J
58/78/63
LOC. J'
58/72/63
LOC. K
58/69/61
LOC. MF
57/74/NA
TRANSFORMER & SWITCHING GEAR PADS
6' HIGH CHAIN LINK FENCE
LOC. I
58/81/63
SEWAGE PUMP STATION #2
FF=7.00
SEWAGE PUMP STATION #1
FF=6.50
LOC. N
62/71/59
LOC. M
62/73/60
LOC. L
59/70/NA
LOC. O
59/64/60
LOC. M'
62/71/59
KEY:
LOCATION
Leq(Bkgrnd)/Leq(w/Dies.Gen.)/Leq(w/C.T.)
NOISE MEASUREMENT RESULTS
ENCLOSURE 1

Appendix B

Comments and Responses

OFFICE OF STATE PLANNING

Office of the Governor

BENJAMIN J. CAYETANO, Governor

MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
STREET ADDRESS: 220 SOUTH KING STREET, 4TH FLOOR
TELEPHONE: (808) 587-2846, 587-2899

FAX: Director's Office 587-2848
Planning Division 587-2834

Ref. No. Z-0065

March 27, 1996

Mr. West Geertsema
Project Engineer
M & E Pacific, Inc.
Suite 500 Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Geertsema:

SUBJECT; Draft Environmental Assessment for Emergency Generator Upgrade, Ala Moana Wastewater Pump Station

Thank you for your letter of March 19, 1996, attaching the Draft Environmental Assessment (DEA) for the subject project. We have reviewed the information provided and offer the following comment.

All lands within the State fall under the purview of Chapter 205A, Coastal Zone Management (CZM), HRS. Therefore, there should be explicit consideration of the project's relationship to CZM program objectives and policies when the final document is prepared. Disclosure of all environmental and resource information will facilitate comprehensive analysis of the project as applicable to the CZM program.

As noted in the DEA, this project is located within the Kakaako Makai Special Management Area (SMA). SMA use approval from the Office of State Planning will be required for this project.

We appreciate the opportunity to comment on this project at this early stage. Should you have any question, please call Howard Fujimoto of my staff at 587-2898.

Sincerely,

Gregory G.Y. Pai, Ph.D.
Director

M&E Pacific, Inc.

A Metcalf & Eddy Company

May 10, 1996

Dr. Gregory G.Y. Pai, Director
Office of State Planning
Office of the Governor
P.O. Box 3540
Honolulu, Hawaii 96811-3540

Dear Dr. Pai

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment
Ref. No. Z-0065

Thank you for your comments on the draft Environmental Assessment (EA) for the above referenced project. We acknowledge that the project site is under the purview of Chapter 205A, Coastal Zone Management (CZM), HRS. It is noted that SMA use approval will be required for this project. The proposed project is consistent with the CZM program objectives and policies. The final EA will contain a special section evaluating the project with respect to the CZM program objectives and policies. This section is attached for your information.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - CCH DWM

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0248

PLANNING DEPARTMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

CHERYL D. SOON
CHIEF PLANNING OFFICER

CAROLL TAKAHASHI
DEPUTY CHIEF PLANNING OFFICER

TH 3/96-0720

April 3, 1996

Mr. Wes Geertsema, Project Engineer
M&E Pacific, Inc.
1001 Bishop Street
Suite 500, Pauahi Tower
Honolulu, Hawaii 96813

Dear Mr. Geertsema:

Draft Environmental Assessment (EA)
for the Ala Moana Wastewater Pump Station
Emergency Generator Upgrade

In response to your letter of March 19, 1996, we have reviewed the subject draft EA and offer the following comments.

1. The proposed project supports the objectives and policies of the General Plan and the Primary Urban Center Development Plan (DP).

   A DP Public Facilities Map amendment to the Primary Urban Center for a publicly funded wastewater pump station/modification symbol was approved by the Honolulu City Council under Ordinance 93-040. Furthermore, the proposed site is currently designated as Public and Quasi-Public on the Primary Urban Center DP Land Use Map.

2. Section 6.8 states that the proposed project will not impact the two historic sites located mauka of the existing pump station. Although the present site is adequate to accommodate the new equipment, the final EA should discuss the potential need for future expansion. The final EA should mention any plans for future land acquisition including the location and estimated land area required.

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Ms. Cheryl D. Soon, Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street, 8th Floor
Honolulu, Hawaii 96811

Dear Ms. Soon

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment
Ref. TH 3/96-0720

Thank you for your comments on the draft Environmental Assessment (EA) for the above referenced project. The final EA text will be revised to reflect the land use designation as defined within the Primary Urban Center Development Plan. Also, the final EA will include a brief description of preliminary plans to acquire land for future expansion of the pump station. Note that additional land will not be required for the generator upgrade project.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

DEPARTMENT OF TRANSPORTATION SERVICES

CITY AND COUNTY OF HONOLULU

PACIFIC PARK PLAZA
711 KAPIOLANI BOULEVARD, SUITE 1200
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

CHARLES O. SWANSON
DIRECTOR

3/96-01332R

April 19, 1996

Mr. Wes Geertsema, Project Engineer
M&E Pacific, Inc.
Suite 500, Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Geertsema:

Subject: Draft Environmental Assessment for the Ala Moana Wastewater Pump Station Emergency Generator Upgrade

In response to your letter dated March 19, 1996, we reviewed the subject draft document. This document relates that the Hawaii Community Development Authority has developed preliminary plans to realign and expand Keawe Street in the immediate vicinity of the proposed project. The project plans should reflect the realignment of Keawe Street.

Should you have any questions regarding this matter, please contact Faith Miyamoto of the Transportation System Planning Division at 527-6976.

Respectfully,

for CHARLES O. SWANSON
Director

cc: Dennis Kaneshiro, Department of Wastewater Management

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Mr. Charles O. Swanson, Director
Department of Transportation Services
City and County of Honolulu
Pacific Park Plaza
711 Kapiolani Boulevard, Suite 1200
Honolulu, Hawaii 96813

Dear Mr. Swanson

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment (EA)
Ref.: 3/96-01332R

Thank you for your comment on the draft EA for the above referenced project. As noted in your letter, the plan for the realignment of Keawe Street is preliminary. We will include a sketch of the proposed realignment in the final EA for reference only.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 11TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 523-4361 • FAX: (808) 527-5857

JEREMY HARRIS
MAYOR

KENNETH E. SPRAGUE
DIRECTOR AND CHIEF ENGINEER

DARWIN J. HANAMOTO
DEPUTY DIRECTOR

ENV 96-079

April 8, 1996

Mr. Wes Geertsema
Project Engineer
M&E Pacific, Inc.
1001 Bishop Street, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Geertsema:

Subject: Draft Environment Assessment (DEA)
Ala Moana Wastewater Pump Station
TMK: 2-1-15: 23

We have reviewed the subject DEA and have the following comment:

Section 7.1 "Short-term Construction Related Impact":
Please address disposal of any effluent from testing if such testing is required for the proposed project.

Should you have any questions, please contact Mr. Alex Ho, Environmental Engineer, at 523-4150.

Very truly yours,

for KENNETH E. SPRAGUE
Director and Chief Engineer

* no testing is required.

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Mr. Kenneth E. Sprague, Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street, 11th Floor
Honolulu, Hawaii 96813

Dear Mr. Kenneth E. Sprague

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment (EA)
Ref: ENV 96-079

Thank you for your comment on the draft EA for the above referenced project. Note that neither construction dewatering nor effluent testing is anticipated for the proposed project.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

JEREMY HARRIS
MAYOR

PATRICK T. ONISHI
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

96-01705(ASK)
'96 EA Comments Zone 2

April 19, 1996

Mr. Wes Geertsema, Project Engineer
M & E Pacific, Inc.
Pauahi Tower, Suite 500
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Geertsema:

Draft Environmental Assessment (DEA) for
Emergency Generator Upgrade at
Ala Moana Wastewater Pump Station
Tax Map Key: 2-1-15: 23

We have reviewed the above-referenced document and offer the following comments:

1. The project is within the Kakaako Community Development District established by Chapter 206E, Part II, Hawaii Revised Statutes (HRS). As such, land uses on the site are regulated by the Hawaii Community Development Authority.

2. The project is within the Special Management Area (SMA). Section 206E-8-5, HRS requires that proposals for development that are within both the SMA and a Community Development District be submitted to the Office of State Planning for review and approval.

Thank you for the opportunity to comment on the proposed project. Should you have any questions regarding the above, please contact Ardis Shaw-Kim of our staff at 527-5349.

Very truly yours,

PATRICK T. ONISHI
Director of Land Utilization

PTO:am

a:alawwpo.ltr7
g:alawwpo.ask

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Mr. Patrick T. Onishi, Director
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Onishi

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment (EA)
Ref: 96-01705 (ASK) '96 EA Comments Zone 2

Thank you for your comments on the draft EA for the above referenced project. It is understood that the project is within the Kakaako Community Development District, and land uses are regulated by the Hawaii Community Development Authority. The application for a Special Management Area (SMA) Use Permit will be submitted to the Office of State Planning.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

HAWAII COMMUNITY DEVELOPMENT AUTHORITY

KAKAAKO

Benjamin J. Cayetano
Governor

Michael K. Kwiatkanda
Chairman

Jan S. Yokoyama
Interim Executive Director

677 Ala Moana Boulevard
Suite 1001
Honolulu, Hawaii
96813
Telephone
(808) 587-2870
Facsimile
(808) 599-2613

Ref. No.: PL WD 11.7a.2

April 18, 1996

Mr. Wes Geertsema
M & E Pacific, Inc.
Suite 500, Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Geertsema:

Re: Draft Environmental Assessment (DEA) for the Emergency Generator Upgrade for the Ala Moana Wastewater Pump Station

We have reviewed the subject DEA and offer the following comments.

- The Hawaii Community Development Authority (HCDA) intends to solicit Requests for Proposals on the adjacent Ala Moana Sewage Pump Station site (TMKs: 2-1-15: 43 & 44) by the end of the year. Any proposal for site expansion should not adversely impact the development potential of those parcels. Further, any expansion beyond the area currently leased would require approval from the State of Hawaii.

- All acoustical recommendations proposed by Y. Ebisu & Associates should be implemented to control the noise generator to 60 dBA or less at the subject project's property line.

- All off-site infrastructure improvements should be coordinated with HCDA infrastructure plans.

- All provisions of the Kakaako Community Development District Makai Area Rules should be complied with.

Should you have any questions, please contact Mr. Larry Leopardi at 587-2870.

Sincerely,

Alex Achimore
Director of Planning
and Development

AA/SJT:gst

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Mr. Alex Achimore, Director
Department of Planning and Development
Hawaii Community Development Authority
677 Ala Moana Boulevard, Suite 1001
Honolulu, Hawaii 96813

Dear Mr. Achimore

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment (EA)
Ref. No.: PL WD 11.7a.2

Thank you for your letter providing comments to the draft EA. The following items are presented in response to your comments.

- The above referenced project will not have adverse impacts on the potential developments in the adjacent parcels (TMKs: 2-1-15: 43 & 44). Any expansion beyond the area currently leased will be coordinated with and approved by the State of Hawaii.

- All acoustical recommendations proposed by Y. Ebisu & Associates will be implemented to control noise impacts.

- No off-site infrastructure improvements associated with this project are anticipated.

- All construction activities will comply with the provisions of the Kakaako Community Development District Makai Area Rules.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

BENJAMIN J CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF LAND MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT
WATER RESOURCE MANAGEMENT

REF: LM JGD

APR -3 1996

Mr. Wes Geertsema
Project Engineer
M & E Pacific, Inc.
Suite 500 Pauahi Tower
1001 Bishop Street
Honolulu, HI 96813

Dear Mr. Geertsema:

Subject: Request for Comments on the Draft Environmental Assessment for the Ala Moana Wastewater Pump Station Emergency Generator Upgrade at Kaakaukukui, Honolulu, Oahu, TMK:2-1-15:23

Thank you for giving us the opportunity to comment on the subject project. The Oahu District Office of Land Management has no objections to the proposed project provided that any of the proposed activities do not conflict with the terms and covenants of General Lease No. S-4658 that encumbers the State-owned land to the City and County of Honolulu for the Wastewater Pump Station and that the applicant obtain all required Federal, State and County permits prior to construction activities.

We note that the two adjacent historic sites, the original Hering pumping station and the old Ala Moana pumping station will not be impacted by this project.

Should you have any questions, you may contact John Dooling at 587-0433.

Very truly yours,

Cecil B. Santos
Oahu District Land Agent

cc: Mr. Nekoba
Mr. Matsumoto

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Mr. Cecil B. Santos, Oahu District Land Agent
Division of Land Management
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Santos

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment
Ref: LM JGD

Thank you for your letter of April 03, 1996. The proposed activities will not create conflicts with the terms and covenants in the lease agreement of the project property. All applicable Federal, State and County permits will be obtained prior to construction activities.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPIOLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813-5249
PHONE (808) 594-1988
FAX (808) 594-1865

April 18, 1996

Mr. Wes Geertsema
M&E Pacific, Inc.
Suite 500, Pauahi Tower
1001 Bishop St.
Honolulu, HI 96813

Dear mr. Geertsema:

Thank you for the opportunity to review the Draft Environmental Statement (DEA) for the Emergency Generator Upgrade, Ala Moana Wastewater Pump Station, Island of Oahu. The Department of Wastewater Management of the City and County of Honolulu proposes the upgrade of the Ala Moana Wastewater Pump Station to accommodate building expansion and equipment upgrade.

After a careful review of the DEA, the Office of Hawaiian Affairs (OHA) has no objections to the proposed project. Based on information contained in the DEA, the proposed improvements at the Ala Moana Wastewater Pump Station apparently bear no significant long-term adverse impacts on adjacent areas, public facilities, or public health. But OHA wishes to clearly state that the implementation of alternative 3A, which calls for the use of additional parcels located on ceded land (page 5 in DEA), must be pursued in close consultation with OHA directives. Please contact me, or Linda K. Delaney, the Land and Natural Resources Division Officer (594-1938), or Luis A. Manrique (594-1935), should you have any questions on this matter.

Sincerely yours,

Linda M. Colburn
Administrator

LM:lm

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Ms. Linda M. Colburn, Administrator
Office of Hawaiian Affairs
State of Hawaii
711 Kapiolani Boulevard, Suite 500
Honolulu, Hawaii 96813-5249

Dear Ms. Colburn

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment (EA)

Thank you for your comments on the draft EA for the above referenced project. As noted, the Office of Hawaiian Affairs (OHA) does not have objections to the proposed improvements at the Ala Moana WWPS. The chosen alternative, described in the final EA, will not require the use of additional parcels located on ceded land. It is noted that any proposal to use additional parcels will be evaluated in close consultation with OHA.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA will be published in the May 23, 1996 OEQC Bulletin. If you have any questions or wish to receive a copy of the final EA, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

BENJAMIN J. CAYETANO
GOVERNOR

GARY GILL
DIRECTOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185
FACSIMILE (808) 586-4186

April 4, 1996

Mr. James K. Honke, Chief
Division of Engineering and Construction
Department of Wastewater Management
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Honke:

Having reviewed a draft environmental assessment ("DEA") entitled *Emergency Generator Upgrade, Ala Moana Wastewater Pump Station, TMK: 2-1-15:23* and transmitted our office by your March 13, 1996, letter (WEP 96-132), we offer the following comment for your response required by section 343-5(b), Hawaii Revised Statutes.

Although page 5 of the DEA makes mention of "ceded lands" for alternate 3A, the list on page 1 does not indicate that consultation with the Office of Hawaiian Affairs ("OHA") took place. Please forward a copy of the draft environmental assessment for this project to OHA. For all future projects involving ceded lands, we request that you send a copy of relevant environmental documents (e.g., exemption determinations, environmental assessments, or environmental impact statements) to OHA for their review and comment.

If there are any questions, please do not hesitate to contact Mr. Leslie Segundo of my staff at 586-4185. Thank you for the opportunity to comment.

Sincerely,

GARY GILL
Director

c: Ms. Linda K. Delaney, Land & Natural Resources Officer, Office of Hawaiian Affairs
Mr. Dennis Kaneshiro, Department of Wastewater Management
Mr. Wes Geertsema, M&E Pacific Inc.

M&E Pacific, Inc.
A Metcalf & Eddy Company

May 10, 1996

Mr. Gary Gill, Director
Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Mr. Gill

SUBJECT: Ala Moana WWPS Emergency Generator Upgrade
Environmental Assessment (EA)

Thank you for your comments on the draft EA for the above referenced project. A copy of the draft EA was sent to the Office of Hawaiian Affairs (OHA) for review. OHA has commented on the draft EA, and M&E Pacific, on behalf of the City and County of Honolulu Department of Wastewater Management, has responded to the comments. We are also informing them of the notice of determination.

The City and County of Honolulu Department of Wastewater Management (proposing agency) has determined that the implementation of this project will not have significant environmental effects. Therefore, the agency is issuing a Negative Declaration (ND). The final EA and ND will be submitted for publication in the May 23, 1996 OEQC Bulletin. If you have any questions, please call me at (808) 521-3051.

Sincerely,

Wes Geertsema
Project Engineer

cc: Dennis Kaneshiro - DWM, C&C

Suite 500 Pauahi Tower
1001 Bishop Street, Honolulu, HI 96813
808-521-3051 FAX 808-524-0246

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

MICHAEL D. WILSON, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTY
GILBERT COLOMA-AGARAN

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

February 21, 1996

Mr. Andy Huang M&E Pacific, Inc.
Suite 500 Pauahi Tower
1001 Bishop Street
Honolulu, Hawaii 96813

LOG NO: 16546
DOC NO: 9602CO05

Dear Mr. Huang:

SUBJECT: **Ala Moana WPS Emergency Generator Upgrade**
TMK 2-1-15:23, Honolulu, Oahu

Thank you for the letter dated February 12, 1996, regarding Environmental Assessment for the Ala Moana WPS Emergency Generator. A review of our records indicates that there are no known historic sites which will be affected by this project. The site is in close proximity to the Kakaako Pumping Station, which is listed in the Hawaii and National Register of Historic Places, but work is relatively limited within your site. We believe that the proposed work should have 'no effect' on the historic site.

Thank you for the opportunity to comment, should you have any questions please call Carol Ogata at 587-0004.

Aloha,

DON HIBBARD, Administrator and
Deputy State Historic Preservation Officer

CO:smf

BUILDING DEPARTMENT
CITY AND COUNTY OF HONOLULU
HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

JEREMY HARRIS
MAYOR

RANDALL K. FUJIKI
DIRECTOR AND BUILDING SUPERINTENDENT

ISIDRO M. BAQUILAR
DEPUTY DIRECTOR AND BUILDING SUPERINTENDENT

PB 96-247

May 1, 1996

M & E Pacific, Inc.
1001 Bishop Street, Suite 500
Honolulu, Hawaii 96813

Attn: Wes Gertsema, Project Engineer

Gentlemen:

Subject: Emergency Generator Upgrade
Ala Moana Wastewater Pump Station
Draft Environmental Assessment (EA)

This is in response to your transmittal of the subject material of March 19, 1996.

We have no comments to offer. Thank you for the opportunity to review the document.

Should there be any questions, please contact Douglas Collinson at 527-6375.

Very truly yours,

RANDALL K. FUJIKI
Director and Building Superintendent

cc: G. Tamashiro

BENJAMIN J. CAYETANO
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HARBORS DIVISION
79 SO. NIMITZ HWY. • HONOLULU, HAWAII 96813-4898

KAZU HAYASHIDA
DIRECTOR

DEPUTY DIRECTORS
JERRY M. MATSUDA
GLENN M. OKIMOTO

IN REPLY REFER TO:
HAR-EP
6642.96

April 3, 1996

Mr. Wes Geertsema
M & E Pacific, Inc.
1001 Bishop Street
Pauahi Tower, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Geertsema:

Subject: Draft Environmental Assessment (EA) for Emergency Generator Upgrade at the Ala Moana Wastewater Pump Station

Thank you for the opportunity to review the subject EA submittal. We have no comments to offer at this time.

Very truly yours,

Thomas T. Fujikawa
Chief

PRE-FINAL

DEPARTMENT OF WASTEWATER MANAGEMENT

CITY AND COUNTY OF HONOLULU

HONOLULU, HAWAII

CONTRACT DOCUMENTS

FOR

ALA MOANA WASTEWATER PUMP STATION

EMERGENCY GENERATOR UPGRADE

OAHU, HAWAII

JOB NO. W13-96

APPROVED:

_____ _____

FELIX B. LIMTIACO
Director

DATE

CONTENTS

The contract documents forming the contract consist of the following:

Notice to Contractors

Special Notice to Bidders

Proposal

Contract

Bond

Special Provisions

Hawaii Administrative Rules Title 3, Department of Accounting and General Services (Hereinafter called the HAR) (Bound Separately)

Revised General Provisions of Construction Contracts (Hereinafter called the General Provisions) (October 1976); Hawaii Administrative Rules, Title 3, Department of Accounting and General Services (Not Physically Attached)

Standard Specifications for Public Works Construction (Hereinafter called the Standard Specifications) (September 1986) (Bound Separately)

Standard Details for Public Works Construction (Hereinafter called the Standard Details)) (September 1984) (Bound Separately)

Plans Consisting of _____ Sheets (Bound Separately)

July 19, 1996

Index to the Special Provisions

General Requirements

Section	General Requirements
161	Prior Notice of Removal of Surface Encroachment
162	Construction Area Appearance
163	Environmental Pollution Control
165	Protection in Shipment and Storage
170	General Requirements for Equipment Furnished and Installed under this Contract
172	Drawings to be Furnished by Contractor
173	Services of Factory Representative

Notice to Contractors

SEALED BIDS will be received up to and publicly opened and read aloud at 2:00 p.m., _____, in the Office of the Division of Purchasing, Department of Finance, City and County of Honolulu to:

Ala Moana Wastewater Pump Station Emergency Generator Upgrade
Oahu, Hawaii
Job No. W13-96

Proposal and contract documents may be obtained from said office upon application and deposit of Fifty dollars ($50.00) each in cash or check made payable to the City Director of Finance. The deposit shall be refunded upon the return of the plans and specifications provided that they are returned in good condition within thirty (30) calendar days after the date designated above for the opening of bids. No refunds shall be made after expiration of such period.

To be eligible to bid, the prospective bidder must in not less than 10 calendar days, give written notice of the bidder's intention to bid. Bidders shall be licensed in accordance with Chapter 444, HRS, relating to the licensing of contractors. Such written notice must be handcarried, mailed, or faxed sufficiently ahead of time to be received by the Director of Finance not later than 4:30 p.m., on _____. Facsimile number is (808) 523-4847.

Bidders' attention is also directed to Section 103D-1002, HRS, which provides preference for Hawaii Products. The Hawaii Products List may be examined at the Division of Purchasing, Department of Finance, City Hall.

_____
DIRECTOR OF FINANCE
City and County of Honolulu

Special Notice to Bidders

Bidders are to reference the following sections of the Special Provisions:

Section 103 - Examination of Site
Section 108 - Licensing Requirement

For information during the bidding period the Project Engineer for Design, Dennis Kaneshiro, may be contacted at telephone no. (808) 527-5848.

Contractor's Name

Address

City State Zip Code

Telephone No.

Date:

Director of Finance
Department of Finance
City and County of Honolulu
Honolulu, Hawaii 96813

Dear Sir:

Proposal

The undersigned hereby proposes and agrees, if this proposal is accepted, to furnish and pay for all labor, materials, tools and equipment and incidental work necessary to construct or install, in place complete, the work called for under and in accordance with the true intent of the Contract Documents for:

Ala Moana Wastewater Pump Station Emergency Generator Upgrade
Honolulu, Hawaii
Job No. W13-96

on file in the office of the Department of Finance, City and County of Honolulu, and that he will take in payment therefor the unit and/or lump sum prices as itemized in the following Proposal Schedule. It is reemphasized that all items in the Proposal Schedule shall be considered as in place complete, in every respect.

Item No.	Description	Estimated Quantity	Unit Price	Total
A.	General:			
1.	MOBILIZATION shall consist of preparation work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to the project site; for the establishment of all offices, buildings and other facilities, including Field Office, necessary for work on the project; and for all other work and operations which must be performed, or costs incurred, prior to beginning work on the various items on the project site.	LUMP SUM		$_____
	A. Temporary Office with approximately 160SF of space for the Plant's worker with toilet.	LUMP SUM		$_____
2.	DEMOLITION in respect to the contract drawings which includes the interior of the Generator Room, Electrical Equipment Room, Electrical Concrete Pad, and Electrical Ducts	LUMP SUM		$_____
3.	Clear & Grubbing	LUMP SUM		$_____
4.	One Test Pile @ 35' Long	LUMP SUM		$_____

Item No.	Description	Estimated Quantity	Unit Price	Total
5.	10 Each 12" SQ. Prestressed Concrete Pile @ 35' Long, driven	LUMP SUM		$_____
6.	C.I.P. Reinforcing Concrete Slabs and Beams	LUMP SUM		$_____
	C. Irrigation System			
7.	Irrigation system to include the removal of existing lines, installation of new sprinkler heads, and installation of control valve.	LUMP SUM		$_____
	D. Exterior Walls			
8.	Exterior walls to include 8" Concrete Walls and 6" Concrete Parapet Wall	LUMP SUM		$_____
	E. Interior Walls			
9.	Interior walls to include 8" CMU Walls and 4" Gypboard Walls with Metal Studs	LUMP SUM		$_____

Item No.	Description	Estimated Quantity	Unit Price	Total
F.	Superstructure			
10.	To include 3-1/2" PC planks with 2-1/2" minimum concrete topping, concrete roof beams, steel roof over silencers, and concrete columns	LUMP SUM		$_____
G.	Roof Over Silencers			
11.	To include roof acoustical insulation, louvers, and metal flashing	LUMP SUM		$_____
H.	Generator Room			
12.	To include the installation of single-ply elastomeric roofing, adding 7" reinforcing concrete slab, providing acoustical treatment, sealing of the ewa wall, installation of new sound rated double doors, new sound rated entry doors, installation of a new diesel engine generator with remote radiator fan, installation of a remote radiator fan, adding a 275 gallon day tank, extend existing exhaust			

Item No.	Description	Estimated Quantity	Unit Price	Total
	pipe, connect fuel lines, provide roof air intake silencers, construct 8" concrete wall, construct 8" CMU wall, provide 1/2" x 1/2" stainless steel bird screen, provide muffler support concrete base, close roof openings, provide super critical engine exhaust silencers, provide insulation for generator exhaust, provide silencer support frames, provide engine exhaust silence support steel framework.			
	LUMP SUM			$_____
I.	New Discharge Plenum Room			
13.	Provide exhaust air silencer, provide entry doors, provide acoustical treatment, provide perforated stainless steel air deflectors, provide silencer support frame.			
	LUMP SUM			$_____
J.	Storage Room			
14.	Provide Entry Door			
	LUMP SUM			$_____
K.	Mechanical Room			
15.	Provide AC with 100% back-up capacity, provide double door, provide entry door, provide temporary location for AC units, provide stainless steel air deflector.			
	LUMP SUM			$_____

Item No.	Description	Estimated Quantity	Unit Price	Total
L.	Janitor Room			
16.	Provide entry door, provide washer/dryer, provide shelves.	LUMP SUM		$_____
M.	Locker Room			
17.	Provide entry door, provide lockers, provide seat.	LUMP SUM		$_____
N.	Toilet Room			
18.	Provide entry door, provide toilet partition stainless steel, and provide 5/8" gyp suspended ceiling.	LUMP SUM		$_____
O.	Office			
19.	Provide entry door, provide window, provide suspended acoustical ceiling, provide 8" diameter roof pipe copper, provide roof catch basin, provide concrete curbing for condensing units	LUMP SUM		$_____
P.	Electrical Equip Room			
20.	Provide glass partition, provide concrete wall for glass, provide acoustical treatment.	LUMP SUM		$_____

Item No.	Description	Estimated Quantity	Unit Price	Total
	Q. Pump Motor Room			
21.	Provide roof mounted exhaust fans, wall pressure relief dampers			
		LUMP SUM		$_____
	R. New Transformer Concrete Pad			
22.	Provide Concrete Pad			
		LUMP SUM		$_____
	S. Plumbing			
23.	Provide all plumbing appurtenances including all supply lines, all cold water lines, all hot water lines, all vent lines, floor clean-outs, floor drains, ground clean-out, provide electric water heater, provide service sink, provide water cooler, provide shower, provide lavatory, provide urinal, provide water closet.			
		LUMP SUM		$_____
	T. Electrical			
24.	Provide power, lighting, interior switchgear, conduits and cables			
		LUMP SUM		$_____
	Allowance for all changes resulting from work performed by HECO.			
		ALLOWANCE		$94,500

Item No.	Description	Estimated Quantity	Unit Price	Total
	Allowance for all changes resulting from work performed by HTEL.			
		ALLOWANCE		$2.520
	TOTAL SUM BID (Items 1 to 24 inclusive)			$_____

The following unit price for each item shall be used for monthly progress payment in accordance with Section 113, Payment for Delivered Materials:

		Unit Price
1.	Diesel Engine Generator with Electrical Ancillaries	
2.	Remote Radiator	
3.	Engine Exhaust Silencer	
4.	Sound Rated Double Door	
5.	Air-Cooled Condensing Unit	
6.	Air Handler	
7.	Switchboard	
8.	Motor Control Center	
9.	4000 Amp Transfer Switch	

The undersigned also agrees as follows:

1. That the quantities of work shown herein are approximate only and are subject to increase or decrease, and offers to do the work whether the quantities are increased or decreased at the Unit Prices state in the Proposal Schedule.

2. That the bids submitted on the various items in this Proposal on which a Lump Sum bid is asked, include all materials, equipment, labor and all other incidental work required for the complete construction and installation of this project in accordance with the plans and specifications.

That the quantities in any item on a Lump Sum bid in this Proposal are approximate only and that payment will be made only for the item in place complete, regardless of amount of material, equipment and labor necessary to complete the same in a proper and workmanlike manner and in accordance with the plans and specifications. That the quantities shown distributed in the Lump Sum items are given only for the bidder's and/or Contractor's convenience and for the purpose of making monthly estimates. The bidder and/or Contractor shall verify these quantities in any manner he deems necessary or expedient.

3. That the estimated quantities shown on items for which a Unit Price is given in this Proposal are only for the purpose of comparing on a uniform basis, bids offered for the work under this contract, and that he is satisfied with and will at no time dispute said estimated quantities as a means of comparing the bids. That he will make no claim for anticipated profit or loss of profit because of a difference between the quantities of the various classes of work done or the materials and equipment actually installed and the said estimated quantities.

That on Unit Price bids, payment will be made only for the actual number of units incorporated into the finished project a the Unit Price bid.

4. That if the product of the Unit Price bid by the number of units does not equal the total amount named by the bidder of any item, it will be assumed that the error was made in computing the total amount and for the purpose of computing the lowest bidder, the named Unit Price alone will be considered as representing the bidder's intention and the total amount bid on such item shall be considered to be the amount arrived at by multiplying the Unit Price by the number of units.

5. That the amount specified for an Allowance item in this Proposal is an estimate only, and may be increased or decreased. Payment for the allowance item shall be made as specified in the Special Provisions. Any unused portion of the allowance item shall remain with the City upon completion of the project.

6. That all prices bid include all taxes which shall be applicable to the products or services or the furnishing, sale, or purchase thereof whether assessed against, chargeable to, or payable by the City and County of Honolulu or any agencies or the undersigned.

7. That bids will be compared on the basis of the Total Sum bid for all items contained in the Proposal, which shall be considered to be the total sum of the actual or corrected amounts bid upon each item, as the case may be.

8. That all work shall be completed within 300 consecutive calendar days from the commencement date in the Notice to Proceed.

9. That after the time fixed for opening of bids, he will not withdraw his bid for a period of sixty (60) calendar days (90 days for CIP projects) after the opening of bids as stipulated Section 2.13 of the General Provisions.

10. That the Director of Finance reserves the right to accept or reject any bid and to waive any defect therein.

11. That if this Proposal shall be accepted and the undersigned shall fail to or neglect to contract as aforesaid, and to furnish the required bonds to the City and County of Honolulu within ten (10) calendar days from the date of receiving from the City, the contract prepared and ready for execution, the City may determine that the bidder has abandoned the contract, and thereupon, forfeiture of the security accompanying the Proposal shall operate and the same shall become the property of the City.

12. That the Undersigned certifies that he is licensed to undertake this project pursuant to Chapter 444, HRS, as amended, relating to licensing of contractors.

13. That the Undersigned certifies that the price submitted (bid) is independently arrived at, without collusion.

14. Bidders' attention is directed to HRS 103-53, amended by Act 314, SLH 1996, Taxation and the Internal Revenue Service, as a prerequisite to entering into contract, and upon final settlement of a contract.

15. Enclosed herewith is:

(Circle one)

surety bond)
certificate of deposit)
legal tender)
cashier's check)
treasurer's check)
teller's check)
official check)
share certificate)
certified check)

for the sum of _____
Dollars ($_____), being not less than 5% of the total sum bid.

Respectfully submitted,

_____
Bidder's signature

_____
Title

Bidder shall be responsible to confirm the existence of any addendum to this bid solicitation by telephoning (808) 523-4682.

Acknowledge addendum (if any) by indicating the date of receipt.

Addendum No. 1 _____ Addendum No. 3 _____

Addendum No. 2 _____ Addendum No. 4 _____

Hawaii Products

It is understood that certain Hawaii products as described in the schedule below are acceptable to be used in this work and that pursuant to Section 103D-1002, Hawaii Revised Statutes, which provides preference for Hawaii products, the bidder proposing to use such Hawaii products and obtain the preference provided, need not fill in the schedule below. However, where there are a number of qualifying classes of Hawaii products, the bidder must indicate on the schedule which class will be furnished by circling the class of the particular Hawaii product that will be used. Otherwise, preference will be given based on the class with the lower percentage.

It is also understood that if the bidder proposes to use an acceptable non-Hawaii product, the bidder must so designate in said schedule by entering the cost of such non-Hawaii product in the appropriate space provided. Failure on the part of the bidder to designate the use of a non-Hawaii product will automatically commit such bidder to use the acceptable Hawaii product.

For the purpose of selecting the lowest bid price, the price bid or offered for a non-Hawaii product item shall be increased by adding thereto three percent, five percent or ten percent where similar Class I, Class II or Class III registered Hawaii products have been offered or bid by another party. The responsible bidder submitting the lowest total bid, taking into consideration the above increase, shall be awarded the contract, but the contract amount of any contract awarded shall be the amount of the price bid or offered, exclusive of such increase.

It is further understood by the bidder that if upon being granted preference for any Hawaii product and being awarded the contract, bidder fails to use such product, the bidder shall be subject to penalties provided in Section 103D-1002, Hawaii Revised Statutes, as amended.

Schedule of Acceptable Hawaii Products &
Designation of Acceptable Non-Hawaii Products
to be Used in Lieu thereof

Basic Bid

Acceptable Hawaii Products			**Acceptable Non-Hawaii Products**	
Description of Item	Class	Manufacturer	Quantity Unit	Cost F.O.B. Jobsite, Unloaded Including Applicable General Excise & Use Taxes
Reinforcing Steel Bars	III	Hawaiian West. Steel Bars	_____ lbs.	$_____
Item 2	II	Honolulu Co.	_____ L.F.	$_____

(Subcontractor listing in the Bid Proposal.)

Section 103D-302, HRS, provides that all bids shall include the name of each person or firm to be engaged by the bidder as a joint contractor or subcontractor in the performance of the construction and the nature and scope of work to be performed by each joint contractor and subcontractor. Construction bids that do not comply with this requirement may be accepted if the Contracting Officer or the HAR conclude that acceptance is in the best interest of the public and the value of the work to be performed by the joint contractor or subcontractor is equal to or less than one percent of the total bid amount. In all other cases, bids which do not comply with this requirement shall be rejected.

In determining work that is to be performed by joint contractors or subcontractors, bidders shall be familiar with HRS 444, relating to licensing of contractors and the Hawaii Administrative rules, Title 16, Department of Commerce and Consumer Affairs, Chapter 77, Contractors.

Where more than one joint contractor or subcontractor is listed for a category of work, the bidder shall identify the scope of work each will perform, including the alternate if alternate bids are requested.

Name of Joint Contractor or Subcontractor	Nature and Scope of Work (Identify alternate number, if applicable)

Acknowledgment of Liquidated Damages Provisions

Project Name and Number: Ala Moana Wastewater Pump Station Emergency Generator Upgrade (W13-96)

This is to certify that I, the undersigned, of _____
Name of Contractor

understand and agree to the provisions for Liquidated Damages, Section 8.4(A) of the Revised General Provisions of Construction Contracts of the City and County of Honolulu, 1976, and that submittal of our bid constitutes acceptance of the provision and amount of liquidated damages that may be assessed per calendar day as specified in the Schedule of Liquidated Damages under Section 8.4(A).

_____
Signature and Title

Dated: _____

Acknowledgment of Examination of Site Provisions

Project Name and Number: Ala Moana Wastewater Pump Station Emergency Generator Upgrade, 3-96

This is to certify that I, the undersigned, of _____,
Name of Contractor
understand the provisions of Section 103, Examination of site, of the Special Provisions and we have thoroughly familiarized ourselves with the existing conditions of the site. The submission of our bid shall be considered as a warranty that we have made such examination and we are satisfied with the conditions to be encountered in performing the work.

_____
Signature and Title

Dated: _____

Suppliers' List

The suppliers of the major equipment and categories of equipment shall be listed below. Such supplier designation shall be limited to one supplier only for each equipment.

The Suppliers' List is considered defective if:

1. No designation of supplier is provided for each of the equipment, or
2. Designation of two (2) or more suppliers for each equipment, or
3. Designation of supplier which was not approved by the City during the bidding period.

The defect may be corrected by supplying a specified or approved brand name by amending the list at no additional cost to the City. An uncorrected defective list shall be cause for the bid to be rejected by the City.

The City's acceptance of the Contractor's bid does not release the Contractor from his responsibility of providing equipment which meet the requirements of the Special Provisions. If any of the equipment listed below does not meet the requirements of the Special Provisions, the Contractor shall provide other new equipment at no additional cost to the City.

1. _____
   _____
2. _____
   _____

Surety Bid Bond

Bond No. _____

KNOW ALL MEN BY THESE PRESENTS:

That we, _____, as Principal, hereinafter called the Principal, and _____, a corporation duly licensed for the purpose of making, guaranteeing, or becoming sole surety upon bonds or undertakings required or authorized by the laws of the State of Hawaii, as Surety, hereinafter called the Surety, are held and firmly bound unto the City and County of Honolulu, as Owner, in the penal sum of _____ dollars ($_____), lawful money of the United States of America, for the payment of which sum well and truly to be made, the said Principal and the said Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS:

The Principal has submitted an offer for _____.

NOW, THEREFORE:

The condition of this obligation is such that if the City and County of Honolulu shall reject said offer, or in the alternate, accept the offer of the Principal and the Principal shall enter into a Contract with the City and County of Honolulu in accordance with the terms of such offer, and give such bond or bonds as may be specified in the solicitation or Contract Documents with good and sufficient surety for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof as specified in the solicitation then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed this _____ day of _____, 19____.

_____
(Principal)

By _____
Its

_____
(Surety)

By _____

Certification of Compliance
with HRS 396-18, Safety and Health Programs
for Contractor Bidding on City Jobs

Project Name and Number: Ala Moana Wastewater Pump Station Emergency Generator Upgrade, (W13-96)

This is to certify that the undersigned will comply with the requirements of HRS 396-18, as follows:

(A) Pursuant to HRS 396-18, all bids and proposals in excess of $100,000 shall include a signed certification from the bidder that a written safety and health plan for the job will be available and implemented by the notice to proceed dates of the project. the written safety and health plan shall include:

(1) A safety and health policy statement reflecting management commitment;

(2) A description of the safety and health responsibilities of all levels of management and supervisors on the job and a statement of accountability appropriate to each:

(3) The details of:

(a) The mechanism for employee involvement in job hazard analysis;

(b) Hazard identification, including periodic inspections and hazard correction and control;

(c) Accident and "near-miss" investigations; and

(d) Evaluations of employee training programs;

(4) A plan to encourage employees to report hazards to management as soon as possible and to require management to address these hazards promptly; and

(5) A certification by a senior corporate or company manager that the plan is true and correct.

(B) Failure to submit the required certification may be grounds for disqualification of the bid.

(C) Failure to have available on site or failure to implement the written safety and health plan by the project's notice to proceed date shall be considered willful noncompliance and be sufficient grounds to disqualify the award and terminate the contract.

_____
Name of Contractor

Date: _____

_____
Signature and Title

Section 101 - Standard Documents

A. The work embraced herein shall be done in accordance with the "Revised General Provisions of Construction Contracts" of the City and County of Honolulu, October 1976, the "Standard Specifications for Public Works Construction", September 1986, and the "Standard Details for Public Works Construction", September 1984, insofar as they may apply, and in accordance with the following special provisions.

The Hawaii Administrative Rules (Interim Draft), Title 3, Department of Accounting and General Services, hereinafter referred to as "HAR", is by reference incorporated herein and made a part of these contract documents. The HAR is available for inspection at the Division of Purchasing, Department of Finance, City and County of Honolulu.

Wherever "chief procurement officer" appears in the HAR, it shall mean the Contracting Officer; wherever "head of the purchasing agency" and "procurement officer" appear in the HAR, both shall mean the officer-in-charge.

The term "General Provisions" used hereinafter refers to the "Revised General Provisions of Construction Contracts" of the City and County of Honolulu, October 1976.

The term "Standard Specifications" used hereinafter refers to the "Standard Specifications for Public Works Construction", September 1986.

The term "Standard Details" used hereinafter refers to the "Standard Details for Public Works Construction", September 1984.

Copies of the General Provisions, Standard Specifications and Standard Details are on file and may be inspected or purchased at the Division of Purchasing, Department of Finance, City Hall.

These special provisions supplement and modify the General Provisions and Standard Specifications.

B. Revisions to "Revised General Provisions of Construction Contracts."

1. Section 2.7, Bid Deposit; 2.11, Preferences for Hawaii Products; 2.12, Listing of Joint Contractors and Subcontractors; 3.5, Bond for Faithful Performance; 5.2, Modifications; 6.2, Delay; 6.15, Wages; 6.19, Assignment of Contract; 7.6, Assignment of Money Due or Payable; 7.7, Final Inspection - Final Payment; 8.1, Suspension of Work; 8.2, Termination of Contract - Work May be Taken Over By City; 8.3, Costs of Completing Contract; and 8.9, special

Emergency Termination, are hereby deleted in their entirety and are revised by provisions herein.

2. Add new paragraph "F" to Section "1.6, Officer-in-Charge."

"F. For Sewer Improvement District Projects and projects of the Department of Wastewater Management of the City, the Director of the Department of Wastewater Management or a representative of the Director of the Department of Wastewater Management acting within the scope of the duties and authority assigned and delegated to him as such representative."

3. Revise Section "1.8, Reference Specifications" by deleting Subparagraph "B" and replacing it with the following:

"B. Standard Detail Drawings, Specifications and Special Provisions. When reference is made to standard detail drawings, specifications or special provisions, such referral for Improvement District projects and projects of the City's Departments of Public Works and Wastewater Management shall be to the standard detail drawings, specifications or special provisions of the Department of Public Works and Wastewater Management shall be to the standard detail drawings, specifications or special provisions of the Department of Public Works and word Engineer, as defined in the specifications, shall also include the Director of the Department of Wastewater Management."

4. Delete Section 2.2, Qualification of Bidders in its entirety and in its place substitute the following new Section 2.2:

"2.2, Qualification of Bidders. Prospective bidders must be capable of performing the work for which bids are being called. Each prospective bidder must file a written notice of intention to bid which shall be received not less than ten calendar days prior to bid opening. If the tenth calendar day prior to the day designated for opening of bids is a Saturday, Sunday, or legal State holiday, the written notice must be received by the Director of Finance no later than 4:30 p.m. on the working day immediately prior to said Saturday, Sunday, or legal State holiday."

5. Amend Section 2.4, Bid Form, Interpretation of:

Third paragraph, 8th line - Delete "No addendum will be issued during the five (5) calendar days immediately preceding the date fixed for the opening of bids."

6. Amend Section 2.14, Bids, Disqualification of:

Delete the first paragraph and in its place substitute the following new paragraph:

"Bids which are conditional or not in compliance with the bidding instruction may be rejected."

Add the following paragraph:

"The apparent successful bidder will be required to submit tax clearances from the State Department of Taxation and the Internal Revenue Service prior to award of the contract. The tax clearance certificate may be an original or a copy certified by the State Department of Taxation."

7. Amend Section 2.7, Bid Deposit:

"Section 2.7, Bid Deposit:

Delete this section in its entirety and substitute the following: "All bid deposits except for surety bonds which have not been forfeited as prescribed by Section 3.6 shall be returned to the bidders who furnished them after either the contract is entered into and the bonds for faithful performance and payment are furnished or the Contracting Officer decides to publish another call for bids."

8. Amend Section 2.14, Bids, Disqualification of:

Delete the first paragraph and substitute the following: "Bids which are conditional or not in compliance with the bidding instructions may be rejected."

9. Delete Section 3.1, Award of Contract, of the General Provisions, and in lieu thereof, substitute of the following:

"3.1. Award of Contract. Notwithstanding Section 3-122-23, HAR, Bid evaluation and award, award of contract, if it be made, shall be made with reasonable promptness by written notice to the lowest responsive, responsible bidder, whose bid, conforming to the invitation for bids, will be most advantageous to the City, price and other factors considered.

No contract will be awarded to any person suspended or debarred by the State or City, or who has not provided tax clearances from the State Department of Taxation and the Internal Revenue Service.

The Contracting Officer reserves the right to reject any or all bids and to waive any defect as, in his judgment, may be in the best interest of the City."

10. Section 3.4, Entering contract:

In the third line, delete "...bond for faithful performance as prescribed in Subsection 3.5..." and substitute in lieu thereof the following: "...bonds for faithful performance and payment as prescribed in the invitation for bid."

11. Section 4.4, Insurance:

    Delete Subsections B and C for site work projects.

12. Section 6.15, Wages, delete the section in its entirety and substitute the following:

    "Bidders shall observe and comply with all the provisions of Chapter 104, HRS, relating to wages ad hours of employees on public works. The contractor shall pay all employees on any contract with the City, the minimum basic wage rate in conformance with applicable Federal and State laws.

    The minimum wages shall be periodically increased during the performance of a contract in an amount equal to the increase in the prevailing wages for those kinds of work as periodically determined by the State Director of Labor and Industrial Relations. Notwithstanding the provisions of the original contract entered into, if the Director of Labor and Industrial Relations determines that the prevailing wage has increased, the rate of pay of laborers and mechanics on the contract shall be raised accordingly. Bidders shall take into consideration increases which may occur during the period of the contract in computing their bid prices. No additional compensation shall be made for failure to do so.

    The minimum basic wage rates in effect are available for inspection in the Purchasing Division, City Hall, where invitation for bids are distributed.

    No labor or mechanic employed on the job site shall be permitted or required to work on Saturday, Sunday, or a legal holiday of the State or in excess of eight hours on any other day unless the laborer or mechanic receives overtime compensation for all hours worked on Saturday, Sunday, and a legal holiday of the State or in excess of eight hours on any other day. For purposes of determining overtime compensation under this subsection the basic hourly rate of any laborer or mechanic shall not be less than the basic hourly rate determined by the Director of Labor and Industrial Relations to be the prevailing basic hourly rate for corresponding classes of laborer and mechanics on projects of similar character in the State.

    A certified copy of all payrolls shall be submitted weekly to the officer-in-charge. The contractor shall be responsible for the submission of certified copies of the payrolls of all subcontractors. The certification shall affirm that the payrolls are correct and complete, that the wage rates contained therein are not less than the applicable rates contained in the wage determination decision of the Director of Labor and Industrial Relations attached to the

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

Add the following paragraph:

"The apparent successful bidder will be required to submit tax clearances from the State Department of Taxation and the Internal Revenue Service prior to award of the contract. The tax clearance certificate may be an original or a copy certified by the State Department of Taxation."

7. Amend Section 2.7, Bid Deposit:

"Section 2.7, Bid Deposit:

Delete this section in its entirety and substitute the following: "All bid deposits except for surety bonds which have not been forfeited as prescribed by Section 3.6 shall be returned to the bidders who furnished them after either the contract is entered into and the bonds for faithful performance and payment are furnished or the Contracting Officer decides to publish another call for bids."

8. Amend Section 2.14, Bids, Disqualification of:

Delete the first paragraph and substitute the following: "Bids which are conditional or not in compliance with the bidding instructions may be rejected."

9. Delete Section 3.1, Award of Contract, of the General Provisions, and in lieu thereof, substitute of the following:

"3.1. Award of Contract. Notwithstanding Section 3-122-23, HAR, Bid evaluation and award, award of contract, if it be made, shall be made with reasonable promptness by written notice to the lowest responsive, responsible bidder, whose bid, conforming to the invitation for bids, will be most advantageous to the City, price and other factors considered.

No contract will be awarded to any person suspended or debarred by the State or City, or who has not provided tax clearances from the State Department of Taxation and the Internal Revenue Service.

The Contracting Officer reserves the right to reject any or all bids and to waive any defect as, in his judgment, may be in the best interest of the City."

10. Section 3.4, Entering contract:

In the third line, delete "...bond for faithful performance as prescribed in Subsection 3.5..." and substitute in lieu thereof the following: "...bonds for faithful performance and payment as prescribed in the invitation for bid."

11. Section 4.4, Insurance:

    Delete Subsections B and C for site work projects.

12. Section 6.15, Wages, delete the section in its entirety and substitute the following:

    "Bidders shall observe and comply with all the provisions of Chapter 104, HRS, relating to wages ad hours of employees on public works. The contractor shall pay all employees on any contract with the City, the minimum basic wage rate in conformance with applicable Federal and State laws.

    The minimum wages shall be periodically increased during the performance of a contract in an amount equal to the increase in the prevailing wages for those kinds of work as periodically determined by the State Director of Labor and Industrial Relations. Notwithstanding the provisions of the original contract entered into, if the Director of Labor and Industrial Relations determines that the prevailing wage has increased, the rate of pay of laborers and mechanics on the contract shall be raised accordingly. Bidders shall take into consideration increases which may occur during the period of the contract in computing their bid prices. No additional compensation shall be made for failure to do so.

    The minimum basic wage rates in effect are available for inspection in the Purchasing Division, City Hall, where invitation for bids are distributed.

    No labor or mechanic employed on the job site shall be permitted or required to work on Saturday, Sunday, or a legal holiday of the State or in excess of eight hours on any other day unless the laborer or mechanic receives overtime compensation for all hours worked on Saturday, Sunday, and a legal holiday of the State or in excess of eight hours on any other day. For purposes of determining overtime compensation under this subsection the basic hourly rate of any laborer or mechanic shall not be less than the basic hourly rate determined by the Director of Labor and Industrial Relations to be the prevailing basic hourly rate for corresponding classes of laborer and mechanics on projects of similar character in the State.

    A certified copy of all payrolls shall be submitted weekly to the officer-in-charge. The contractor shall be responsible for the submission of certified copies of the payrolls of all subcontractors. The certification shall affirm that the payrolls are correct and complete, that the wage rates contained therein are not less than the applicable rates contained in the wage determination decision of the Director of Labor and Industrial Relations attached to the

contract, and that the classifications set forth for each laborer or mechanic conform with the work the laborer or mechanic performed.

If the Officer-in-Charge finds that any laborer or mechanic employed on the job site by the contractor or any subcontractor has been or is being paid wages at a rate less than the required rate by the contract or the specifications, or has not received the laborer's or mechanic's full overtime compensation, the Officer-in-Charge may take appropriate action in accordance with HRS 104-5, or the Contracting Officer may, upon recommendation of the officer-in-charge, by written notice to the contractor, terminate the contractor's right, or the right of any subcontractor, to proceed with the work or with the part of the work in which the required wages or overtime compensation have not been paid and may complete such or part by contract or otherwise, and the contractor and the contractor's sureties shall be liable to the City for any excess costs occasioned thereby.

The contractor is required to post the applicable wage schedule in a prominent and easily accessible place at the job site. The contractor shall give to each laborer and mechanic employed under the contract a copy of the rates of wages required to be posted.

On federally funded or federally assisted projects, the current federal wage rate determination in effect at the time of advertising for bids is incorporated as part of the invitation for bids, and both State and federal wage rates shall apply. Where rates for any class of laborers and mechanics differ, the higher rates shall prevail. The minimum federal wage rates shall be those in the U.S. Department of Labor Wage Determination Decision and Modifications in effect ten days prior to the bid opening date."

13. Section 6.34, Final Inspection:

Delete the section in its entirety and insert in lieu thereof the following:

"Upon notice from the contractor of completion of the entire contract including compliance with Subsection 6.18, and submittals of all required documents, the officer-in-charge, within seven days, will make final inspection with representatives of City agencies interested in the contract. If the inspection discloses any deficiencies, the Officer-in-Charge will notify the contractor in writing of the particular items or portions of work that are deficient, hereinafter referred as the "punch list." The contractor shall, within ten working days, proceed to complete the items on the punch list. All items on the punch list must be completed within ten working days unless extended by the officer-in-charge. Upon completion, the contractor shall again notify the officer-in-charge, who will make another inspection. If the inspection discloses satisfactory completion of the contract, the officer-in-charge shall accept the project as of the date of the final inspection.

The contractor shall be relieved of the contractor's responsibility in maintaining and protecting the work and site and for injury to persons or property after all work including items on the punch list have been completed and accepted by the officer-in-charge.

14. Section 7.1, Payment:

Delete the second sentence in the fourth paragraph, and the fifth paragraph. Section 125.3, Variations in estimated quantities, of the Special Provisions replaces the deleted materials.

15. Section 7.3, Force Account:

Delete paragraph D and F in their entirety and substitute the following in lieu thereof:

"D. The allowances for all overhead, extended overhead resulting from adjustments to contract time (including home office and field overhead) and profit combined, shall not exceed the percentages set forth below:

(1) For the contractor, for any work performed by its own forces, fifteen percent of the total cost of items A, B, and C;

(2) For each subcontractor involved, for any work performed by its own forces, fifteen percent of the cost of items A, B, and C;

(3) For the contractor or any subcontractor, for work performed by their subcontractors, seven percent of the amount due the performing subcontractor.

F. Not more than three line item percentages for fee and overhead, not to exceed the maximum percentages shown above, will be allowed regardless of the number of tier subcontractors.

G. To the sum costs of labor, materials, premiums and contributions (under Item C) and rental of machinery or equipment (including the allowance in Item D), there shall be added a sum not to exceed 4.166% for general excise tax. For the contractor or any subcontractor, for work performed by their subcontractors, the general excise tax not to exceed 4.166% will be applied to the seven percent allowed."

16. Delete Section 7.7 in its entirety and substitute in lieu thereof the following new section:

"7.7 Final Inspection - Final Payment

A. After completion of the work which shall include all punch list items required under the contract and final acceptance thereof by the

Officer-in-Charge, the contractor will be paid the balance due in accordance with the Officer-in-Charge's final estimate of the construction actually performed, provided that final payment will be made only with the approval of the Contracting Officer, or for improvement districts, the City Council, and upon submittal of the following:

(1) A written list of equipment installed or provided under the contract, listing the description, make, model, serial number, cost, and location of the equipment of room number in which it is located;

(2) Written consent of the surety or sureties on the contractor's bond;

(3) Tax clearance certificate from the State Director of taxation and the Internal Revenue Service; and

(4) Completed form DF-P-65, acknowledging any outstanding claims arising out of the performance of the contractor's work.

B. Equipment as specified in paragraph (1) is defined as any item such as a water heater that can be removed with a hand tool, or like an air conditioner, is capable of being moved or transferred to another location, and is accessible to tagging with an identification number such as a generator.

C. The tax clearances required in paragraph (3) shall be on an original certificate and valid for a period of forty-five (45) calendar days from the later date stamped on the certificate, provided that the contractor does not delay in obtaining clearances from both agencies.

D. Failure to comply. If the contractor delays or fails to comply with the requirements of this section, the Contracting Officer may terminate the contract for default, or upon notice from the State Department of Taxation or Internal Revenue Service, assign payment to the appropriate tax agency.

17. Delete paragraph b under Subsection 8.8, Authority to Withhold Money Due or Payable and substitute in lieu thereof the following:

"B. Satisfy any obligation of the contractor to the City, State Department of Taxation, Internal Revenue Service, including obligations not relating to the contract, and the obligation of the contractor to the workers, subcontractors, and suppliers who have performed labor or furnished material and equipment under the contract as provided by law; and"

18. "Acceptable bid security, contract performance and payment bonds. (a) Acceptable bid security, contract performance and payment bonds shall be limited to:

a. Surety bond underwritten by a company licensed to issue bonds in this State;

b. Legal tender; or

c. A certificate of deposit; share certificate; or cashier's, treasurer's, teller's, or official check drawn by, or a certified check accepted by a bank, a savings institution, or credit union insured by the Federal Deposit Insurance Corporation or the National Credit Union Administration, and payable at sight or unconditionally assigned to the Director of Finance, City and County of Honolulu.

(1) These instruments may be utilized only to a maximum of $100,000.

(2) If the required security or bond amount totals over $100,000, more than one instrument not exceeding $100,000 each and issued by different financial institutions shall be accepted.

d. The bond forms shall be consistent with the forms included in the invitation for bids."

In addition, if federally funded, (1) above should read: "Surety bond underwritten by a company licensed to issue bonds in this State and listed in the U.S. Department of the Treasury Circular 570 of acceptable sureties".

19. "Bid security. Bid security shall be in an amount equal to at least five per cent of the amount of the bid."

20. "Contract performance and payment bonds. Performance and payment bonds shall each be in an amount equal to one hundred per cent of the amount of the contract price."

21. "Independent price determination. By submitting a bid, the bidder certifies that the price submitted was independently arrived at without collusion."

22. "Cancellation of solicitations and rejection of bids and proposals. Any solicitation may be cancelled, or may be cancelled, or may be rejected in whole or in part if the Contracting Officer determines it is in the best interest of the City."

23. Include the attached provisions for the sections listed below (from Chapter 125, Modifications and Terminations of Contracts):

a. Change order

b. Suspension of work

c. Variations in estimated quantities

d. Differing site conditions - Price adjustments

e. Price adjustment

f. No assignment

g. Recognition of a successor in interest; assignment

h. Change of name

i. Claims based on oral directives

j. Default, delay, and time extension

k. Liquidated damages

l. Termination for convenience

m. Prompt payment by contractors to subcontractors

n. Remedies

o. Disputes

24. Add the following new provision and include the attached certification with the bid proposal.

"HRS 396-18, Safety and Health Programs for Contractors Bidding on City Project. The Bidder shall certify that, if awarded the contract, it will comply with Section 396-18, HRS, relating to safety and health programs for contractors bidding on City construction projects, where the bid is in excess of $100,000. The certificate of compliance included in the bid proposal shall be submitted with the Bidder's bid. Failure to submit the required certification may be grounds for disqualification of the Bidder's bid."

C. Revisions to "Standard Specifications for Public Works Construction."

1. Section 13 - Structure Excavation and Backfill, page 21, first paragraph: The last sentence shall be revised to read as follows:

"When ledge rock or coral is encountered, the excavation shall be carried into the ledge rock or coral to form a key for the concrete footing or structure, or to such additional depth as specified in the special provisions or directed by the Engineer."

2. Section 19 - Reinforced Concrete Sewer Pipe and Appurtenances, page 53, add the following at the bottom of the page:

"19.4 Measurement

A. Reinforce Concrete Sewer Pipe

The lengths of pipeline, excluding precast bends, measured for payment shall be the actual number of linear feet of pipe, of the several sizes, installed in place as determined by horizontal measurement. Where the grades exceed 10%, the actual length of pipe installed will be measured.

B. Precast Pipe Fittings

Fittings measure for payment shall be the actual number placed as ordered.

19.5 Payment

A. Pipe

Payment for reinforce concrete sewer pipe as measured above will be made at the unit price bid and shall be full compensation for the installation of the sewer pipe in place complete.

B. Precast Pipe Fittings

Payment for fittings as measured above will be made at the unit price bid and shall be full compensation for the fittings in place complete."

D. The Hawaii Administrative Rules (HAR), supersedes the following subsections of the General Provisions:

a. Section 2.11, Preference for Hawaii Products

b. Section 2.12, Listing of Joint Contractors and Subcontractors

c. Section 3.5, Bond for Faithful Performance

d. Section 5.2, Modifications

e. Section 6.2, Delay

f. Section 8.1, Suspension

g. Section 8.2, Termination

h. Section 8.9, Special Emergency Termination

Any other provision of the Revised General Provisions not inconsistent with the HAR shall apply to this contract.

-- End Section 101 --

Section 102 - Bid Security, Contract Performance and Payment Bonds

Delete Section 2.7, Bid Deposit and Section 3.5, Bond for Faithful Performance, of the General Provisions in its entirety and in its place substitute Subchapter 24, Bid Security, Contract Performance and Payment Bonds, of Chapter 122, HAR.

The following shall supplement Subchapter 24, Bid Security, Contract Performance and Payment Bonds:

1. Bid Security

   Bid Security, except for surety bonds, which have not been forfeited as prescribed by Section 3.6 shall be returned to the bidders who furnished them after either the contract is entered into and the bond for faithful performance and payment is furnished or the Contracting Officer decides to publish another call for bids.

   Bid Security shall be in an amount equal to at least five per cent (5%) of the amount bid. The bond forms shall be consistent with the forms attached to and made a part of the contract documents.

2. Performance and Payment Bonds

   Performance and payment bonds shall each be in an amount equal to one hundred per cent (100%) of the amount of the contract price. The performance and payment bonds shall be consistent with the forms attached to and made a part of the contract documents.

3. Acceptable Financial Instruments

   Acceptable bid security, contract performance and payment bonds shall be limited to:

   A. Surety bond underwritten by a company licensed to issue bonds in this State;

   B. Legal tender; or

C. A certificate of deposit; share certificate; or cashier's, treasurer's, teller's, or official check drawn by, or a certified check accepted by a bank, a savings institution, or credit union insured by the Federal Deposit Insurance Corporation or the National Credit Union Administration, and payable at sight or unconditionally assigned to the Director of Finance, City and County of Honolulu.

(1) These instruments may be utilized only to a maximum of $100,000.

(2) If the required security or bond amount totals over $100,000, more than one instrument not exceeding $100,000 each and issued by different financial institutions shall be accepted.

-- End of Section 102 --

Section 103 - Examination of Site

Bidders are to thoroughly familiarize themselves with the existing conditions and the amount and kind of work to be performed, in compliance with Section 2.9 of the General Provisions. The submission of a bid shall be considered as a warranty that the bidder has made such examination and is satisfied with the conditions to be encountered in performing the work.

Bidders are instructed to call Dennis Kaneshiro of the Department of Wastewater Management at (808) 527-5848 to arrange for inspection of the job site.

-- End Section 103 --

Section 104 - Trade Names and Alternatives

This section shall modify Subsection 2.10, "Trade Names and Alternatives", of the General Provisions.

Delete in its entirety, paragraph B. After Bid Opening and in lieu thereof insert the following:

> "After Bid Opening. Substitution of equipment, articles, materials or systems for either specified items or alternates after bid opening may not be made without the prior written approval of the Officer-in-Charge.
>
> Substitution of equipment, articles, materials or systems under this paragraph shall also be of equal or more cost to qualify for substitution. Request for substitution of items of lower cost than those specified or pre-qualified prior to bid opening may be made only if the cost savings are credited to the City.
>
> The Officer-in-Charge shall be the sole judge as to acceptability of the substitution with the cost factor to be considered."

-- End Section 104 --

Section 105 - Award of Contract

This section shall modify Subsection 3.1, "Award of Contract", of the General Provisions.

First paragraph, line 2, delete "lowest responsible" and insert "lowest, responsive, and responsible".

-- End Section 105 --

Section 107 - Health and Safety

This section shall supplement Subsection 4.2, "Laws, Regulations", of the General Provisions.

1. General:

   The Contractor shall comply with the standards of the Occupational Safety and Health Administration and all applicable Federal, State, and City laws and regulations relating to safety in the performance of the work.

   The Bidder shall certify that, if awarded the contract, it will comply with Section 396-18, HRS, relating to safety and health programs for contractors bidding on City construction jobs, where the bid is in excess of $100,000. The certificate of compliance included in the bid proposal shall be submitted with the Bidder's bid. Failure to submit the required certification may be grounds for disqualification of the Bidder's bid.

2. Payment

   The cost of the work under this section shall not be paid for directly but shall be considered incidental and included in the prices bid for the various items of work.

-- End Section 107 --

Section 108 - Licensing Requirement

Licensed Bidders: All prospective bidders must hold a current _____ contractor's license from the State of Hawaii. Any bid submitted by an unlicensed or non-qualified contractor will be rejected.

-- End Section 108 --

Section 110 - Cancellation of Solicitations and Rejection of Bids and Proposal

Any solicitation may be canceled, or may be rejected in whole or in part if the Contracting Officer determines it is in the best interest of the City.

-- End Section 110 --

Section 112 - Payments During Performance of Work

This section shall modify Subsection 7.4, "Payments During Performance of Work", of the General Provisions.

Within 7 calendar days following the commencement date in the Notice to Proceed, the Contractor shall submit an itemized breakdown of lump sum costs for the Officer-in-Charge's approval and for subsequent use in determining progress payments.

-- End Section 112 --

Section 113 - Payment for Delivered Materials

This section shall modify Subsection 7.5, "Payment for Delivered Materials", of the General Provisions.

Delete the last sentence in Section 7.5 and add the following:

"Such inclusion in the monthly estimate will be made only if all costs are substantiated by evidence of delivery in good condition and payment, and only for such materials or equipment as are specifically described or referred to in the contract as being the subject matter for such inclusion in the monthly estimate for progress payment.

The City reserves the right to withhold monthly payments to the Contractor until presented with evidence of payment to the suppliers for materials delivered and paid for in past monthly payments. Minor discrepancies are expected between the Contractor's request and the amount actually paid to the supplier because of unit price changes, discounts and other varying circumstances."

This provision shall apply to the following:

1. Diesel Engine Generator with Electrical Ancillaries
2. Remote Radiator
3. Engine Exhaust Silencers
4. Sound Rated Double Doors
5. Air-Cooled Condensing Units
6. Air Handlers
7. Switchboard
8. Motor Control Center
9. 4000 Amp Transfer Switch

Section 114 - Acknowledgment of Third Party Liability

No officer or employee shall accept on behalf of the City a construction project unless and until the Contractor has submitted in writing to the Officer-in-Charge or the Director of Finance that the Contractor has accepted and acknowledged all claims for liabilities related to the construction project.

Notwithstanding the provisions of the General Provisions, Section 7.7, Final Inspection-Final Payment, final payment shall be made upon receipt of the completed "acknowledgment of third party liability" form as shown and in full compliance of the requirements set forth in said Section 7.7.

(Date)

Director of Finance
City and County of Honolulu
Honolulu, Hawaii 96813

Dear Sir:

Subject: _____(Project)_____

As of this date, _____(Name of Company)_____ acknowledges receipt of the following outstanding bodily injury or death and property damage claims made by third parties arising out of the performance of its work in connection with Contract No. _____(Contract No.)_____. The Contractor agrees to notify the City of the final disposition of said claims; or, if no final disposition of such claims, their status before actual payment of an amount withheld by the City.

1. _____
2. _____
3. _____

Sincerely,

_____
(Signature)

-- End Section 114 --

Section 115 - Final Acceptance Test

1. Hydrostatic Test for Wet Well

   A. The hydrostatic test for the wet well shall be performed by filling the wet well (to the top of the access manhole) with potable water for not less than 24 hours during which time the water surface shall not change more than 1/4".

      In order to ensure accurate testing, sealing of wet well access manholes, and any other openings and piping shall be required. Sealing of manholes may be accomplished by installing "Rain Catchers".

2. Measurement and Payment

   A. The cost of work under this section shall not be paid for directly but shall be considered incidental and included in the prices bid for the various items of work.

-- End Section 115 --

Section 116 - Acknowledgment of Liquidated Damages Provision

Section 8.4 of the General Provisions relating to Damages for Delay states that the parties to the contract mutually understand and agree that time shall be of the essence to the contract and that in case of failure on the part of the Contractor to complete the work under the contract within the specified time, the City will be damaged thereby, and that the amount of said damages, being difficult if not impossible of definite ascertainment and proof, the Contractor hereby agrees to pay liquidated damages in the amount and manner specified in Section 8.4.(A).

The acknowledgment form attached to and made a part of the bid document shall be completed, signed by the Contractor, and submitted with its bid. Failure to acknowledge and submit the form with the bid may be cause for rejection of a bid.

-- End of Section 116 --

Section 117 - Guarantee

The Contractor guarantees all materials and equipment against defects and poor workmanship and to be in operable condition upon final acceptance of the work and that all such materials and equipment conform to the requirements of this contract and be fit for the use intended.

When he is responsible for the design, the Contractor guarantees the design to meet the criteria and operating requirements specified and against failure to perform in accordance with such criteria and operating requirements.

This guarantee shall commence upon acceptance of the work by the City, and shall extend for a period of one year for all materials and equipment. Furthermore, this period shall be extended from the time of correction of any defect or failure, corrected under the terms of this guarantee, for a like period of one year.

The Contractor shall correct all defects or failures discovered within the guarantee period. The City will give the Contractor prompt written notice of such defects or failures following their discovery. The Contractor shall commence corrective work within 10 days following notification and shall diligently prosecute such work to completion. The Contractor shall bear all costs of corrective work, which shall include necessary disassembly, transportation, reassembly and retesting, as well as repair or replacement of the defective materials or equipment and any necessary disassembly and reassembly of adjacent work.

If the Contractor fails to perform corrective work in the manner and within the time stated, the City may proceed to have such work performed at the Contractor's expense, and his sureties will be liable therefor. The City shall be entitled to reasonable attorney's fees and court costs necessarily incurred by the Contractor's refusal to honor and pay such costs of corrective work.

The Contractor's performance bond shall continue in full force and effect during the period of this guarantee.

The rights and remedies of the City under this provision do not preclude the exercise of any other rights or remedies provided by this contract or by law with respect to unsatisfactory work performed by the Contractor.

This guarantee shall be deemed supplemented to guarantee provisions provided in other sections of the specifications for the individual units and systems of units so specified.

-- End Section 117 --

Section 118 - Sexual Harassment Policy for Employer Having A Contract With the City

All City contractors must comply with City Ordinance 93-84 on sexual harassment. All contractors shall have and enforce a policy prohibiting sexual harassment. The contractor's sexual harassment policy must set forth the same or greater protection than those contained or required by the ordinance. The ordinance is applicable to the employer's business and includes the following:

a. Prohibitions against an officer's or employer's sexual harassment of the following:

   1) Another officer or employee of the employee of the employer;

   2) An individual under consideration for employment with the employer; or

   3) An individual doing business with the employer;

b. A provision prohibiting a management or supervisory officer or employee from knowingly permitting a subordinate officer or employee to engage in the sexual harassment prohibited under subdivision a;

c. A prohibition against retaliation towards an officer, employee, or individual who has complained of sexual harassment, conducted an investigation of a complaint;

d. A prohibition against a malicious false complaint of sexual harassment by an officer, employee, or individual;

e. Provisions allowing an officer, employee, or individual to make a sexual harassment complaint to an appropriate management, supervisory, or personnel officer or employee;

f. Procedures for investigating a sexual harassment complaint in a unbiased, fair, and discreet manner with appropriate safeguards to maintain confidentiality and protection from embarrassment;

Section 118 - Sexual Harassment Policy for Employer Having A Contract With the City

All City contractors must comply with City Ordinance 93-84 on sexual harassment. All contractors shall have and enforce a policy prohibiting sexual harassment. The contractor's sexual harassment policy must set forth the same or greater protection than those contained or required by the ordinance. The ordinance is applicable to the employer's business and includes the following:

a. Prohibitions against an officer's or employer's sexual harassment of the following:

   1) Another officer or employee of the employee of the employer;

   2) An individual under consideration for employment with the employer; or

   3) An individual doing business with the employer;

b. A provision prohibiting a management or supervisory officer or employee from knowingly permitting a subordinate officer or employee to engage in the sexual harassment prohibited under subdivision a;

c. A prohibition against retaliation towards an officer, employee, or individual who has complained of sexual harassment, conducted an investigation of a complaint;

d. A prohibition against a malicious false complaint of sexual harassment by an officer, employee, or individual;

e. Provisions allowing an officer, employee, or individual to make a sexual harassment complaint to an appropriate management, supervisory, or personnel officer or employee;

f. Procedures for investigating a sexual harassment complaint in a unbiased, fair, and discreet manner with appropriate safeguards to maintain confidentiality and protection from embarrassment;

g. A provision requiring the use of the "reasonable person of the same gender standard," to determine if sexual harassment has occurred. Under the standard, sexual harassment shall be deemed to have occurred if the alleged offender's conduct would be considered sexual harassment shall be deemed to have occurred if the alleged offender's conduct would be considered sexual harassment from the perspective of a reasonable person of the same gender as the alleged victim. If the alleged victim is a woman, the "reasonable person of the same gender standard" shall be equivalent to and may be called the "reasonable woman standard";

h. Disciplinary actions which may be imposed on an officer or employee who committed a prohibited act; and

i. For an employer with at least five employees, a provision requiring the annual viewing of a video on the sexual harassment policy be each management or supervisory officer or employee.

The policy required under this section shall be in effect for at least the duration of the employer's contract with the City.

The action of the bidder or proposer in submitting its bid, proposal or signing of the contract shall constitute its pledge and acceptance of the provisions for the sexual harassment policy as required by City Ordinance 93-84.

City Ordnance 93-84 is on file and available for viewing in the Purchasing Division. Bidders or contractors needing a copy must pick up the copy from the Office of the City Clerk, Room 203, City Hall, 530 S. King Street, Honolulu.

-- End Section 118 --

Section 120 - Final Inspection - Final Payment

This section shall modify Subsection 7.7, "Final Inspection - Final Payment", of the General Provisions.

Delete Subsection 7.7 in its entirety and in lieu thereof insert the following:

"7.7 Final [acceptance] inspection, final payment. (a) After completion of the work which shall include all punch list items required under the contract and final acceptance thereof by the Officer-in-Charge, the contractor will be paid the balance due in accordance with the Officer-in-Charge's final estimate of the construction actually performed, provided that final payment will be made only with the approval of the contracting officer and upon receipt of the following documents:

(1) A written list of equipment installed or provided under the contract, listing the description, make, model, serial number, cost, and location of the equipment [of room number in which it is located] (i.e. room number in which it is located);

(2) Written consent of the surety or sureties on the contractor' bond;

(3) Certificates fro the director of taxation of the state as provided in HRS 103-53; and

(4) Completed form DF-P-65, acknowledging any outstanding claims arising out of the performance of the contractor's work.

(b) For the purposes of this section, "equipment" means any item such as a water heater that can be removed with a hand tool, or like an air conditioner, is capable of being moved or transferred to another location, and is accessible to tagging with an identification number such as a generator. [HRS] §103-53]"

-- End Section 120 --

Section 122 - Qualifications of Bidders

Prospective bidders or offerors must be capable of performing the work for which bids are being called. Each prospective bidder or offeror must file a written notice of intention to bid which shall be received no later than the time and date indicated in the notice to contractors.

-- End Section 122 --

Section 125 - Modifications and Terminations of Contracts

1. Change Order

   A. The officer-in-charge, with the approval of the Contracting Officer, at any time, and without notice to any surety, in a signed writing designated or indicated to be a change order, may make changes in the work within the scope of the contract as may be found to be necessary or desirable. Such changes shall not invalidate the contract or release the sureties, and the contractor will perform the work as changed, as the contractor will perform the work as changed, though it had been part of the original contract. Minor changes in the work may be directed by the officer-in-charge at no change in contract price or time.

   B. Adjustment of price or time for performance. If any change order increases or decreases the contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed by the order, an adjustment shall be made and the contract modified in writing accordingly. Any adjustment in contract price made pursuant to this clause shall be determined in accordance with the price adjustment clause of this contract. Failure of the parties to agree to an adjustment shall not excuse a contractor from proceeding with the contract as changed, provided that the City promptly and duly make such provisional adjustments in payments or time for the direct costs of the work as changed as the City deems reasonable. The right of the contractor to dispute the contract price or time or both shall not be waived by the contractor performing the work, provided however, that the contractor follows the notice requirements for disputes and claims established by the contract or these provisions.

   C. Time period for claim. Within thirty days after receipt of a written change order under subsection A of this section, unless such period is extended by the officer-in-charge in writing, the contractor shall file notice of intent to assert a claim for an adjustment. The requirement for timely written notice cannot be waived and shall be a condition precedent to the assertion of a claim.

D. Claim barred after final payment. No claim by the contractor for an adjustment hereunder shall be allowed if notice is not given prior to final payment under this contract.

E. Claims not barred. In the absence of such a change order, nothing in this clause shall restrict the contractor's right to pursue a claim arising under the contract or for breach of contract.

2. Suspension of Work

A. The officer-in-charge may be written order, suspend the performance of the work, either in whole or in part for such periods as the officer-in-charge may deem necessary for any cause, including but not limited to:

(1) Weather or soil conditions considered unsuitable for prosecution of the work;

(2) Failure on the part of the contractor to:

(a) Correct conditions unsafe for the general public or for the workers;

(b) carry out orders given by the officer-in-charge;

(c) Perform the work in strict compliance with the provisions of the contract; or

(d) Provide adequate supervision on the jobsite.

(3) Whenever a redesign that may affect the work is deemed necessary by the officer-in-charge;

(4) Unacceptable noise or dust arising from the construction even if it does not violate any law or regulation; or

(5) The convenience of the City.

B. Suspension of work on some but not all items of work shall be considered a "partial suspension". Suspension of work on all items shall be considered "total suspension". The period of suspension shall be computed from the date set out in the written order for work to cease until the date of the order for work to resume.

C. In the event that the contractor is ordered by the officer-in-charge in writing as provided herein to suspend all work under the contract in accordance with the above paragraph (3), (4), or (5), the contractor may be reimbursed for actual money expended towards the project during the period of suspension. No allowance will be made for anticipated profits.

D. If the performance of all or any part of the work is, suspended, for reasons beyond the control of the contractor, an adjustment shall be made for any increase in the cost of performance of this contract excluding profit) necessarily caused by such suspension, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension:

(1) To the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault of negligence of the contractor; or

(2) For which an adjustment is provided for or excluded under any other provisions of the contract.

E. Any adjustment in contract price made pursuant to this clause shall be determined in accordance with the provisions on changes and claims for adjustment. Claims for the compensation shall be filed in writing with the officer-in-charge within thirty days after the date of the order to resume work or the claims will not date of the order to resume work or the claims will not be considered. Together with the claim, the contractor shall submit substantiating documents covering the entire amount shown on the claim. The officer-in-charge shall take the claim under consideration and may make such investigations as are deemed necessary. The Contracting Officer shall be the sole judge as to the equitability of such the and the Contracting Officer's decision shall be final.

F. No provision of this section shall entitle the contractor to any adjustments for delays due to failure of surety, for suspensions made at the request of the contractor, for any delay required under the contract, for suspensions, either partial or whole, made by the officer-in-charge under the provisions in paragraph A(2) of this section.

3. Variations in Estimated Quantities

A. Where the quantity of a pay item in this contract is an estimated quantity and where the actual quantity of such pay item varies more than fifteen per cent above or below the estimated quantity stated in this contract, an adjustment in the contract price shall be made upon demand of either party. The adjustment shall be based upon any increase or decrease in costs due solely to the variation above one hundred fifteen per cent or below eighty-five per cent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the officer-in-charge shall, upon receipt of a timely written request for an extension of time, prior to the date of final settlement of the contract, ascertain the facts and make such adjustment for extending the completion date as in the judgment of the officer-in-charge the findings justify.

B. Adjustment of price. Any adjustment in contract price made pursuant to this clause shall be determined in accordance with the price adjustment clause of this contract.

4. Differing Site Conditions - Price Adjustments

A. The contractor shall promptly, and before such conditions are disturbed, notify the officer-in-charge of:

(1) Subsurface or latent physical conditions at the site differing materially from those indicated in this contract; or

(2) Unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this contract.

B. Adjustments of price or time for performance. After receipt of the notice, the officer-in-charge shall promptly investigate the site, and if it is found that the conditions do materially so differ and cause an increase in the contractor's cost of, or the time required for, performance of any part of the work under this contract, whether or not changed as a result of the conditions, an adjustment shall be made and the contract modified in writing accordingly. Any adjustment in contract price made pursuant to this clause shall be determined in accordance with the price adjustment clause of this contract.

B. In determining the cost or credit to the City resulting from a change, the allowances for all overhead, extended overhead resulting from adjustments to contract time (including home office and field overhead) and profit combined, shall not exceed the percentages set forth below:

(1) For the contractor, for any work performed by its own labor forces, fifteen percent of the cost;

(2) For each subcontractor involved, for any work performed by its own forces, fifteen percent of the cost;

(3) For the contractor or any subcontractor, for work performed by their subcontractors, seven percent of the amount due the performing subcontractor.

C. Not more than three line item percentages for fee and overhead, not to exceed the maximum percentages shown above, will be allowed regardless of the number of tier subcontractors.

6. No Assignment

No contract is transferable, or otherwise assignable, without the written consent of the Contracting Officer.

7. Recognition of a Successor in Interest; Assignment

When in the best interest of the City, a successor in interest may be recognized in an assignment agreement in which the transferor and the transferee and the City shall agree that:

(1) The transferee assumes all of the transferor's obligations;

(2) The transferor remains liable for all obligations under the contract but waives all rights under the contract as against the City; and

(3) The transferor shall continue to furnish, and the transferee, shall also furnish all required bonds.

8. Change of Name

When a contractor requests to change the name in which it holds a contract with the City, the Contracting Officer shall, upon receipt of a document indicating such change or name (for example an amendment to the articles of incorporation of the corporation), enter into an agreement with the requesting contractor to effect such a change of name. The agreement changing the name shall specifically indicate that no other terms and conditions of the contract are thereby changed.

9. Claims Based on Oral Directives

A. Any oral order, direction, instruction, interpretation or determination from the officer-in-charge which in the opinion of the contractor causes any change, can be considered as a change only if the contractor gives the officer-in-charge written notice of its intent to treat such oral order, direction, instruction, interpretation or determination as a change directive. The written notice must be delivered to the officer-in-charge before the contractor acts in conformity with the oral order, direction, instruction, interpretation or determination, but not more than five days after delivery of the oral order to the contractor. The written notice shall state the date, circumstances, whether a time extension will be requested, and source of the order that the contractor regards as a change. The written notice may not be waived and shall be a condition precedent to the filing of a claim by the contractor. Unless the contractor acts in accordance with this procedure, any oral under shall not be treated as a change and the contractor waives any claim for an increase in the contract time or contract price related to the work.

B. Not more than five days after receipt of the written notice from the contractor the officer-in-charge shall issue a change order for the subject work if the officer-in-charge agrees that it constitutes a change. If no change order is issued in the time established, it shall be deemed a rejection of contractor's claim for a change. If the contractor objects to the officer-in-charge's refusal to issue a change order, it shall file a written protest with the officer-in-charge within thirty days after delivery to the officer-in-charge of the contractor's written notice of its intention to treat the oral order as a change. In all cases the contractor shall proceed with the work. The protest shall be determined as provided in the disputes and claims sections.

10. Default, Delay, and Time Extensions

A. Default. If the contractor refuses or fails to perform the work, or any separable part thereof, with such diligence as will assure its completion within the time specified in this contract, or any extension thereof, fails to complete the work within such time, or commits any other substantial breach of this contract, and further fails within seven days after receipt of written notice from the officer-in-charge to commence and continue correction of the refusal or failure with diligence and promptness, the officer-in-charge, with the approval of the Contracting Officer may, by written notice to the contractor, declare the contractor in breach and terminate the contractor's right to proceed with the work or such part of the work as to which there has been delay or other beach of contract. In such event the City may take over the work and prosecute the same to completion, by contract or otherwise, and may take possession of, and utilize in completing the work, the materials, appliances, and plants as may be on the site of the work and necessary therefor. Whether or not the contractor's right to proceed with the work is terminated, the contractor and the contractor's sureties shall be liable for any damage to the City resulting from the contractor's refusal or failure to complete the work within the specified time.

B. Liquidated damages upon termination. If fixed and agreed liquidated damages are provided in the contract, and if the City so terminates the contractor's right to proceed, the resulting damage will consist of such liquidated damages for such time as may be required for final completion of the work.

C. Liquidated damages in absence of termination. If fixed and agreed liquidated damages are provided in the contract, and if the City does not terminate the contractor's right to proceed, the resulting damage will consist of such liquidated damages until the work is completed or accepted.

D. Time extension. The contractor's right to proceed shall not be so terminated nor shall the contractor be charged with resulting damage if:

(1) The delay in the completion of the work arises from causes such as: acts of God; acts of the public enemy; acts of the State and any other governmental entity in either a sovereign or contractual capacity; acts of another contractor in the performance of a contract with the City; in the performance of a contract with the City; fires; floods; epidemics; quarantine restrictions; strikes or other labor disputes; freight embargoes; unusually severe weather; delays of subcontractors due to causes similar to those set forth above; or shortage of materials; provided, however, that no extension of time will be granted for a delay caused by a shortage of materials, unless the contractor furnishes to the officer-in-charge proof that the contractor has diligently made every effort to obtain the materials from all known sources, and further proof that the inability to obtain the materials when originally planned did in fact cause a delay in final completion of the entire work which could not be compensated for by revising the sequence of the contractor's operations; and

(2) The contractor, within ten days from the beginning of any such delay (unless the officer-in-charge grants a further period of time before the date of final payment under the contract), notifies the officer-in-charge in writing of the causes of delay. The officer-in-charge shall ascertain the facts and the extent of the delay and extend the time for completing the work when, in the judgment of the officer-in-charge, the findings of fact justify such an extension.

E. Additional rights and remedies. The rights and remedies of the City provided in this clause are in addition to any other rights and remedies provided by law or under this contract.

11. Termination for Convenience

A. Terminations. The officer-in-charge may, with the approval of the Contracting Officer, when the interests of the City so require, terminate this contract in whole or in part, for the convenience of the City. The Contracting Officer shall give written notice of the termination to the contractor specifying the part of the contract terminated and when termination becomes effective.

B. Contractor's obligations. the contractor shall incur no further obligations in connection with the terminated work and on the date set in the notice of termination the contractor will stop work to the extent specified. The contractor shall also terminate outstanding orders and subcontracts as they relate to the terminated work. The contractor shall settle the liabilities and claims arising out of the termination of subcontracts and orders connected with the terminated work subject to the City's approval. The Contracting Officer, upon recommendation by the officer-in-charge, may direct the contractor to assign the contractor's right, title, and interest under terminated orders or subcontracts to the City. The contractor must still complete the work not terminated by the notice of termination and may incur obligations as necessary to do so.

C. right to construction and goods. The Contracting Officer may, upon recommendation by the officer-in-charge, require the contractor to transfer title and deliver to the City in the manner and to the extent directed by the Contracting Officer.

(1) Any completed constructions; and

(2) The partially completed construction, goods, materials, parts, tools, dies, jigs, fixtures, plans, drawings, information, and contract rights (hereinafter called "construction material") as the contractor has specifically produced or specially acquired for the performance of the terminated part of this contract.

The contractor shall protect and preserve property in the possession of the contractor in which the City has an interest. If the Contracting Officer does not exercise this right, the contractor shall use best efforts to sell the construction, goods, and construction materials in accordance with the standards of section 490:2-706, HRS. This is no way implies that the City has breached the contract by exercise of the termination for convenience clause.

D. Compensation

(1) The contractor shall submit a termination claim specifying the amounts due because of the termination for convenience together with cost or pricing data, submitted to the extent required by subchapter 15, chapter 3-122, HAR, bearing on such

claim. If the contractor fails to file a termination claim within one year from the effective date of termination, the Contracting Officer, upon recommendation of the officer-in-charge, may pay the contractor, if at all, an amount set in accordance with subparagraph (3)(b) of this subsection.

(2) The Contracting Officer, upon recommendation of the officer-in-charge, and the contractor may agree to a settlement provided the contractor has filed a termination claim supported by cost or pricing data submitted as required and that the settlement does not exceed the total contract price plus settlement costs reduced by payments previously made by the City, the proceeds of any sales of construction, goods, and construction materials under subparagraph (3)(c) of this clause, and the contract price of the work not terminated.

(3) Absent complete agreement under paragraph (2) of this subsection, the Contracting Officer, upon notice from the officer-in-charge, shall pay the contractor the following amounts, provided payment sunder paragraph (2) shall not duplicate payments under this paragraph the total (without duplication of any items) of:

(a) The cost of all contract work performed prior to the effective date of the notice of termination work plus a five percent mark up on actual direct costs on the portion of the work (the markup shall not include anticipatory profit or consequential damages) less amounts paid or to be paid for completed portions of such work; provided, however, that if it appears that the contractor would have sustained a loss if the entire contract would have been completed, no markup shall be allowed or included and the amount of compensation shall be reduced to reflect the anticipated rate of loss;

(b) Subject to the prior approval of the Contracting Officer, the costs of settling and paying claims arising out of the termination of subcontracts or orders pursuant to subsection B of this section. Subcontractors shall be entitled to a markup of no more than ten percent on direct costs incurred to the date of termination. These costs must not include costs paid in accordance with subparagraph (a) of this paragraph;

(c) The total sum to be paid the contractor under this paragraph shall not exceed the total contract price reduced by the amount of any sales of construction, goods, and construction materials under subsection C of this clause, and the contract price of work not terminated.

(4) Cost claimed, agreed to, or established under subparagraph (2) and (3) of this paragraph shall be in accordance with chapter 3-123, HAR.

12. Prompt Payment by Contractors to Subcontractors

A. Any money, other than retainage, paid to a contractor shall be dispersed to subcontractors within ten days after receipt of the money in accordance with the terms of the subcontract; provided that the subcontractor has met all the terms and conditions of the subcontract and there are no bona fide disputes; and

B. Upon final payment to the contractor, full payment to the subcontractor, including retainage, shall be made within ten days after receipt of the money; provided that there are no bona fide disputes over the subcontractor's performance under the subcontract.

13. Remedies

Any dispute arising under or out of this contract is subject to chapter 3-126, HAR.

14. Disputes

A. All controversies between the City and the contractor which arise under, or are by virtue of, this contract and which are not resolved by mutual agreement between contractor and officer-in-charge, shall be decided by the Contracting Officer after review of the officer-in-charge's recommendations, in writing, within ninety calendar days after a written request by the contractor for a final decision concerning the controversy' provided that if the Contracting Officer does not issue a written decision within ninety calendar days after written request for a final decision, or within such longer period as may be agreed upon by the parties, then the contractor may proceed as if an adverse decision had been received.

B. The Contracting Officer shall immediately furnish a copy of the decision to the contractor, by certified mail, return receipt requested, or by any other method that provides evidence of receipt.

C. Any such decision shall be final and conclusive, unless fraudulent, or the contractor brings an action seeking judicial review of the decision in the circuit court of this State within the six months from the date of receipt of the decision.

D. The contractor shall comply with any decision of the Contracting Officer and proceed diligently with performance of this contract pending final resolution by the circuit court of this State of any controversy arising under, or by virtue of, this contract, except where there has been a material breach of contract by the City; provided that in any event the contractor shall proceed diligently with the performance of the contract where the Contracting Officer has made a written determination that continuation of work under the contract is essential to the public health and safety.

-- End Section 125 --

Section 130 - Commencement of Work

This section shall supplement Subsection 6.1, "Time", of the General Provisions.

The Notice to Proceed shall designate the official commencement date for the work. The commencement date shall not be less than 30 days nor more than 60 days after execution of contract by the Director of Finance unless otherwise agreed upon.

-- End Section 130 --

Section 131 - Performance Schedule

This section shall replace Subsection 6.3, "Performance Schedule", of the General Provisions.

Performance Schedule:

The schedule shall be of the critical path method (CPM) type or approved equal in the form of a network diagram and activity listing. The schedule shall show in sufficient detail and in orderly sequence all activities, their description, duration and dependencies necessary to the completion of the work. It shall contain, but not be limited to, the sequence of all operations including procurement and mobilization of equipment, plant and materials to complete the work within the contract period.

Within 7 calendar days after the commencement date in the Notice to Proceed, the Contractor shall furnish to the Officer-in-Charge a preliminary performance schedule.

Within 7 calendar days after receipt of the recommended revisions to the preliminary performance schedule, the Contractor shall submit his revised performance schedule to the Officer-in-Charge for approval. The Contractor shall participate in the evaluation of the schedule and shall make any revisions resulting from such evaluation. Progress payments will be withheld until final approval of the schedule.

At all times the schedule shall represent the Contractor's plan for orderly completion of the work. Any changes to the schedule shall require the approval of the Officer-in-Charge. The Contractor shall update the schedule within 15 days of adoption of any change or deviation of 30 calendar days from the approved schedule.

Payment Schedule:

The Contractor shall submit an estimated payment schedule to coincide with the approved performance schedule. This payment schedule shall list the anticipated monthly payment and shall be used by the City for project budgeting purpose. Revised payment schedules shall be submitted on approval of revised performance schedules.

-- End Section 131 --

Section 132 - Overtime Inspection

This section shall modify Subsection 6.12c, "Control of the Contract - Inspection" of the General Provisions

Delete in its entirety, the last paragraph of Subsection 6.12c and add the following:

The Contractor shall pay for all inspection services performed for overtime work. Overtime work is any work performed by the Contractor (1) in excess of an eight-hour work shift, 92) on weekends, or (3) on all legal City holidays.

For any overtime inspection performed by City personnel at the request of the Contractor, the Contractor shall pay the City at a rate to be set annually by the Director of Finance based on current salaries and applicable fringe benefits for City inspectors. The current rate which the City charges the Contractor for overtime inspection is $41.00 per hour.

It is further understood that for overtime work to be performed, the Officer-in-Charge shall be notified, in writing, at least 24 hours prior to the time of inspection and will be subject to the availability of personnel.

-- End Section 132 --

Section 133 - Wages and Conditions of Employment

This section shall supplement Subsection 6.15, "Wages", of the General Provisions.

Chapter 104, HRS, as amended, Wages and Hours of Employees on Public Works is incorporated by reference and made part of this contract.

The Contractor shall pay all employees a minimum basic wage in conformance with applicable Federal and State laws.

The minimum basic wage rates in effect at the time of the printing of these Special Provisions are posted in the office of the Division of Purchasing, Department of Finance, City Hall and copies are available upon request. However, the rates are subject to change at any time by the Director of Labor and Industrial Relations.

The minimum wages shall be periodically increased during performance of the contract in an amount equal to the increase in the prevailing wages for those kinds of work as periodically determined by the Director of labor and Industrial Relations.

Notwithstanding the provisions of the original contract entered into, if the Director of Labor and Industrial Relations determines that the prevailing wage has increased, the rate of pay of laborers and mechanics on this contract shall be raised accordingly.

The Contractor is required to post the applicable wage schedule in a prominent and easily accessible place at the job site. The Contractor shall give to each laborer and mechanic employed under the contract a copy of the rates of wages required to be posted.

Contractors shall take into consideration increases which may occur during the period of the contract in computing their bid prices. No additional compensation shall be made for failure to do so.

(The current Federal wage rate determination in effect at the time of advertising for bids is attached hereto. However, the minimum Federal wage rates shall be those in the U.S. Department of Labor Wage Determination Decision and Modifications in effect ten (10) days prior to bid opening date.)

The Contractor shall be responsible for the weekly submission of two (2) sets of all certified payrolls, including those of his subcontractors. The City reserves the right to withhold monthly progress payments for failure to submit the certified payroll records.

-- End Section 133 --

Section 134 - Contractual Relations of Parties

The Contractor shall be responsible under the contract for the acts and omissions of his subcontractors, suppliers, and persons either directly or indirectly employed by them, as fully as he is for acts and omissions of his own employees. Nothing in the contract shall create any contractual relation between any subcontractor or supplier and the City, or any obligation on the part of the City to pay any money to, or cause to be paid any money from any subcontractor or supplier

-- End Section 134 --

Section 135 - Advisory Sign

The Contractor shall construct, install, maintain, and remove two (2) advisory signs as directed by the Engineer. The two (2) signs shall be placed at each end of the **force main** along a major street or highway. The signs shall have black letters and edging on orange background. The size of the sign shall be 4'-0" high by 8'-0" wide.

The sign message shall include the project starting date, daily working hours, limits and duration of construction. The height of the letters shall be eight (8) inches, Series D. A minimum height of six (6) inches, Series D, may be used if approved by the Engineer. The advisory sign wording shall be approved by the Engineer and shall be installed two (2) weeks prior to the start of construction.

In addition, the Contractor shall take all measures necessary to insure that the safe and easily accessible passage is provided at all times for pedestrians who must travel in or near the construction zone.

The furnishing, placing, maintaining, and removing the advisory signs and insuring and accessible passage for pedestrians shall not be paid for directly but shall be considered as incidental to the various items in the Proposal.

-- End Section 135 --

Section 151 - Field Office and Field Telephone

A field office and a field telephone are required for this project in accordance with Subsection 6.4, "Field Office and Field Telephone", of the General Provisions, with the following modifications:

Add the following to Subsection 6.4A, "Field Office", of the General Provisions:

> The field office shall be for the exclusive use and entry of the City personnel and shall be separated by a sound proof wall if it adjoins the Contractor's *office.*
>
> Air conditioners must be provided to keep the field office at 76 degrees Fahrenheit or cooler.
>
> The desk provided shall be the executive type and the chair shall be the executive type with arms and swivel.

Add the following to Subsection 6.4B, "Field Telephone", of the General Provisions:

> The telephone must have touch tone to use with telephone pagers and computer modems.

Add the following Subsections:

6.4.C Temporary Office and Toilet. Provide a temporary 160 square feet minimum office with a telephone and a toilet as indicated for the exclusive use of the Pump House operating and maintenance personnel. The toilet may be a uni-sex toilet and as a minimum shall include a water closet and a lavatory. The temporary office and toilet shall be provided within seven (7) calendar days after commencement of work under the contract until the new office and toilet facilities become operational. The existing furniture and office supplies shall be relocated to the temporary office. Air conditioning and lighting shall be provided. The facility shall be maintained in a clean and sanitary condition by the Contractor.

-- End Section 151 --

Section 153 - Electrical and Water Services

This section shall replace Subsection 6.22, "Electrical and Water Services", of the General Provisions.

The Contractor shall make his own arrangements for telephone, electrical and water services required for the performance of the contract and shall pay all expenses. The cost of the work under this section shall be considered incidental and included in the bid prices for the various items of work.

With approval of the City, nominal usage of available telephone, power and water within the sewage facility may be used by the Contractor without cost. The Contractor shall make all necessary connections for these utilities.

-- End Section 153 --

Section 154 - Existing Utilities

This section shall supplement Subsection 6.23, "Utilities, Underground", of the General Provisions.

General

The Contractor shall be responsible for the protection of existing surface and subsurface utilities and poles within and abutting the project site, trench excavations, borrow sites, and other work areas. Any utilities that the Contractor encounters during the progress of the work, such as telephone ducts, electric ducts, water lines, sewer lines, electric lines, and drainage pipes; whether or not shown on the plans, shall not be disturbed or damaged unless otherwise instructed in the plans and specifications. The Contractor shall notify the Officer-in-Charge and the affected utility company immediately of any damaged or disturbed utility.

Temporary Relocations

The contractor shall arrange and pay for all temporary relocation of utilities required to complete the work. These payments shall be considered incidental and included in the prices bid for the various items of work.

HECO Overhead Facilities

Since the project site is near existing HECO overhead facilities which will remain energized during construction, the Contractor's attention is directed to the following conditions:

1. The location of HECO's overhead facilities shown on the plans are from existing records with varying degrees of accuracy and are not guaranteed as shown. The Contractor shall exercise extreme caution whenever construction crosses or is in the proximity of underground lines and shall maintain adequate clearance when operating equipment within or under any overhead lines.

2. The Contractor shall comply with the State of Hawaii's Occupational Safety and Health Law (DOSH).

3. When trench excavation is adjacent to or beneath existing HECO structures or facilities, the Contractor is responsible for properly sheeting and bracing the excavation to prevent slides, cave-ins and settlements and for protecting existing structures or facilities with beams, struts, or underpinning.

4. For pole bracing instructions, the Contractor shall call the HECO District Construction Superintendent at phone 262-5454 a minimum of 72 hours in advance.

5. Should it become necessary, any work required to relocate HECO facilities shall be done by HECO; the Contractor shall be responsible for all coordination, and for costs if applicable.

6. The Contractor shall be liable for any damages to HECO's facilities. The Contractor shall report any damages to HECO's facilities to the HECO Trouble Dispatch at Phone No. 548-7961.

Water System Specifications (BWS)

The Honolulu Board of Water Supply's "Water System Standards," Volumes 1 and 2, dated 1985, and all subsequent amendment and additions, shall be applicable to the water main construction for this project. Should a discrepancy exist between the Standards and these specifications, the latter shall govern.

The Contractor shall notify the Board of Water Supply and the Officer-in-Charge in writing one week prior to commencing work on the water system if work on the water system becomes necessary.

The Contractor shall notify the Board of Water Supply of any damage to the existing mains, and the Board of Water Supply will perform the necessary repairs. All costs incurred in this work shall be paid for by the Contractor.

Coordination with Utility Agencies and Others

Whenever the trench work crosses underground utilities, or if for other reasons during the course of the work it becomes necessary to relocate existing utilities, the Contractor shall notify and coordinate his operations with the respective agencies affected.

Utility	Agency	Phone
Communication Lines		
CATV	Oceanic Cablevision	834-4145
Fiber Optics	AT&T	455-1010
Overhead	Hawaiian Telephone Co.	834-6273
Underground	Hawaiian Telephone Co.	834-6214
(Military)		
City and County Lines	Dept. of Transportation Services	
Fiber Optics		527-5007
Street Lights		523-4705
Traffic Signals		527-5004
Gas Lines	GASCO, Inc.	547-3560
Power Lines	Hawaiian Electric Co.	548-7961
Water Lines	Board of Water Supply	527-5204
Fuel	Chevron	682-2242
	Navy	474-6011
	Air Force	449-7273

-- End Section 154 --

Section 155 - Maintaining Existing Services

The existing wastewater facilities shall be maintained in full operation with the exception of connection of new work to the existing system as shown on the plans and in the specifications. For this exception, the wastewater facility may be shut down for short periods when the flow is low. Low flows may occur between midnight and 5:00 a.m. The Contractor must confirm the amount and the time of the low flow in the shut down request. The shutdown request shall be submitted in writing to the Officer-in-Charge at least three (3) weeks prior to the shutdown. No work which requires the shutdown shall be done without prior written approval.

Where the work cannot be accomplished during these short stoppages, temporary pumps and piping may be installed to bypass construction activity. Such equipment and material shall be provided, installed, operated, and removed at the sole expense of the Contractor. The Contractor shall be responsible for coordination with the Department of Wastewater Management to insure that any such bypass is compatible with the design and operation of the existing wastewater facilities and sewer system.

-- End Section 155 --

Section 159 - Legal Notice

The Contractor shall publish a legal notice in a newspaper of general circulation for three (3) consecutive days, one week prior to the start of work on this project, to inform the public of the proposed work. The legal notice shall be coordinated with the Officer-in-Charge, and shall contain but shall not be limited to the following information:

A. Map of project area, identifying street(s) to be affected, together with general description of work to be undertaken.

B. Date work will start and approximate date of completion.

C. Working hours and days of work.

D. Detour pattern, if any, and description of traffic flow in detour area.

E. Suggestion that motorists use alternative routes, and drive with caution in construction area.

F. If the project will be constructed in phases, include phases and anticipated start and completion dates.

G. Any information which will be of help to the public.

The Contractor shall submit a sample of the notice to the City for approval.

-- End Section 159 --

Section 160 - Project Sign

This section shall supplement Section 56, "Project Signs", of the Standard Specifications and Subsection 6.28, "Project Sign", of the General Provisions.

General

The Contractor shall furnish, erect and subsequently remove as his property, one (1) project sign to identify the project.

The signboard shall be 3/4" thick, 4' x 8' exterior grade fir plywood. All the corners of the signboard shall have a 6" radius curve. A sample shall be submitted as required in Section 56 of the Standard Specifications.

Information on Sign

The sign shall show, but not be limited to, the information shown on the attached sample.

-- End Section 160 --

Section 162 - Construction Area Appearance

The Contractor shall throughout the duration of the project keep all streets, sidewalks, driveways, field office sites, and field baseyard free from all debris produced from the project. The Contractor shall keep the project and surrounding area neat and free from dust nuisance. The City may require supplementary measures as necessary.

Upon completion of each phase of the project, the Contractor shall immediately remove all excess material and thoroughly clean the affected area.

Upon completion of the work, the Contractor shall remove all equipment, signs and unused materials provided for the work and shall restore the project site to a neat and clean condition and do all the other required cleaning as specified above.

Should the Contractor fail to comply with the foregoing provisions, the City may, with or without notice, cause the cleaning to be done and deduct the cost of such work from any moneys due the Contractor under this contract.

The cost of work under this section shall not be paid for directly but shall be considered incidental and included in the prices bid for the various items of work.

-- End Section 162 --

Section 163 - Environmental Pollution Control

This section shall supplement Subsection 6.33, "Environmental Pollution Control", of the General Provisions.

Add the following to Subsection 6.33G:

The Contractor shall comply with the provisions of Chapter 43, Community Noise Control for Oahu, of the State Department of Health Administrative Rules. *Where required, the Contractor shall obtain a Community Noise* Permit. Construction equipment and on-site vehicles or devices requiring an exhaust of gas or air shall have mufflers. The Contractor shall comply with conditional use of the permit as specified in the rules and the conditions issued with the permit. Should there be a baseyard or stockpile area located adjacent to residences, mitigative measures, such as barriers or berms, shall be developed in the event that noise complaints are received.

Construction activities shall not create "excessive noise" when measured at or beyond the property line of the construction site for the hours before 7:00 a.m. and after 6:00 p.m. of the same day.

Construction activities which emit noise exceeding 95 dBA at or beyond the property line of the construction site shall be restricted to the hours between 9:00 a.m. and 5:30 p.m. of the same day.

Construction activities which emit noise exceeding 95 dBA at or beyond the property line of the construction site shall be prohibited on Saturdays.

Construction activities which emit noise exceeding the "allowable noise levels" at or beyond the property line of the construction site shall be prohibited on Sundays and on the following holidays: New Year's Day, President's Day, Memorial Day, King Kamehameha Day, Independence Day, Labor Day, Discoverers' Day, Veterans' Day, Thanksgiving Day, and Christmas Day.

Compliance with the provisions of this section by the subcontractors will be the responsibility of the Contractor.

The Officer-in-Charge will notify the Contractor of any non-compliance with the foregoing provisions and the action to be taken. If the Contractor fails or refuses to comply promptly, the engineer with the approval of the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No extension of time or payment for excess costs or damages shall be made for the time lost due to such stop action.

Add the following to the end of Subsection 6.33:

The cost of environmental pollution control shall not be paid for directly but shall be considered incidental and included in the prices bid for the various items of work.

-- End Section 163 --

Section 165 - Protection in Shipment and Storage

1. General

All materials and equipment to be installed under the Contract shall be properly prepared and crated for shipment and handled during shipment and storage to prevent damage. The materials and equipment shall be properly protected and stored. Protective coatings and wrappings shall be removed and cleaned from the materials and equipment immediately prior to painting or final inspection.

2. Pipe

Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with soft coatings such as coal tar enamel, paint, or the like shall be stored to protect the coating from physical damage or other deterioration and shall only be handled with padded, wide slings. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.

3. Equipment

A. Definition:

For the purpose of this section, equipment means any mechanical, electrical, or instrumentation devices, and other items with one or more moving parts requiring an electrical, pneumatic, electronic or hydraulic connection.

B. Packing and Marking:

1. All equipment shall be adequately and effectively protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site. Each item or package shall be clearly marked with the number unique to the specification reference covering the item. Each separate portion of plant shall receive, as far as practicable, a fitting or distinguishing mark which shall be shown on the packing lists.

2. The bearings of motors shall be relieved of load during transport by means of jacks of some other method to prevent brinelling.

3. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or subassembled units where possible.

C. Identification of Equipment:

All equipment items and values with an assigned equipment number in this project manual shall have affixed to them in a prominent location, a label or tag displaying the assigned equipment number. Equipment item and valves lacking a number shall have a similar tag providing a unique description of the item. Markers shall be of stainless steel, affixed to the item in question with stainless steel fasteners or as otherwise authorized by the Officer-in-Charge. Plastic tape labels will be acceptable.

D. Storage of Equipment:

1. During the interval between delivery and installation, all equipment to be incorporated into the project shall be stored in enclosed, weather-tight licensed commercial warehouses equipped with fire detection and sprinkler systems. Environmental controls such as heaters or protective encapsulation shall be provided to ensure against condensation and moisture damage. In the event prolonged (more than 90 days) storage is required for any item of rotative equipment, the Contractor shall include grease protection of bare metal surfaces, periodic indexing of rotating parts, renewal of grease in bearings and any procedures recommended by the manufacturer. The Contractor shall maintain adequate records to demonstrate full compliance with these requirements. All equipment shall be available for inspection by the Officer-in-Charge.

2. The Contractor shall obtain full coverage insurance covering all stored equipment against loss due to fire, flood, and windstorm. Evidences of insurance demonstrating compliance with this requirement shall be filed with the Officer-in-Charge.

3. The Contractor shall assume sole responsibility for all losses, damages and thefts of any material or equipment stored onsite or offsite, until final acceptance of the Project.

E. Protection of Equipment After Installation:

After all installation, all equipment shall be protected from damage, including but not limited to, dust, abrasive particles, debris and dirt generated by the replacement, chipping, sandblasting, cutting, finishing and grinding of new or existing concrete, terrazzo and metal; and the fumes, particulate matter, and splatter from welding, brazing and painting of new or existing or existing piping and equipment. The Contractor is advised that as minimum, vacuum cleaning, blowers with filters, protective shieldings, and other dust suppression methods will be required at all times to adequately protect all equipment. During concreting, including finishing, all equipment that may be affected be cement dust must be completely covered. during painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint. Electrical switchgear, unit substation, and motor load centers shall not be installed until after all concrete work and sandblasting in those areas have been completed and accepted.

4. Delivery of Material or Equipment:

The City personnel or representatives of the City will not accept materials or equipment deliveries for the Contractor.

-- End Section 165 --

TABLE OF CONTENTS

DIVISION 9 FINISHES

09110	Non-Load Bearing Wall Framing Systems
09200	Lath and Plaster
09250	Gypsum Board
09300	Tile
09500	Acoustical Treatment
09510	Acoustical Ceilings
09650	Resilient Flooring
09900	Painting

DIVISION 10 SPECIALTIES

10100	Markerboard Tackboard
10160	Toilet Partitions
10200	Louvers
10440	Signage
10501	Locker Accessories and Lock
10800	Toilet Accessories

DIVISION 15 MECHANICAL

15011	Mechanical General Requirements
15200	Noise and Vibration Control
15250	Mechanical Insulation
15400	Plumbing Systems
15483	Fuel Oil Handling Systems
15601	Central Refrigeration Equipment for Air Conditioning
15850	Air Handling Equipment
15895	Ductwork and Ductwork Accessories

DIVISION 16 ELECTRICAL

16011	Electrical General Requirements
16205	Standby Diesel- Electric Generators (Design 4), 1,001 KW or Larger
16262	Automatic Transfer and Bypass/Isolation Types.
16312	Low-Voltage Switchgear
16402	Interior Wiring Systems
16431	Short Circuit and Coordination Report, and Relay Settings
16510	Interior Lighting

SECTION 01000

DESCRIPTION OF WORK

PART 1 GENERAL

1.1 LOCATION AND DESCRIPTION OF WORK

1.1.1 Location of Work

The work to be performed under this Contract is located at the Ala Moana Wastewater Pump Station No. 2, Honolulu, Oahu, Hawaii.

1.1.2 General Description of the Work

The work to be performed under this contract consists of furnishing and installing all materials and providing all labor, equipment, tools and incidentals necessary and required to construct the following:

a. Site Work - Demolition, grading, water system, irrigation system, drainage system, electrical power system, and other miscellaneous improvements.

b. Other Work - Provide new diesel engine-driven generator set, replace existing 1,500 KVA transformers with 2,000 KVA transformers, sound attenuating systems, air conditioning and ventilating systems, new building additions, plumbing and interior electrical power distribution and lighting.

1.1.3 Drawings Furnished to the Contractor

The following plans are bound separately and are made a part of this contract:

Drawing No.	Description
T-1	Title Sheet, Index of Drawings
T-2	Construction Phasing Plan & Equipment Schedule
C-1	General Site Plan, Abbreviations & General Notes
C-2	Site Plan & Soils Boring Log
C-3	Irrigation Equipment List & Details
A-1	Architectural Demolition Plan
A-2	Ground Floor Plan
A-3	Exterior Elevations
A-4	Building Sections
A-5	Interior Elevations
A-6	Interior Elevations
A-7	Reflected Ceiling Plan
A-8	Roof Plan
A-9	Typical Wall Sections
A-10	Door & Window Types, Schedule & Details
A-11	Miscellaneous Details
A-12	Miscellaneous Details
S-1	Structural Notes
S-2	Floor & Foundation Plan & Typical Slab Sections

S-3	Roof Framing Plan & Typical RB & GB Elevations
S-4	Wall & Foundation Sections & GB/RB Schedules
S-5	Wall & Foundation Sections & Misc. Det.
S-6	Intake & Discharge Silencers Area - Roof Plans & Sections/Elevations
S-7	Intake & Discharge Silencers Are - Sections & Details
S-8	Silencer Supporting Cage Details
S-9	Miscellaneous Details - 1
S-10	Miscellaneous Details - 2
S-11	Miscellaneous Details - 3
M-1	Mechanical Demolition Plan & Detail
M-2	Air Conditioning & Ventilation Plan
M-3	Air Conditioning & Ventilation Sections & Details
M-4	Partial Mechanical Roof Plans
M-5	Diesel Engine Generator Plan & Section
M-6	Plumbing Plan & Fixture Schedule
M-7	Plumbing Diagrams & Details
E-1	Electrical Notes, Legend, & Abbreviations
E-2	Electrical Demolition Plan
E-3	Existing Electrical Plan
E-4	Existing One-Line Diagrams
E-5	Power Plan
E-6	Lighting Plan
E-7	One-Line Diagrams & Schedule of Feeders & Raceways
E-8	New Switchboard One-Line Diagram
E-9	Switchboard Elevations & Details

The drawings show conditions as they are believed to exist, based upon interpretation of field observations or "As-Built" plans. It is not intended nor to be inferred that the conditions as shown thereon constitute a representation that such conditions are actually in existent, nor shall the Contractor be relieved of the liability under this contract for any loss sustained by the Contractor as a result of any variance between conditions as shown on the drawings and the actual conditions revealed during the progress of work or otherwise.

Revisions of the above listed drawings may be made, and when deemed necessary by the Officer-in-Charge during progress of the work, additional detailed drawings will be furnished to the Contractor. These additional drawings will be considered as forming part of this contract.

1.2 CONTROL OF WORK

1.2.1 Work Days

Work days shall be Monday through Friday. No work shall be performed on Saturday, Sunday, and on State Holidays.

1.2.2 Work Hours

Work hours shall be between the hours of 7:00 a.m. and 3:30 p.m., Monday through Friday.

1.3 SAFETY

a. The Contractor shall take all necessary precautions to protect all his workmen and all other personnel from injuries. The rules and regulations promulgated by the Occupational Safety and Health Acts are applicable and made a part of these specifications.

b. Barricades and warning signs shall be erected by the Contractor in the work area to properly protect all personnel in the area.

c. During the progress of the work all debris, empty crates, waste, material drippings, etc., shall be removed by the Contractor at the end of each work day, and the work area shall be left clean and orderly.

d. Safety Plan

A Health and Safety Plan which conforms to the Federal, State and local law rules and regulations, will be required for the project.

e. The Contractor shall confer with the Officer-in-Charge to develop a mutual understanding relative to the administration of the Safety Program. The plan shall include:

(1) Identification of hazards expected to be encountered and the procedure/method of guarding or correction.

(2) Appointment of a competent job site supervisory employee to effectively carry out the safety and health program.

(3) Providing each employee with initial safety indoctrination/instruction to enable the employee to perform work in a safe manner. These instructions shall include pertinent safety regulations, specific hazards expected, availability of medical facilities, reporting of accidents, and the proper use of safety equipment.

1.4 OPERATION OF THE WASTEWATER PUMP STATION DURING THE CONSTRUCTION

a. The Contractor shall coordinate the phases of work under this contract with the Officer-in-Charge and as indicated to permit the continuing operation of existing pump station.

b. Outages for water, power, communications, or any other utility, if necessary, shall be kept to a minimum and scheduled for off-peak hours, generally from 2:00 a.m. to 6:00 a.m. Written request for such outages must be obtained by the Officer-in-Charge not later than 12 days in advance. The Contractor shall not proceed with such outages until written approval is received.

1.5 MEASUREMENT AND PAYMENT

Measurement and payment for work described in this section shall not be made separately but shall be included in the various items in the Proposed Schedule.

-- End of Section --

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal

Shop drawings, product data, samples, and administrative submittals presented for review and approval.

1.1.2 Types of Submittals

All submittals are classified as indicated as follows:

a. Shop drawings: As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this Contract, by the Contractor or through the Contractor by way of a subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate a portion of the work.

b. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the work, but not prepared exclusively for this Contract.

c. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to a portion of the work, illustrating a portion of the work or establishing standards for evaluating the appearance of the finished work or both.

d. Administrative submittals: Data presented for reviews and approval to ensure that the administrative requirements of the project are adequately met but not to ensure directly that the work is in accordance with the design concept and in compliance with the Contract documents.

1.2 SUBMITTALS

Submit the following in accordance with the requirements of this section.

1.2.1 SD-18, Records

a. Submittal register

1.2.1.1 Submittal Register

State for each submittal the Contractor's planned submittal date. Submit within 30 days after notice to proceed. Insert dates on copies of the "Submittal Register."

1.3 PROCEDURES FOR SUBMITTALS

1.3.1 Reviewing, Certifying, Approving Authority

The Contractor shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. The approving authority on submittals is the Officer-in-Charge unless otherwise specified for the specific submittal.

1.3.2 Constraints

a. Submittals listed or specified in this Contract shall conform to the provisions of this Section, unless explicitly stated otherwise.

b. Submittals shall be complete for each definable feature of work; components of the definable feature interrelated as a system shall be submitted at the same time.

c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, the submittal will be returned without review.

d. Approval of a separate material, product, or component does not imply approval of assembly in which the item functions.

1.3.3 Scheduling

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of the work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

b. Except as specified otherwise, allow a review period of 21 working days for submittals for Officer-in-Charge approval. The period of review for each resubmittal is the same as for the initial submittal.

1.3.4 Variations

Variations from contract requirements will be considered if determined to be beneficial. When proposing a variation, submit a written request to the Officer-in-Charge, with documentation of the nature and features of the variation and why the variation is desirable and beneficial. If lower cost is a benefit, also include an estimate of the cost saving. Identify the proposed variation separately and include the documentation for the proposed variation along with the required submittal for the item. When submitting a variation for approval, the Contractor warrants the following:

1.3.4.1 Variation Is Compatible

The Contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of the work.

1.3.4.2 Review Schedule Is Modified

In addition to the normal submittal review period, a period of 10 working days will be allowed for submittals with variations.

1.3.5 Contractor's Responsibilities

a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and Contract documents.

b. Transmit submittals to the Officer-in-Charge in orderly sequence, in accordance with the Submittal Register, and to prevent delays in the work, or delays to separate contractors.

c. Advise the Officer-in-Charge of variation, as required by the paragraph entitled "Variations."

d. Correct and resubmit submittal as directed by the Officer-in-Charge. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the Contractor shall provide a copy of that previously submitted transmittal including all reviewer comments.

e. Furnish additional copies of submittals when requested by the Officer-in-Charge to a limit of 10 copies per submittal.

f. Complete work which must be accomplished as a basis of a submittal in time to allow the submittal to occur as scheduled.

g. Ensure no work has begun until submittals for that work have been returned as "approved," or "approved as noted", except to the extent that a portion of the work must be accomplished as a basis of the submittal.

h. Update the submittal register as submittal actions occur and maintain the submittal register at the project site until final acceptance of all work by the Officer-in-Charge.

i. Retain a copy of approved submittals at the project site, including the Contractor's copy of approved samples.

1.4 FORMAT OF SUBMITTALS

1.4.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels, to the office of the approving authority. Transmit submittals with a transmittal form prescribed by the Officer-in-Charge and standard for the project. The transmittal form shall identify the Contractor, indicate the date of the submittal, and include information prescribed by the transmittal form and required in the paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

1.4.2 Identifying Submittals

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on the transmittal form. mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction Contract number.

c. The Section number of the specification Section by which the submittal is required.

d. The submittal description (SD) number of each component of the submittal.

e. When a resubmission, an alphabetic suffix on the submittal description, for example, SD-10A, to indicate the resubmission.

f. The name, address, and telephone number of the subcontractor, supplier, manufacturer and any other second tier contractor associated with the submittal.

g. Product identification and location in project.

1.4.3 Format for Product Data

a. Present product data submittals for each Section as a complete, bound volume. Include a table of contents listing page and catalog item numbers for product data.

b. Indicate, by prominent notation, each product which is being submitted; indicate the specification Section number and paragraph number to which it pertains.

c. Supplement product data with material prepared for the project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for the project.

1.4.4 Format for Shop Drawings

a. Shop drawings shall not be less then 8 1/2 by 11 inches nor more than 30 x 42 inches.

b. Present 8 1/2 x 11 inches sized shop drawings as a part of the bound volume for the submittals required by the Section. Present larger drawings in sets.

c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to the information required in the paragraph entitled "Identifying Submittals."

d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Identify materials and products for work shown.

1.4.5 Format of Samples

a. Furnish samples in the sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately the same size as specified:

(1) Sample of Equipment or Device: Full size.

(2) Sample of Materials Less Than 2 by 3 Inches: Built up to 8 1/2 by 11 inches.

(3) Sample of Materials Exceeding 8 1/2 by 11 Inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

(4) Sample of Linear Devices or Materials: 250 mm (10 inch) length or length to be supplied, if less than 250 mm (10 inches). Examples of linear devices or materials are conduit and handrails.

(5) Color Selection Samples: 2 inches by 4 inches.

(6) Sample Panel: 4 by 4 feet.

(7) Sample Installation: 100 square feet.

b. When a color, texture or pattern is specified in naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.4.6 Format of Administrative Submittals

a. Operation and Maintenance Manual Data: Submit in accordance with Section 01730, "Operation and Maintenance Data." Include components required in that Section and the various technical sections.

1.5 QUANTITY OF SUBMITTALS

1.5.1 Number of Copies of Product Data

a. Submit six copies of submittals of product data requiring review and approval. Submit three copies of submittals of product data for operation and maintenance manuals.

1.5.2 Number of Copies of Shop Drawings

Submit shop drawings in compliance with the quantity requirements specified for product data.

1.5.3 Number of Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.

b. Submit one sample panel. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

1.5.4 Number of Copies of Administrative Submittals

a. Unless otherwise specified, submit the administrative submittals compliance with the quantity requirements specified for product data.

b. Submit administrative submittals required under "SD-19, Operation and Maintenance Manuals" to conform to Section 01730, "Operation and Maintenance Data."

1.6 SCHEDULE OF SUBMITTAL DESCRIPTIONS (SD)

SD-01, Data

Submittals which provide calculations, descriptions, or other documentation regarding the work.

SD-02, Manufacturer's Catalog Data

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. A type of product data.

SD-03, Manufacturer's Standard Color Charts

Preprinted illustrations displaying choices of color and finish for a material or product. A type of product data.

SD-04, Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work. A type of shop drawing.

SD-05, Design Data

Design calculations mix designs, analyses, or other data, written in nature and pertaining to a part of the work. A type of shop drawing.

SD-06, Instructions

Preprinted material describing installation of a product, system, or material, including special notices and Material Safety Data Sheets, if any, concerning impedances, hazards, and safety precautions. A type of product data.

SD-07, Schedules

A tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work. A type of shop drawings.

SD-08, Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other lower tier contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality. A type of shop drawing.

SD-09, Reports

Reports of inspection and laboratory test, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-10, Test Reports

A report signed by an authorized official of a testing laboratory that a material, product, or system identical to the material, product or system to be provided has been tested in accordance with requirements specified by naming the test method and material. The test report must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. Testing must have been within three years of the date of award of this Contract. A type of product data.

SD-11, Factory Test Reports

A written report which includes the findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for this project before it is shipped to the job site. The report must be signed by an authorized official of a testing laboratory and must state the test was performed in accordance with the test requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. A type of shop drawing.

SD-12, Field Test Reports

A written report which includes the findings of a test made at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation. The report must be signed by an authorized official of a testing laboratory or agency and must state the test was performed in accordance with the test

requirements; state the test results; and indicate whether the material, product, or system has passed or failed the test. A type of shop drawing.

SD-13, Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system, or material meet specified requirements. The statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address. A type of shop drawing.

SD-14, Samples

Samples, including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work. A type of sample.

SD-15, Color Selection Samples

Samples of the available choice of colors, textures, and finishes of a product or material, presented over substrates identical in texture to that proposed for the work. A type of sample.

SD-16, Sample Panels

An assembly constructed at the project site in a location acceptable to the Officer-in-Charge and using materials and methods to be employed in the work; completely finished; maintained during construction; and removed at the conclusion of the work or when authorized by the Officer-in-Charge. A type of sample.

SD-17, Sample Installations

A portion of an assembly or material constructed where directed and, if approved, retained as a part of the work. A type of sample.

SD-18, Records

Documentation to ensure compliance with an administrative requirement or to establish an administrative mechanism. A type of administrative submittal.

SD-19, Operation and Maintenance Manuals

Data intended to be incorporated in an Operations and Maintenance Manual. A type of administrative Submittal.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

PART 4 MEASUREMENT AND PAYMENT

Submittals shall not be measured separately for payment but shall be included for various items of work.

-- End of Section --

SECTION 01310

PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.1.1 SD-07, Schedules

a. Progress Chart

b. Equipment delivery schedule

1.2 CONSTRUCTION SCHEDULE

Within 15 days after receipt of the Notice of Award, prepare and submit to the Officer-in-Charge for approval a practicable schedule for construction and equipment delivery. The Contractor may use the critical path method (CPM) or, subject to the approval of the Officer-in-Charge, some other computer generated network analysis system affording similar and equal information and control to that provided by the CPM.

1.2.1 CPM Submittals and Procedures

Submit hard copy of all network analysis and updates as well as on 5 1/4 inch dual sided, double density floppy disks. Two complete sets of the program software and user documentation shall be provided. The network analysis program shall be capable of running on an MS-DOS compatible computer with 640KB memory and a 20MB hard disk, operating under DOS 3.3 or later DOS version. Prior approval is required for any other system proposed by the Contractor. The program disks/diskettes and user documentation shall become the property of the Officer-in-Charge, and he shall be granted all rights customarily afforded to a software licensee by the software company. The network analysis system shall be kept current, with changes made to reflect the actual progress and status of the construction. Updated software and copies shall be provided as directed.

1.3 EQUIPMENT DELIVERY SCHEDULE

1.3.1 Initial Schedule

Within 30 calendar days after approval of the proposed construction schedule, submit for Officer-in-Charge approval a schedule showing procurement plans for materials, plant, and equipment. Submit in the format and content as prescribed by the Officer-in-Charge, and include as a minimum the following information:

a. Description.

b. Date of the purchase order.

c. Promised shipping date.

d. Name of the manufacturer or supplier.

e. Date delivery is expected.

f. Date the material or equipment is required, according to the current construction schedule.

1.4 UPDATED SCHEDULES

Update the construction schedule and equipment delivery schedule at monthly intervals or as directed. Reflect any changes occurring since the last update. Submit copies of the purchase orders and confirmation of the delivery dates as directed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit operation and maintenance (O&M) data/manuals which are specifically applicable to this contract and a complete and concise depiction of the provided equipment or product. Data containing extraneous information to be sorted through to find applicable instructions will not be accepted. Present information in sufficient detail to clearly explain user O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01300, "Submittals."

1.1.1 Quantity

Submit five copies of the manufacturers' O&M information specified herein for the components, assemblies, subassemblies, attachments, and accessories. The item for which O&M data/manual are required is listed in the technical section which specifies that particular item.

1.1.2 Package Content

For each product, system, or piece of equipment requiring submission of O&M data, submit the data package required in the individual technical section. Data package content shall be as required in the paragraph entitled "Schedule of Operations and Maintenance Data Packages."

1.1.3 Delivery

Submit O&M data to the Officer-in-Charge for review and acceptance; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

a. In the event the Contractor fails to deliver O&M Data/Manuals within the time limits set forth above, the Officer-in-Charge may withhold from progress payments 50 percent of the price of the item with which such data/manuals are associated.

1.1.4 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M data. Changes, additions, or revisions required by the Officer-in-Charge for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 Operator Prestart

Include procedures required to set up and prepare each system for use.

1.2.1.3 Startup, Shutdown, and Postshutdown Procedures

Provide narrative description for each operating procedure including control sequence for each.

1.2.1.4 Normal Operations

Provide narrative description of normal operating procedures. Include control diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 Emergency Operations

Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and gage reading recording.

1.2.1.7 Environmental Conditions

Include a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair.

1.2.2.1 Lubrication Data

Include lubrication data, other than instructions for lubrication in accordance with paragraph entitled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications;

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and

c. A lubrication schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance

Include manufacturer's recommendations on procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and list tools required to restore product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. List spare parts and supplies that have a long lead time to obtain.

1.2.3.6 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.4 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.4.1 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

a. Manufacturer's standard commercial practice: The parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as a master parts catalog, in accordance with the manufacturer's standard commercial practice.

b. Other than manufacturer's standard commercial practice: End item manufacturer may add a cross-reference to implement components' assemblies and parts requirements when implementation in manual form varies significantly from the style, format, and method of manufacturer's standard commercial practice. Use the format in the following example:

End Item Manufacturer's Alphanumeric Sequence	Actual Manufacturer's Name and FSCM	Actual Manufacturer Part No.
100001	John Doe & Co. 00000	2000002

List FSCM in accordance with DLA H4/H8.

1.2.4.2 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.4.3 Personnel Training Requirements

Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.

1.2.4.4 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.4.5 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each subcontractor installing the product or equipment. Include local representatives and service organizations most convenient to the project site. Provide the name, address, and telephone number of the product or equipment manufacturers.

1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.3.1 Data Package 1

a. Safety precautions

b. Maintenance and repair procedures

c. Warranty information

d. Contractor information

1.3.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Maintenance and repair procedures

g. Removal and replacement instructions

h. Spare parts and supply list

i. Parts identification

j. Warranty information

k. Contractor information

1.3.3 Data Package 3

a. Safety precautions

b. Normal operations

c. Emergency operations

d. Environmental conditions

e. Lubrication data

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring diagrams and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Parts identification

m. Warranty information

n. Testing equipment and special tool information

o. Contractor information

1.3.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and postshutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Corrective maintenance man-hours

p. Parts identification

q. Warranty information

r. Personnel training requirements

s. Testing equipment and special tool information

t. Contractor information

1.3.5 Data Package 5

a. Safety precautions

b. Environmental conditions

c. Preventive maintenance plan and schedule

d. Troubleshooting guides and diagnostic techniques

e. Wiring and control diagrams

f. Maintenance and repair procedures

g. Spare parts and supply list

h. Warranty information

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

PART 4 MEASUREMENT AND PAYMENT

No direct measurement is taken of work performed in accordance with this section. Payment for work performed in accordance with this section is considered incidental to the various contract items in the proposal.

-- End of Section --

SECTION 02020

SOIL INVESTIGATION DATA

PART 1 GENERAL

1.1 DESCRIPTION

a. Soil investigation reports have been prepared by Geolab-Hawaii dated April 26, 1996.

b. A copy of the complete report may be inspected at the office of the Officer-in-Charge. Boring logs are shown on Drawing No. C-2.

c. Report and log of Borings are made available for Contractor's information but are not a warranty of subsurface conditions.

d. Additional Investigation: Contractor should visit site and acquaint himself with the site conditions.

-- End of Section --

SECTION 02050

DEMOLITION AND REMOVAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.6 (1990) Demolition Operations

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 61-SUBPART M National Emission Standards for Asbestos

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Officer-in-Charge. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the building. Store materials that cannot be removed daily in areas specified by the Officer-in-Charge.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 Statements

a. Demolition plan

b. Notification of demolition and renovation

Submit proposed salvage, demolition and removal procedures to the Officer-in-Charge for approval before work is started.

1.3.1.1 Required Data

Demolition plan shall include procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work.

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," safety requirements shall conform with ANSI A10.6.

1.4.1 Notifications

Notify the Officer-in-Charge in writing 10 days prior to the commencement of work. "Notification of Demolition and Renovation" form is required for all demolition involving "load-supporting" structures and/or asbestos work.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, flooding, or pollution. Vacuum and dust the work area daily.

1.6 PROTECTION

1.6.1 Existing Work

Protect existing work which is to remain in place, be reused, or remain the property of the Government. Repair items which are to remain and which are damaged during performance of the work to their original condition, or replace with new. Do not overload structural elements and pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Officer-in-Charge approval.

1.6.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent displacement.

1.6.3 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.7 BURNING

Burning will not be permitted.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated which

are damaged or replace damaged items with new undamaged items as approved by the Officer-in-Charge.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Utilities and Related Equipment

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Officer-in-Charge. If utility lines are encountered that are not shown on drawings, contact the Officer-in-Charge for further instructions.

3.1.2 Roofing

Sequence work to minimize building exposure between demolition and new roof materials installation. Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary work prior to installation of permanent roof system materials unless approved otherwise by the Officer-in-Charge. Make provisions for worker safety during demolition and installation of new materials as described in paragraphs entitled "Statements" and "Regulatory and Safety Requirements." Sequence the work to minimize hazard to workers.

3.1.2.1 Reroofing

When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the Officer-in-Charge. No opening in the roof cover shall be attempted in threatening weather and any opening made shall be kept covered prior to suspension of work the same day.

3.1.3 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated.

3.1.4 Concrete

Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.5 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surfaces and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Holes and depressions caused by previous physical damage or left as a result of removals in existing masonry walls to remain shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from the property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition and removal procedures, and authorization by the Contracting Officer to begin demolition. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3 CLEANUP

3.3.1 Debris and Rubbish

Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Limit to 3/8-cubic yard capacity buggies or other conveyances used on roofs and within the building to transport removed debris to chute locations. Clean up spillage from pavements, streets and adjacent areas.

PART 4 MEASUREMENT AND PAYMENT

The various components of the demolition and removal work shown on the plans and as may be required by the new construction shall be measured and paid for on a per unit or lump sum basis as specified in the proposal schedule. Payment made at the bid price shall be full compensation for all labor, tools, equipment and materials required to perform the demolition and removal work.

-- End of Section --

SECTION 02220

GENERAL EXCAVATION, FILLING, AND BACKFILLING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1993) Concrete Aggregates
ASTM C 136	(1993) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m))
ASTM D 1140	(1992) Amount of Material in Soils Finer Than the No. 200 (75-Micrometer) Sieve
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft (2,700 kN-m/m))
ASTM D 1883	(1994) Test Method for CBR (California Bearing Ratio) of Laboratory-Compacted Soils
ASTM D 2321	(1989) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1993) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1993) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600 (1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909 Fertilizer

1.2 SUBMITTALS

1.2.1 Drawings

a. Supporting systems drawings

1.2.1.1 Required Drawings

Submit drawings and calculations by a registered professional engineer. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal.

1.2.2 Design Data

a. Supporting system calculations

1.2.2.1 Required Data

Submit drawings and calculations by a registered professional engineer. Calculations shall include data and references used.

1.2.3 Statements

a. Supporting systems work plan

Submit 15 days prior to starting work.

1.2.4 Field Test Reports

a. Fill and backfill test

b. Select material test

c. Porous fill test for capillary water barrier

d. Density tests

1.3 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.4 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated,

will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

d. Material character is indicated by the boring logs.

e. Blasting will not be permitted. Remove material in an approved manner.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.1 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.2 Backfill Material

Material specified in accordance with the applicable provisions of Section 11.3, "Trench Excavation and Backfill", of the Standard Specifications.

2.1.3 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.1.4 Select Material

Material specified in accordance with Section 14.2, "Rock for Fill", of the Standard Specifications.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 Clearing and Grubbing

The work shall be in accordance with the applicable provisions of Section 10, "Clearing and Grubbing", of the Standard Specifications.

3.2 EARTHWORK

3.2.1 Quality Assurance

Unless indicated otherwise on the drawings, the contours and elevations shown shall be finished surface of the completed facility.

Compacting and Material Testing: All soils analysis, including compaction test, will be performed by the Contractor. If, in the opinion of the Engineer, based on reports of the testing service and field observations, the fills which have been placed are below the specified density, the Contractor shall provide additional compaction and testing at no additional expense to the City & County of Honolulu.

Construction Monitoring: Earthwork operations should be observed by a representative of Geolabs-Hawaii to evaluate whether undesirable materials are encountered during the excavation and scarification process and whether the exposed soil/rock conditions are similar to those encountered in their exploration.

The items of construction that are critical which require "Special Inspection" include observation of the production pile installation. Other aspects of earthwork construction should also be closely monitored by a representative of Geolabs-Hawaii. This is to observe compliance with the design concepts, specifications, or recommendations and to expedite suggestions for design changes that may be required in the event that subsurface conditions differ from those anticipated at the time the soils report was prepared.

If actual exposed subsurface conditions encountered during construction are different from those assumed or considered in the soils report, then appropriate modifications to the design shall be made by Geolabs-Hawaii.

At the on-set of earthwork, all areas within the contract grading limits should be thoroughly cleared and grubbed. All vegetation, debris, and other unsuitable materials should be removed and disposed of properly offsite. If zones of soft, loose, or saturated soils are encountered at the subgrade level, a deeper over-excavation may be required to expose the underlying firm material. The resulting over-excavation should be backfilled with compacted select granular material.

Slabs and foundations of the existing structures that are to be demolished should be completely removed. Any over-excavation resulting from the demolition should be backfilled with compacted granular fill material.

3.2.2 Trench Excavation and Backfill

Work shall be in accordance with Section 11, "Trench Excavation and Backfill", of the Standard Specifications and as supplemented and/or modified herein.

Existing utilities to be abandoned should be removed, and the resulting excavation should be properly backfilled with select granular fill material placed in 8-inch loose lifts and compacted to a minimum of 90 percent relative compaction. Utilities that are to be abandoned in-place under the

proposed structure should be backfilled by pumping lean concrete under low pressure.

A granular bedding consisting of 6 inches of No. 3B Fine gravel (ASTM C 33, No. 67 gradation) is recommended under pipes. If soft/loose soils are encountered at the proposed pipe inverts, an additional 18 inches of No. 3B Fine gravel wrapped in a filter fabric (Mirafi 140N or equivalent) should be provided below the bedding layer for more uniform support. Free-draining granular materials, such as No. 3B Fine gravel should be used for the trench backfill up to about 12 inches above the pipes (or 12 inches above the groundwater level) to provide adequate support around the pipes and to reduce compaction of the backfill, thus reducing the potential for damaging the pipes.

The upper portion of the trench backfill from the level one foot above the pipes to the top of the subgrade or finished grade should consist of select granular material or the onsite granular soils. The backfill should be moisture-conditioned to above the optimum moisture content, placed in maximum 8 inch level loose lifts, and mechanically compacted to not less than 90 percent relative compaction to reduce the potential for future ground subsidence. Where trenches are below pavement areas, the upper 2 feet of the trench backfill below the pavement subgrade should be compacted to at least 95 percent relative compaction.

3.2.3 Embankment

Work shall be in accordance with Section 17, "Embankment", of the Standard Specifications and as supplemented and/or modified herein.

After demolition, clearing and grubbing, all areas at grade or to receive fills should be scarified to a minimum of 10 inches, moisture-conditioned to above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Where needed, imported materials should consist of import borrow, crushed coral or basalt gravel. The material should be well-graded from coarse to fine with no particles greater than 3 inches in largest dimension. The material should have a laboratory California Bearing Ratio (CBR) value of 20 or higher, and a swell potential of not more than 1 percent when tested in accordance with ASTM D 1883. It should also contain between 10 and 30 percent passing the No. 200 sieve. Any imported fill material should be tested and approved by Geolabs-Hawaii prior to delivery to the project site for its intended use.

3.2.4 Structure Excavation and Backfill

Work shall be in accordance with Section 13, "Structure Excavation and Backfill", of the Standard Specifications and as supplemented and/or modified herein.

The backfill shall be placed in horizontal layers not more than 8 inches thick after compaction. Each layer shall be compacted to a minimum 90 percent relative compaction.

3.2.5 Pile Cap Excavation and Backfilling

Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Officer-in-Charge. Backfill and compact over-excavations and changes in grade due to pile driving operations to minimum 90 percent of ASTM D 698 maximum density.

A representative from Geolabs-Hawaii shall be present during all pile driving operations to observe the actual driving behavior and to further evaluate the field performance. It should be noted that the pile design and driving criteria recommended were developed from pile analysis using the field exploration data. Observation of the pile driving operations by Geolabs-Hawaii is necessary to confirm design assumptions.

3.3 FINISH OPERATIONS

3.3.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain away from structures. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.3.2 Seed

Scarify existing subgrade. Provide 6 inches of topsoil for newly graded finish earth surfaces and areas disturbed by the Contractor. If there is insufficient onsite topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available. Seed shall match existing vegetation. Provide seed at 5 pounds per 1,000 square feet. Provide CID A-A-1909, Type I, Class 2, 10-10-10 analysis fertilizer at 25 pounds per 1,000 square feet. Provide commercial agricultural limestone of 94-80-14 analysis at 70 pounds per 1,000 square feet. Provide mulch and water to establish an acceptable stand of grass.

3.3.3 Protection of Surfaces

Protect newly graded areas from traffic, erosion, and settlements that may occur. Repair or re-establish damaged grades, elevations, or slopes.

3.4 DISPOSITION OF SURPLUS MATERIAL

Remove from project site property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, and roots.

3.5 FIELD QUALITY CONTROL

3.5.1 Quality Control Testing During Construction

The Engineer shall observe and accept subgrades and fill layers before further construction work is performed thereon. Tests of the subgrade and fill layers will be taken as follows:

a. Foundation Backfill - Take at least two field density tests, at locations and elevations as directed by the Engineer.

b. Site Embankment - Take one test per 10,000 square feet, of each lift for areas compacted by other than hand operated machines. For hand operated machines take one test per 2,000 square feet per lift.

c. Utility Trench Backfill - Take one test per 100 linear feet for each lift.

If, in the opinion of the Engineer, based on report of the testing service and inspection, the subgrade or fills which have been placed are below the specified density, provide additional compaction and testing at no additional cost to the City & County of Honolulu.

The results of density tests which may be selected are in each instance equal to or greater than the specified density, and not more than 1 density test out of 5 has a greater value than 2% below the required density.

PART 4 MEASUREMENT AND PAYMENT

No direct measurement is taken of work performed in accordance with this section. Payment for all work performed in accordance with this section is considered incidental to the various contract items in the proposal.

-- End of Section --

SECTION 02367

PRESTRESSED CONCRETE PILING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318	(1989; R 1992) Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1990; Rev. A) Steel Wire, Plain for Concrete Reinforcement
ASTM A 416	(1993) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 615	(1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706	(1993; Rev. A) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C 33	(1993) Concrete Aggregates
ASTM C 150	(1994) Portland Concrete
ASTM D 1143	(1981; R 1987) Piles Under Static Axial Compressive Load

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1992) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI STD-112	(1984) Standard Prestressed Concrete Piles

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-04, Drawings

a. Piles

b. Driving helmets, capblocks, and pile cushions

1.2.1.1 Piles

Prepare in accordance with ACI 315. Indicate placement of reinforcement including tendons. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pickup.

1.2.1.2 Driving Helmets, Capblocks, and Pile Cushions

Show details of driving helmets, capblocks, and pile cushions. Submit 2 weeks prior to test pile installation.

1.2.2 SD-05, Design Data

a. Concrete mix design

Submit a concrete mix design before concrete is placed, for each type of concrete used for the piles.

1.2.3 SD-08, Statements

a. Precasting manufacturer's quality control procedures

b. Pile driving plan

c. Suitability of pile driving equipment

1.2.3.1 Quality Control Procedures

Submit three copies of precasting manufacturer's quality control procedures established in accordance with PCI MNL-116.

1.2.3.2 Installation Procedures

Submit installation instructions for pile driving plan.

1.2.4 SD-11, Factory Test Reports

a. Aggregates

1.2.4.1 Aggregates

Prior to pile fabrication, submit certified test reports for the following tests specified in ASTM C 33:

a. Grading

b. Amount of material finer than No. 200 sieve

c. Organic impurities

d. Soundness

e. Clay lumps and friable particles

f. Coal and lignite

g. Weight of slag

h. Abrasion of coarse aggregate

i. Fineness modulus

j. Reactive aggregates

k. Freezing and thawing

1.2.5 SD-12, Field Test Reports

a. Concrete

b. Load test

Submit load test data. Submit concrete cylinder compressive strength test results.

1.2.6 SD-13, Certificates

a. Prestressing steel

b. Portland cement

c. Concrete mix design

1.2.6.1 Portland Cement

Certification identifying cement; brand name, type, mill location, quantity to be used, size of lot represented by quality control sample, lot number, and destination of shipment.

1.2.6.2 Concrete Mix Design

Certify, using a Government-approved independent commercial testing laboratory, that proportioning of mix is in accordance with ACI 211.1 or ACI 318 for specified strength and is based on aggregate data which has been determined by laboratory tests during last twelve months.

1.2.7 SD-18, Records

a. Pile records

Submit pile and test pile records. Submit load test data and results.

1.3 REQUIREMENTS

1.3.1 Piling

Provide prestressed pretensioned concrete piles. From test pile data the Government will determine and list "calculated" tip elevations or driving resistances for each pile. This information will be given to the Contractor no later than 10 days from receipt of complete test data. Use this list as the basis for ordering the piles. do not order piles until list is provided by the Government. Test piles shall be 5 feet longer than the bid length.

1.3.2 Pile Lengths and Quantity

Base bids upon the following Table I:

Table I

Number	Size	Capacity	Length
10	12 sq. ft.	40 tons	35 ft.

Should total number of piles or number of each length vary from that specified as the basis for bidding, an adjustment in the contract price and time for completion will be made. Adjustments in contract price will not be made for cutting off piles; for any portion of a pile remaining above cut-off elevation; or for broken, damaged, or rejected piles.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cement

ASTM C 150, Type II.

2.1.2 Water

Use potable water.

2.1.3 Aggregates

ASTM C 33. Do not mix, store in same stockpile, or use fine aggregates from different sources of supply in same concrete mix or same structure without approval.

2.1.4 Admixtures

If required, ASTM C 494, Type A and ASTM C 618, Type C. Do not use admixtures containing chlorides.

2.1.5 Prestressing Steel

Use seven-wire stress relieved strand conforming to ASTM A 416. Use prestressing steel free of grease, oil, wax, paint, soil, dirt, and loose rust. Do not use prestressing strands or wire having kinks, bends, or other defects.

2.1.6 Reinforcing Steel

ASTM A 615, ASTM A 706, Grade 60. Weld reinforcing steel in accordance with AWS D1.4.

2.1.7 Ties and Spirals

Steel, ASTM A 82 for spirals and ASTM A 615 for ties.

2.1.8 Grout

Provide cement grout for prestressed piles using materials conforming to requirements stipulated herein for concrete mixes, PCI JR-119. Use admixtures, if required, known to have no injurious effects on steel or concrete. Do not use calcium chloride.

2.2 CONCRETE MIX DESIGN

ACI 318, Chapter 4. Use concrete with a minimum compressive strength of 6000 psi at 28 days and a maximum size aggregate of 3/4 inches.

2.3 FABRICATION OF PRETENSIONED PILES

2.3.1 Formwork

Provide forms of metal, braced and stiffened against deformation, accurately constructed, watertight, and supported on unyielding casting beds. Forms shall permit movement of pile without damage during release of prestressing force. Form precast dowel holes with galvanized flexible metal conduit. Make piles to dimensional tolerances in accordance with PCI MNL-116.

2.3.2 Pretensioning

Measure tension to which steel is to be pretensioned by jack pressure read on a calibrated gage and verify by elongation of steel. Use gage calibrated within last 6 months by a laboratory approved by Contracting Officer. Provide means for measuring elongation of steel to nearest 1/8 inch. When difference between results of measurement and gage reading is more than 5 percent, determine cause of discrepancy and correct. Give tensioning steel a uniform prestress prior to being brought to design prestress. Induce same initial prestress in each unit when several units of prestressing steel in a pile are stretched simultaneously.

2.3.3 Casting

2.3.3.1 Conveying

Clean conveying equipment thoroughly before each run. Convey concrete from mixer to forms as rapidly as practicable by methods which will not cause segregation or loss of ingredients. Deposit concrete as nearly as practicable to its final position. During placing, make any free vertical drop of the concrete less than 3 feet. Remove concrete which has segregated in conveying or placing.

2.3.3.2 Placing and Casting

Perform concrete casting within 3 days after pretensioning steel; however, do not deposit concrete in forms until placement of reinforcement and anchorages has been inspected and approved by pile manufacturer's quality control representative. Produce each pile of dense concrete straight with smooth surfaces with reinforcement retained in its proper position during fabrication. Use vibrator with heads smaller than the minimum distance between steel for pretensioning. Make surface of pile ends perpendicular to axis of pile. Chamfer, a minimum 3/4 inch ends of piles and corners of square piles.

2.3.4 Curing of Piles

Cure piles using moist or accelerated curing.

2.3.4.1 Moist Curing

Moist cure using moist burlap coverings, plastic sheeting, or membrane curing compound until minimum strength to detension is achieved.

2.3.4.2 Accelerated Curing

After placement of concrete, moist cure for a period of 4 hours. Accelerated cure until concrete has reached specified release strength. Enclose casting bed for accelerated curing with a suitable enclosure. During application of steam or heat, increase the air temperature at a rate not to exceed 60 degrees F per hour. Cure at a maximum temperature of 160 degrees F until concrete has reached specified release strength. Reduce temperature at a rate not to exceed 60 degrees F per hour until a temperature of 20 degrees F above ambient air temperature is reached. After accelerated curing, moist cure using either water or membrane curing until a total accelerated and moist curing time of 72 hours is achieved.

2.3.5 Detensioning

Perform releasing of prestressed steel in pretensioned piles in such an order that eccentricity of prestress will be minimized. Gradually release tension in strands from anchorage. Detension after approval by pile manufacturer's quality control representative. Perform transfer of prestressing force when concrete has reached a minimum compressive strength of 4000 psi.

2.4 EQUIPMENT

2.4.1 Pile Hammers

Furnish a hammer capable of developing the indicated ultimate pile capacity considering hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross section, length, and total weight of pile; and character of subsurface material to be encountered. Use the same type pile hammer, operating at the same rate and in the same manner, as that used for driving test piles. Obtain required driving energy of hammer, except for diesel hammers, by use of a heavy ram and a short stroke with low impact velocity. At final driving, operate pile hammer in accordance with manufacturer's recommendation for driving either end bearing piles or friction piles. At final driving, operate diesel powered hammers at rate recommended by manufacturer for hard driving. Maintain pressure at steam or air hammer so that: (1) for double-acting hammer, the number of blows per minute during and at completion of driving of a pile is equal approximately to that at which hammer is rated; (2) for single-acting hammer, there is a full upward stroke of the ram; and (3) for differential type hammer, there is a slight rise of hammer base during each downward stroke.

2.4.2 Driving Helmets and Cushion Blocks

2.4.2.1 Driving Helmets or Caps and Pile Cushions

Use a steel driving helmet or cap including a pile cushion between top of pile and driving helmet or cap to prevent impact damage to pile. Use a driving helmet or cap and pile cushion combination capable of protecting pile head, minimizing energy absorption and dissipation, and transmitting hammer energy uniformly over top of pile. Provide driving helmet or cap fit sufficiently loose around top of pile so that pile may be free to rotate without binding within driving helmet. Use pile cushion of solid wood or of laminated construction using plywood, softwood or hardwood boards with grain parallel to end of pile. Provide pile cushion with thickness of 3 inches minimum of 6 inches maximum. Replace pile cushion when it becomes highly compressed, charred or burned, or has become spongy or deteriorated in any manner.

2.4.2.2 Hammer Cushion or Capblock

Use a hammer cushion or capblock between driving helmet or cap and hammer ram consisting of aluminum and micarta or equal discs stacked alternately in a steel housing. Use steel plates at top and bottom of capblock. Replace aluminum or micarta discs that have become damaged, split or deteriorated in any manner. Do not use small wood blocks, wood chips, rope or other materials that permit excessive loss of hammer energy.

2.5 PRODUCT QUALITY CONTROL

Piles shall be manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control" perform product quality control in accordance with PCI MNL-116.

PART 3 EXECUTION

3.1 PILE DRIVING

3.1.1 Driving Piles

Drive piles to or below indicated tip elevation to reach a driving resistance in accordance with the schedule which the Government will prepare from the test-pile driving data. During initial driving and until pile tip has penetrated beyond layers of very soft soil or below bottom of predrilled holes, use a reduced driving energy of the hammer of 15,000 - 25,000 foot pounds per blow maximum or as otherwise directed by the Engineer. Remove fluid soil and water rising inside hollow pile more than 10 feet above the original ground or water level or to within 5 feet of pile top before driving is continued, unless methods approved by the Engineer is used to prevent pile damage. If a pile fails to reach indicated tip elevation, or if a pile reaches indicated tip elevation without reaching required driving resistance. Notify the Engineer and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB.

3.1.2 Protection of Piles

Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving, but allow rotation in leads. Square top of pile to longitudinal axis of pile. Maintain axial alignment of pile hammer with that of the pile.

3.1.3 Tolerances in Driving

Drive piles with a variation of not more than 2 percent from vertical for plumb piles. Maintain and check axial alignment of pile and leaders at all times. If subsurface conditions cause pile drifting beyond allowable axial alignment tolerance, notify Contracting Officer and perform corrective measures as directed. Place butts within 4 inches of location indicated. In addition to specified tolerances, maintain a location to provide a clear distance of at least 5 inches from butt to edge of pile cap. If clear distance can not be maintained, then notify the Engineer. Check each pile for heave. Redrive heaved piles to required point elevation.

3.1.4 Pile Cut-Off

Cut off piles with a smooth level cut using pneumatic tools, sawing, or other suitable methods approved by Contracting Officer. Use of explosives for cutting is not permitted.

3.2 FIELD QUALITY CONTROL

3.2.1 Test Piles

Use test piles of types, and drive as specified for piling elsewhere in this section. The Government will use Contractor test pile data to determine "calculated" pile tip elevation or necessary driving resistance. Drive test piles at the locations indicated. Drive test piles to indicated

bidding lengths. Drive piles driven one day an additional 6 inches on the next working day, unless refusal 20 blows per one inch is encountered. Record any increase or decrease in driving resistance. If there is a decrease in driving resistance, a load test, at Government expense, may be required by the Contracting Officer. Use test piles, if located properly and offering adequate driving resistance in finished work. Pre-drilling is permitted only when test piles clearly establish validity of its use, or as directed by the Engineer.

3.2.2 Load Tests

Perform load tests on one pile in accordance with ASTM D 1143 as modified herein. Do not use anchor piles. Provide apparatus for applying vertical loads as required by method, using load from weighted box or platform applied to pile by hydraulic jack. Increase load in increments until rapid progressive settlement takes place or until application of total load of 80 tons. Consider load test satisfactory when after one hour at full test load gross settlement of pile butt is not greater than gross elastic pile compression plus 0.15 inch plus one percent of pile tip diameter or width inches, slope of gross load-settlement curve under full test load does not exceed 0.05 inches per ton, net settlement after removal of test load does not exceed 3/4 inch. Make load tests at locations shown on driven test piles. Additional load tests, at Government expense, may be required by the Contracting Officer. Loading, testing, and recording and analysis of data must be under the direct supervision of a Registered Professional Engineer provided and paid for by the Contractor.

3.2.3 Pile Records

For each driven pile, keep a record of the number of blows required for each foot of penetration and number of blows for the last 6 inches penetration or fraction thereof as required for the driving resistance. Include in the record the beginning and ending times of each operation during driving of pile, type and size of hammer used, rate of operation, stroke or equivalent stroke for diesel hammer, type of driving helmet, and type and dimension of hammer cushion (capblock) and pile cushion used. Record retap data and unusual occurrences during pile driving. Notify the Engineer 10 days prior to driving of test piles and load test.

PART 4 MEASUREMENT AND PAYMENT

Pay length for furnishing piles shall be the length ordered and delivered to the job site, as approved by the Officer-in-Charge.

Pay length for driving piles shall be the actual length remaining in the work after piles are cut off. The two-foot strand embedment into pile cap shall be considered incidental, and shall not be measured for pay length.

Pile build-ups shall be considered incidental and shall not be paid for separately.

-- End of Section --

SECTION 02810

IRRIGATION SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

1.1.1 General

a. Provide a landscape irrigation system in the areas shown on the drawings. All work indicated on the drawings by notes shall be provided whether or not specifically mentioned in the Specifications. Items not specifically shown in the drawings or specified, but normally required to conform with such intent, are considered part of the work.

b. Make field adjustments required due to existing site conditions and revisions that are a result of project construction and not noted in the plans to insure adequate coverage and even distribution of water in all landscaped areas.

1.1.2 Codes and Standards

Perform work in accordance with all applicable laws, codes, and regulations required by authorities having jurisdiction over such work and provide for all inspections and permits required by Federal, State, and local authorities in furnishing, transporting, and installing materials.

a. The work in this Section includes, but is not limited to the following:

1. Excavation and backfilling.

2. Pipes, fittings and sprinkler heads.

3. Valves and cross connection devices.

4. Automatic controller, remote control valves and control wire.

5. Adjustment and instructions.

6. Project record drawings.

7. Warranty.

1.1.3 Product Data

Submit manufacturer's technical data and installation instruction for the irrigation system.

1.2 SUBMITTALS

1.2.1 Substitutions

Requests for substitutions of any equipment or material specified or indicated will be considered if the proposed substitution is judged to be equal or superior for the particular purpose or application specified; or if proof is established the materials specified or indicated are not available.

a. Submit written request to the Engineer during the bidding period.

b. Approvals of substitution requests will be granted in writing.

1.2.2 Construction Schedule

At the pre-construction meeting, provide a written copy of the projected construction schedule noting the estimated completion date, number of working days required and any special coordination requirements.

1.2.3 As-Built Drawings

Provide a reproducible copy of the as-built drawings of the irrigation system.

1.2.4 Instructions

a. Furnish the Owner with two copies of a complete set of operating instructions.

b. After the system has been completed and accepted by final inspection, instruct the Owner's representative in the complete operation and maintenance of the system.

1.2.5 Certificates of Warranty

Provide all certificates of warranty from the irrigation equipment manufacturers.

1.3 JOB CONDITIONS

1.3.1 Acceptance of Previous Work

Inspect and accept the condition of the site relative to this Section before commencing with the work covered herein. If not acceptable, notify the Engineer in writing. By proceeding with the work under this Section, the Contractor indicates his acceptance of all previous related work.

1.3.2 Meet on Site

Prior to commencing work, meet with the Engineer and all other concerned parties on the site to review the work under this Section. Request this meeting one week prior to desired meeting time.

1.3.3 Underground Utilities and Obstructions

Verify the location of all underground utilities and other obstructions that may affect the work. Any obstructions encountered shall be reported to the Engineer. Repair all damage to any known utility line or other underground obstruction at Contractor's expense. Report damage to any unknown utilities to the Engineer.

1.3.4 Protection

a. Provide necessary safeguards and exercise caution against injury or defacement of existing site improvements. Prevent vehicles of any kind from passing over sidewalks, curbs, etc., unless adequate protection is provided. Do not store materials or equipment, or operate equipment near or under the branches of any existing plants that are to remain, except as actually required for construction in those areas.

b. Be responsible for damages caused by leaks in the piping systems being installed or during the Warranty period due to failure of workmanship or materials. Repair all damages and return the area to the previous condition at Contractor's expense.

1.3.5 Clean Up

Keep all areas of work clean, neat and orderly at all times during period of Contract. Clean all construction areas at end of each day.

1.3.6 Final Inspection

a. At the completion of all irrigation work request a final inspection. Notify the Engineer five (5) working days prior to the inspection so a mutually agreeable time for inspection so a mutually agreeable time for inspection may be arranged.

b. The Engineer, Landscape Contractor, and the Owner, or their representatives, shall be present at the inspection.

c. If, after the inspection, the Engineer and the Owner are of the opinion all work has been performed in accordance with the Drawings and Specifications, written notice of acceptance and completion of the project will be given. If all or certain portions of the work are not acceptable under the terms and intent of the Drawings and Specifications, a reasonable amount will be retained from the final payment and the defects in the work shall be corrected before the work is accepted by the Engineer and the Owner.

1.3.7 Warranty

Warranty all work for a period of one year after acceptance. Immediately repair or replace without cost to the Owner all material and equipment found to be defective due to faulty material or workmanship during the period. This warranty does not include vandalism, negligence by others or acts of God.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General

Materials incorporated in the system shall be new, without flaws or defects and of quality and performance specified. Material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.

2.1.2 Asbestos Prohibition

No asbestos-containing materials shall be used under this Section. The Contractor shall insure that all materials incorporated in the project are asbestos-free.

2.1.3 Pressure Mains

a. 1/2" thru 3" Schedule 40 PVC, ASTM D 1785.

b. 1 1/2" and larger Class 200 PVC, SDR 21, ASTM D 2241 with integral elastomeric seal coupler, ASTM D 3139.

c. 1 1/2" thru 3" may be either of the above at the Contractor's option.

2.1.4 Laterals

Class 200 PVC, SDR 21, ASTM D 2241 with integral solvent weld bell end, ASTM D 2672; solvent weld coupling, ASTM D 2466; or integral elastomeric seal coupler, ASTM D 3139.

2.1.5 Visible Pipe and Fittings

a. General: Integral gray color or painted as directed on Drawings or in Specifications.

b. Threaded Risers and Nipples: Schedule 80 PVC.

c. Other Risers and Fittings: Schedule 40 PVC, Type 1, solvent weld.

d. Cement: ASTM D 2564 or as recommended by the manufacturer.

e. Flexible Tubing: Toro 850-01 thick wall pipe or equal for flexible swing joints.

2.1.6 Sleeves

a. 4" and Smaller: Schedule 80 PVC.

b. Conduit: Schedule 80 PVC.

2.1.7 Valves

Manufacturer's standard, of type and size indicated, and as follows:

a. Remote Control Valves: Globe valves operated by low-power solenoid, normally closed, manual flow adjustment.

b. Gate Valves: American made 200 WOG brass with non-rising stem and threaded ends.

c. Valve Boxes: Plastic box with hinged locking lid. Ametek, brooks, Carson or equal. Rectangular for remote control valves. Round for gate valves.

2.1.8 Sprinkler Heads

Manufacturer's standard unit designed to provide uniform coverage over areas shown on drawings.

a. Bubbler: Fixed pattern, with screw-type flow adjustment.

b. Shrubbery: Fixed pattern, with screw-type flow adjustment.

c. Pop-Up Spray: Fixed pattern, with screw-type flow adjustment and stainless steel retraction spring.

2.2 MISCELLANEOUS

2.2.1 Control Wire

a. Wire Conformation: Provide wires conforming to U1 83 THW, THWN, UL 44. Only wires with "W" in the type designation shall be used in wet or damp locations. #14 minimum size.

b. Use white jacket for common and different color coded wires (as available) for individual control lines.

c. Size of conductor shall meet all the requirements of the installation instructions of the manufacturer of the valves and controllers.

2.2.2 Wire Connectors

Spears Dry-Splice, Penlite or equal.

2.2.3 Thrust Blocks

One cu. ft. of redi-mix concrete or minimum 1 cu. ft. of 2,500 psi/28 day concrete.

PART 3 EXECUTION

3.1 SYSTEM DESIGN

Do all necessary excavation for the proper installation of the irrigation system.

3.1.1 Design Pressures

As indicated on drawings, at connection to building system and at last head in circuit.

3.1.2 Location of Heads

Design location is approximate. Make minor adjustments as necessary to avoid plantings and other obstructions.

3.1.3 Minimum Water Coverage

a. Turf Area: 95%.

b. Other Planting Areas: 85%.

Layout may be modified, if necessary to obtain coverage, to suit manufacturers standard heads. Do not decrease number of heads indicated unless otherwise acceptable to Engineer.

3.2 TRENCHING AND BACKFILLING

3.2.1 General

Excavate straight and true with bottom uniformly sloped to low points.

a. Protect existing plantings. Remove and replant as necessary to complete installation. Replace damaged plants with new to match existing shown.

3.2.2 Trench Depth

Excavate trenches to depths as shown on Details.

a. Boulders, roots and other obstructions shall be entirely removed or cut out to the width of the trench and a depth of 6" below the trench bottom. Such debris shall be disposed of off site.

b. Any rock over 2" in largest dimension excavated during trenching shall be removed and disposed of off site.

c. Over excavation shall be backfilled and carefully tamped to provide a smooth and firm-bearing surface for laying the pipe.

3.2.3 Minimum Cover

Provide the following minimum cover over top of installed piping:

a. 18" minimum over pressure mains.

b. 12" minimum over laterals.

c. 24" minimum over sleeves under paving.

3.2.4 Backfill

Backfill with clean material from excavation. Remove organic material as well as rocks and debris larger than 1" diameter. Place acceptable backfill material in 8" lifts, compacting each lift.

3.3 INSTALLATION

3.3.1 Remote Control Valves

Install in valve box, connected directly to the main line with sufficient clearance for service and operation.

a. Adjust to provide flow rate of rated operating pressure required for each sprinkler circuit.

b. Thoroughly clean, adjust and inspect all valves for operation and performance.

3.3.2 Valve Boxes

a. Where feasible, several valves shall be grouped together in a large valve box with 4" minimum clearance between valves and from the box.

b. Install above a 3" deep gravel pit for drainage. The box shall be reasonably free from dirt and debris.

c. The top shall be level or following the adjacent finish grade as detailed.

3.3.3 Control Wire

a. All work shall conform with the NEC. Wires shall be installed at a minimum depth of 18".

b. Splices and connections shall be watertight.

c. Wire shall be within a protective conduit.

d. A minimum loop of 24" shall be left at each valve; at each splice; at each change in direction; at every 500 ft. of straight run; and at each controller for expansion.

e. Wire shall be placed under the pipe in the trench and bundled and tied at 10 ft. intervals.

f. Wire shall be within a protective conduit, for pavement crossings, or where other conditions make it necessary.

3.3.4 Sprinkler Heads

Flush circuit lines with full head of water and install heads after hydrostatic test is completed.

a. Set heads plumb and level at the locations indicated on the Drawings.

b. Thoroughly clean, adjust and inspect all heads for proper operation and performance.

c. In turf areas heads shall be initially installed on the risers 1/2" above grade level. Prior to final inspection of the landscape planting adjust all heads as necessary.

3.3.5 Pipe Fittings and Assembly

a. All pipes shall be installed as dimensioned or approximately in the locations shown and shall be of the sizes indicated.

b. Parallel piping shown on the Drawings may be installed in the same trench with all pipe at the same depth and 1" (minimum) horizontal separation between pipes. Parallel piping shall not cross in the trench.

c. Piping shall be laid accurately to the line and grade required, with full bearing on the trench bottom. No pipe shall be laid on soft fill or unstable material.

d. Crossing pipes shall have 2" (minimum) vertical separation. No direct contact between other pipes or structures will be permitted.

e. Work shall be performed in strict accordance with the manufacturer's installation instructions for the various types of pipe herein specified.

f. Pipes shall be flushed out thoroughly to remove all debris and foreign matter.

g. Prior to backfilling, pipes shall be inspected for leaks at the joints and fittings and repaired or replaced as required.

3.3.6 Dielectric Protection

Use dielectric fittings at connection where pipes of dissimilar metal are joined.

3.3.7 Hydrostatic Test

After installation of the irrigation system and prior to completion of the trench backfilling, the system shall be tested for leaks and flushed under pressure to remove any dirt, scale or other objectionable materials then tested for operational adequacy. All pressure tests are to be conducted in

the presence of the Engineer.

a. Solvent welded and threaded pipe fittings shall be pressure tested after installation in accordance with manufacturer's specifications.

b. All pipes, after installation, shall be tested to 100 psi before operating pressure with the pressure not dropping more than 5 psi in 30 minutes.

3.3.8 Operational Testing

Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads adjusted to final position.

3.4 VALVES

Valves shall be installed plumb and with sufficient clearance for service and operation. Adjust the flow control for proper operation of the sprinklers. Thoroughly clean, adjust and inspect all valves for operation and performance.

3.5 ADJUSTING SYSTEMS

Prior to final inspection, adjust all sprinklers to provide adequate and uniform spray coverage within each planting area. Balance spray patterns by adjusting individual sprinkler heads with the adjustment screws. Adjust and balance each system at the listed water pressure for each type of sprinkler head.

3.6 REPAIR OF LEAKS

All leaking joints, whether discovered at time of installation nor at any time during the Warranty period, shall be remade with all new materials. Use of caulking or cement to repair leaks is prohibited.

3.7 BACKFILLING

As soon as the work has been installed and reviewed, all trenches shall be backfilled. Use only sand or select backfill material within 2" of all pipes. No debris or rocks over 2" in largest dimensions shall be used to backfill the remainder of the trench. After backfilling, trenches shall be flush with, or slightly above, adjacent finished grade. Repair paving cuts with materials to match original surface. Reseed, resod or replant the trenched areas as needed. Should the soil level of the trenches settle during the Warranty period, refill the trenches as needed at no additional cost. The Landscape Contractor shall not disrupt or alter any drainage swales.

PART 4 MEASUREMENT AND PAYMENT

Irrigation system work shown on the plans shall be measured for payment as a lump sum item. Payment shall be full compensation for all labor, tools, equipment and materials required to install modifications to th existing irrigation system.

-- End of Section --

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M182	(1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(1990) Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1994) Structural Concrete for Buildings
ACI 302.1R	(1989) Concrete Floor and Slab Construction
ACI 304R	(1989) Measuring, Mixing, Transporting, and Placing Concrete
ACI 304.2R	(1991) Placing Concrete by Pumping Methods
ACI 305R	(1991) Hot Weather Concreting
ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318	(1989; R 1992) Building Code Requirements for Reinforced Concrete
ACI 347R	(1994) Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 185	(1990; Rev. A) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 615/A 615M	(1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1993; Rev. A) Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregates
ASTM C 39	(1993; Rev. A) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1990) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 150	(1994) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 260	(1986) Air-Entraining Admixtures for Concrete
ASTM C 309	(1993) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 881	(1990) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(1987) Elastomeric Joint Sealants
ASTM C 1017	(1992) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107	(1991; Rev. A) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 4397	(1991) Polyethylene Sheeting for

Construction, Industrial, and Agricultural Applications

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4 (1992) Structural Welding Code Reinforcing Steel

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS-1 (1983) Construction and Industrial Plywood

1.2 DEFINITIONS

a. "Cementitious material" as used herein shall include all portland cement, pozzolan, fly ash, ground iron blast-furnace slag, and silica fume.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Materials for curing concrete

b. Joint sealants

c. Joint filler

d. Epoxy bonding compound

1.3.2 SD-04, Drawings

a. Reinforcing steel

Reproductions of contract drawings are unacceptable.

1.3.2.1 Reinforcing Steel

ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.3.3 SD-05, Design Data

a. Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, and admixtures; and applicable reference specifications. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Obtain acknowledgement of receipt prior to concrete placement.

1.3.4 SD-10, Test Reports

a. Concrete mix design

1.3.4.1 Concrete Mix Design

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. Test reports shall be submitted along with the concrete mix design. Obtain approval before concrete placement.

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to the mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Officer-in-Charge.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 for job site storage of materials. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

PART 2 PRODUCTS

2.1 CONCRETE

2.1.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318, ACI 304.2R except as otherwise specified. The compressive strength (f'c) of the concrete for each portion of the structure(s) shall be as indicated and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (psi)	ASTM C 33 Aggregate (Size No.)	Range of Slump (inches)	Water-Cement Ratio (by weight)	Air Entr. (percent)
Reinforced Ground Floor Slabs and Toppings and Beams	3000	67	2-4	0.45	4-8
Roof Slabs, Beams and Reinforced Walls	4000	67	1-3	0.4	4-8
Building Columns	4000	67	1-3	0.4	4-8
Walks, Curbs, and Gutters	2500	67	3-5	0.5	4-8
Utility Structures	3000	67	2-4	0.45	4-8
Drainage Structures	3000	67	2-4	0.45	4-8
All Other Areas	3000	67	2-4	0.45	4-8

Maximum slump shown above may be increased one inch for methods of consolidation other than vibration. Slump may be increased to 7 inches when superplasticizers are used. The water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days shall not exceed 0.30.

2.1.2 Required Average Strength of Mix Design

The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall be as follows:

a. For f'c less than 3000 psi, 1000 psi plus f'c.

b. For f'c between 3000 and 5000 psi, 12000 psi plus f'c.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type II.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

ASTM C 33, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Nonshrink Grout

ASTM C 1107.

2.2.5 Admixtures

Calcium chloride shall not be used as an admixture.

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.5.2 Accelerating

ASTM C 494, Type C.

2.2.5.3 Retarding

ASTM C 494, Type B, D, or G.

2.2.5.4 Water Reducing

ASTM C 494, Type A, E, or F.

2.2.5.5 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494, Type F and ASTM C 1017.

2.2.5.6 Surface Colors

Ready to use dry shake comprised of specially graded quartz aggregate and finely ground, alkali-fast, light-fast, non-leaching, inorganic coloring pigments as manufactured under "Kolorblen" by Conrad Sorig Co., Inc. or "Lithochrom" by L. N. Schofield Co. or "Color-cron" by Master Builders or "Harcol" by Sonneborn Division of Contech Inc., or equal. Color wax or color-sealer shall be as recommended by manufacturer. Materials for installation shall be the product of one manufacturer.

2.2.6 Materials for Forms

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Plywood: PS-1, B-B concrete form panels or better. Steel form surfaces shall not contain irregularities, dents, or sags.

2.2.6.1 Form Ties and Accessories

The use of wire alone is prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.

2.2.7 Reinforcement

2.2.7.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A 615/A with the bars marked A, Grade 60; or ASTM A 706.

2.2.7.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

2.2.7.3 Welded Wire Fabric

ASTM A 185. Provide flat sheets of welded wire fabric for slabs and toppings.

2.2.7.4 Wire

ASTM A 82.

2.2.8 Waterproof Paper

Kraft paper, glass reinforming fibers and layers of polyethylene laminated under heat and pressure to form a single layer meeting the requirements of FS UU-B-790, Type I, Grade A, Style 4; or waterproof paper, regular, conforming to ASTM C 171, consisting of two sheets of kraft paper cemented together with bituminous material in which are embedded cords or strands of fiber running in both directions not more than 30 mm (1 1/4 inch) apart.

2.2.9 Polyethylene Sheeting

ASTM D 4397, minimum 6 mil thickness.

2.2.10 Materials for Curing Concrete

2.2.10.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.2.10.2 Pervious Sheeting

AASHTO M182.

2.2.10.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.2.11 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.2.12 Expansion/Contraction Joint Filler

ASTM D 1751 or ASTM D 1752, 13 mm (1/2 inch) thick, unless otherwise indicated.

2.2.13 Joint Sealants

2.2.13.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T.

2.2.13.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.2.14 Epoxy Bonding Compound

ASTM C 881. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.2.15 Dovetail Anchor Slot

Preformed metal slot approximately one by one inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

PART 3 EXECUTION

3.1 FORMS

ACI 301. Provide forms, shoring, and scaffolding for concrete placement unless indicated or specified otherwise. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and

external corners of concrete (0.75 inch) unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.

3.1.1 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats or nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.1.2 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347R. Prevent concrete damage during form removal.

3.1.2.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.1.3 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, slabs and beams over 10 feet in span and cantilevers over 4 feet shall be reshored for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carrying capabilities as original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not contain rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length of the reinforcement has been reduced to less than that specified in paragraph entitled "Reinforcing Bars." Remove loose rust prior to placing steel. Tack welding is prohibited.

3.2.1 Reinforcement Supports

Place reinforcement and secure with galvanized or noncorrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other noncorrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.2.2 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches.

3.2.3 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Bolt threads shall match the connector. Countersink the connector in the concrete. Calk the depression after the bolt is installed.

3.2.4 Cover

ACI 301 for minimum coverage, unless otherwise indicated.

3.2.5 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.2.6 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.2.7 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used.

3.3 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94, ACI 301, ACI 302.1R, and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.3.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.3.2 Mixing

ASTM C 94 and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.3.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.4 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other.

3.4.1 Vibration

ACI 301. Furnish a spare vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 18 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 18 inch maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.4.2 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.4.3 Pumping

ACI 304R and ACI 304.2R. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. Rapid changes in pipe sizes shall be avoided. Maximum size of course aggregate shall be limited to 33 percent of the diameter of the pipe. Maximum size of well rounded aggregate shall be limited to 40 percent of the pipe diameter. Samples for testing shall be taken at both the point of delivery to the pump and at the discharge end.

3.4.4 Hot Weather

ACI 305R. Maintain required concrete temperature using Figure 2.1.5 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.5 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.5.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.5.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.

3.5.3 Formed Surfaces

3.5.3.1 Tolerances

ACI 117 and as indicated.

3.5.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch this holes and defects and level abrupt *irregularities*. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.5.3.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Patch tie holes and defects and completely remove all fins.

3.5.4 Tooled Finish

Provide concrete indicated with a textured finish shall be tooled finished:

The thoroughly cured concrete surface shall be dressed with electric, air, or hand tools to a uniform texture, and shall be given a hand tooled, rough or fine pointed, crandalled, or bush hammered surface texture, to match the existing textured surface finish.

3.6 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where indicated. Where straightedge measurements are specified, Contractor shall provide straightedge.

3.6.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.6.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below, the surface shall be roughened with stiff brushes of rakes before final set.

3.6.1.2 Floated

Use for surfaces to receive roofing, exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, surface shall be checked with a 3 meter (10 foot) straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. High spots shall be cut down and low spots filled during this procedure to produce a surface level 1/4 inch in 10 feet.

3.6.1.3 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. First, provide a floated finish. The finish shall next be power troweled two times, and finally hand troweled. The first troweling after floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks and uniform in texture and appearance. The finished surface shall produce a surface level 1/4 inch in 10 feet.

3.6.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.6.1.5 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained. Round edges and joints with an edger having a radius of 1/8 inch.

3.6.1.6 Concrete Toppings Placement

The following requirements apply to the placement of toppings of concrete on base slabs that are on hardened base slabs.

a. Bonding to a Hardened Base: When the topping is to be bonded to a floated or troweled hardened base, roughen the base by scarifying, grit-glasting, scabbling, planing, flame cleaning, or acid-etching to lightly expose aggregate and provide a bonding surface. Remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the clean base wet for a period of 12 hours preceding the application of the topping. Remove excess water and apply a 1:1:1/2 cement-sand-water grout, and brush into the surface of the base slab. Do not allow the cement grout to dry, and spread it only short distances ahead of the topping placement. Do not allow the temperature differential between the completed base and the topping mixture to exceed 10 degrees F at the time of placing. Place the topping and finish as indicated.

3.6.2 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.6.3 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.6.4 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and shall be 24 inches long, 12 inches wide, and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.7 CURING AND PROTECTION

ACI 301 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforment, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on

surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

3.7.1 Moist Curing

Remove water without erosion or damage to the structure.

3.7.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

3.7.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period.

3.7.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.7.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.7.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

3.7.1 Moist Curing

Remove water without erosion or damage to the structure.

3.7.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete.

3.7.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period.

3.7.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.7.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.7.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.7.2.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.7.2.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.7.3 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. The sealer-hardener shall not be applied until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.7.4 Curing Periods

ACI 301 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that will be in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Officer-in-Charge.

3.8 COLORED FLOORS

Interior floors not covered with other flooring material shall be of cement color. Color shall be selected by the Officer-in-Charge. Colored concrete samples shall be submitted by the Contractor for approval and selection of colors. Color shall match existing floor where patching or new topping on existing floor is required. Preparation, application, curing and precautions shall be performed in strict compliance with manufacturer's recommendations and directions for medium duty floors of uniform coloring and shall generally consist of:

3.8.1 Basic Application

Two (2) coat application of dry-shake into freshly floated concrete, worked into surface and troweled to desired finish.

3.8.2 Interior Wax Application

One (1) coat application of wax in corresponding color as soon as surface has hardened sufficiently, buffed lightly after drying to remove stippled effect. One (1) coat application of thinned wax just before completion and buffed to final finish.

3.8.3 Precautions

Colored floors require extra care during installation and must be protected until completion. Should the final floor finish be uneven or stained at completion, the Contractor shall take remedial action to provide a satisfactory finish, uniform in color, if necessary with an alternate product of different characteristics to be approved by the Engineer, which is to be applied over the unsatisfactory installation, covering entire floor area within room.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31 for making test specimens.

3.9.2 Testing

3.9.2.1 Slump Tests

ASTM C 143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 10 cubic yards maximum of concrete.

3.9.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot conditions above 80 degrees F for each batch (minimum) or every 10 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.9.2.3 Compressive Strength Tests

ASTM C 39. Make five test cylinders for each set of tests in accordance with ASTM C 31. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards

of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 500 psi, take a minimum of three ASTM C 42 core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.9.2.4 Air Content

ASTM C 231 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 03412

PRECAST PRESTRESSED CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 305R	(1991) Hot Weather Concreting
ACI 309R	(1987) Consolidation of Concrete
ACI 318	(1989; R 1992) Building Code Requirements for Reinforced Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1990; Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	(1990; Rev. A) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 416	(1993) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 615	(1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 33	(1993) Concrete Aggregates
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 150	(1994) Portland Cement
ASTM C 494	(1992) Chemical Admixtures for Concrete

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.4	(1992) Structural Welding Code Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116	(1985) Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120	(1992) Design Handbook - Precast and

1.2 DESCRIPTION OF WORK

The work includes the provision of precast, prestressed concrete herein referred to as prestressed members. Prestressed members shall be the product of a manufacturer specializing in the production of precast prestressed concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" where it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Officer-in-Charge.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-04, Drawings

a. Drawings for precast prestressed concrete members

1.3.1.1 Content of Drawings

Submit drawings indicating complete information for the fabrication, handling, and erection of the prestressed member. Drawings shall not be reproductions of contract drawings. Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer registered in Hawaii, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

a. Marking of members for erection;

b. Connections for work of other trades;

c. Connections between members, and connections between members and other construction;

d. Location and size of openings which cut prestressing strands, or require the relocation of prestressing strands to be cast in the member;

e. Headers for openings;

f. Joints between members, and joints between members and other construction,

g. Reinforcing, including prestressing steel details;

h. Schedule and sequence of tensioning and detensioning prestressing strands;

i. Material properties of steel and concrete used;

j. Lifting and erection inserts;

k. Dimensions and surface finishes of each member;

l. Estimated camber;

m. Erection sequence and handling requirements;

n. All loads used in design (such as live, dead, handling, and erection);

o. Bracing/shoring required; and

p. Areas to receive toppings, topping thickness.

1.3.2 SD-05, Design Data

a. Precast prestressed concrete design calculations

b. Concrete mix design

1.3.2.1 Design Calculations

Submit calculations reflecting design in accordance with the paragraph entitled "Precast Prestressed Concrete Member Design." Design calculations and drawings of prestressed members (including connections) shall be prepared and sealed by a registered professional engineer registered in Hawaii, and submitted for approval prior to fabrication. Submit calculations for volume change as part of the design calculations.

1.3.2.2 Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

1.3.3 SD-08, Statements

a. Quality control procedures

1.3.3.1 Procedures

Submit quality control procedures established in accordance with PCI MNL-116 by the prestressing manufacturer.

1.3.4 SD-11, Factory Test Reports

a. Concrete mix test reports

1.3.4.1 Requirements

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain approval before concrete placement.

1.3.5 SD-18, Records

a. Concrete batch ticket information

1.3.5.1 Batch Test

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

1.4 QUALITY ASSURANCE

1.4.1 Precast Prestressed Concrete Member Design

ACI 318 and the PCI MNL-120. Design prestressed members (including connections) for the design load conditions and spans indicated, and for additional loads imposed by openings and supports of the work of other trades. Design prestressed members for handling without cracking in accordance with the PCI MNL-120. Concrete toppings shall be used in establishing the design strength of the prestressed members.

1.4.2 Fabrication, Sampling and Testing

PCI MNL-116, at the prestressor's option, in lieu of core samples, ACI 318 full scale load tests may be performed. Perform on randomly selected members, as directed by the Engineer.

1.5 DELIVERY, STORAGE, AND HANDLING

Lift and support prestressed members at the lifting and supporting points indicated on the detail drawings. Store prestressed members off the ground. Separate stacked prestressed members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

PART 2 PRODUCTS

2.1 CONCRETE

ACI 318, for contractor furnished mix design. The minimum compressive strength of concrete at 28 days shall be 6,000 psi, unless otherwise indicated.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type I, II.

2.2.2 Water

Water shall be fresh, clean, and potable.

2.2.3 Aggregates

2.2.3.1 Grading and Composition

ASTM C 33, Size 7, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement.

2.2.4 Nonshrink Grout

ASTM C 1107.

2.2.5 Admixtures

2.2.5.1 Accelerating

ASTM C 494, Type C or E.

2.2.5.2 Water Reducing

ASTM C 494, Types A, E, or F.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

ASTM A 615, Grade 60.

2.2.6.2 Welded Wire Fabric

ASTM A 185 or ASTM A 497.

2.2.6.3 Spiral Wire

ASTM A 82.

2.2.6.4 Prestressing Strands

a. Seven Wire Stressed Relieved: ASTM A 416 or ASTM A 416 with supplement for low relaxation wire.

2.2.7 Bearing Pads

2.2.7.1 Elastomeric

AASHTO HB14, for plain neoprene bearings.

2.2.8 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

2.3 FABRICATION

PCI MNL-116, unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318 for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between prestressed and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Placing

ACI 309R, unless otherwise specified.

2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 50 and 190 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Prestressing

Do not transfer prestressing forces during detensioning until the concrete has reached a minimum compressive strength of 4,000 psi, unless a higher strength is required by the Contractor furnished design.

2.3.5 Surface Finish

Repairs to honeycombed sections located in a bearing area shall be approved by the Engineer prior to repairs. Prestressed members which contain honeycombed sections deep enough to expose prestressing strands shall be rejected. Prestressed members containing hairline cracks which are visible and are less than 0.02 inches in width, may be accepted. However, prestressed members which contain cracks greater than 0.02 inches in width shall be approved by the Officer-in-Charge. When approved, the member shall be repaired. Any prestressed member that is structurally impaired shall be rejected.

2.3.5.1 Unformed Surfaces

Provide a floated finish.

2.3.5.2 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

a. Unexposed Surfaces: Provide a commercial surface finish.

b. Exposed Surfaces: Provide a finish Grade B surface finish. In addition to a Grade B surface finish, members shall have a smooth rubbed finish.

PART 3 EXECUTION

3.1 SURFACE REPAIR

Prior to erection, and again after installation, check prestressed members for damage, such as cracking, spalling, and honeycombing. As directed by the Officer-in-Charge, prestressed members that do not meet the surface finish requirements specified in Part 2 in paragraph titled, "Surface Finish" shall be repaired, or removed and replaced with new prestressed members.

3.2 ERECTION

Erect prestressed members after the concrete has attained the specified compressive strength, unless otherwise approved by the prestressing manufacturer. In addition, prestressed members shall not be rigidly fixed in position until the prestressed member has "aged" 90 days after detensioning. Erect in accordance with the approved detail drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Provide a 1:500 tolerance, if no tolerance is specified. Brace prestressed members, unless design calculations submitted with the detail drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place prestressed members level, plumb, and square within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the prestressed member and adjacent prestressed members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place prestressed members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

3.4 WELDING

AWS D1.4 for welding connections and reinforcing splices. Do not weld prestressing strands. Protect the concrete and prestressing strands from heat during welding.

3.5 OPENINGS

Holes or cuts requiring prestressing steel to be cut, which are not indicated on the approved detail drawing, shall only be made with the approval of the Engineer and the prestressing manufacturer. Drill holes less than 12 inches in diameter with a diamond tipped core drill.

3.6 GROUTING

Clean and fill indicated keyways between prestressed members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

3.7 SEALANTS

Provide as indicated and as specified in Section 07920, "Sealants."

3.8 CONCRETE TOPPING

Provide as indicated and as specified in Section 03300, "Cast-in-Place Concrete."

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 04230

REINFORCED MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 318	(1989; R 1992) Building Code Requirements for Reinforced Concrete
ACI 530.1	(1992) Masonry Structures (ASCE 6-92)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82	(1990; Rev. A) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 497	(1990; Rev. B) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615	(1993) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 90	(1993) Load-Bearing Concrete Masonry Units
ASTM C 270	(1994) Mortar for Unit Masonry
ASTM C 476	(1991) Grout for Masonry
ASTM C 1019	(1989; Rev. A, R 1993) Sampling and Testing Grout
ASTM D 1056	(1991) Flexible Cellular Materials - Sponge or Expanded Rubber

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	(1991) Uniform Building Code

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-13, Certificates

a. Concrete masonry units

b. Grout

c. Mortar

1.3 QUALITY ASSURANCE

1.3.1 Inspection

Inspection is not required for non-structural masonry.

1.4 DELIVERY, STORAGE, AND HANDLING

a. Handle masonry units to avoid chipping and breaking. Deliver cement and lime in unbroken bags, barrels, or other sealed containers. Plainly mark and label containers with manufacturer's name and brand.

b. Protect masonry units from contact with the soil. Protect moisture-controlled units from rain or ground water. Keep anchors, ties, and reinforcement free of loose rust and scale. Keep cementitious materials dry. Store and handle cement to prevent inclusion of foreign materials. Store aggregates in a manner to avoid contamination or segregation.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

2.1.1 Hollow Load and Non-Load Bearing Units

ASTM C 90, Type II normal weight. Nominal size 8 inches.

2.2 MORTAR

2.2.1 Mortar Properties

ASTM C 270, Type S. Test in accordance with ASTM C 780. Use Type I portland cement.

2.2.2 Admixtures

Do not use admixtures containing chlorides.

2.2.2.1 Air Entrainment

When structural reinforcement is incorporated, maximum air-content 12 percent in cement-lime mortar and 18 percent in masonry cement mortar.

2.3 WATER

Water for mixing shall be potable.

2.4 GROUT

ASTM C 476, fine. Slump between 8 and 11 inches. Provide minimum grout strength 2000 psi in 28 days, as tested by ASTM C 1019.

2.5 HORIZONTAL JOINT REINFORCEMENT

	Long Wire	Cross Wire
Standard	9 gage (0.1483 inch)	9 gage

Fabricate from cold drawn steel wire, ASTM A 82. Hot-dip galvanize after fabrication, ASTM A 153, B-2. Provide ACI 530.1 truss type reinforcement with two or more longitudinal wires welded to continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c.

2.6 REINFORCING BARS

Deformed bars, ASTM A 615.

PART 3 EXECUTION

3.1 ERECTION OF MASONRY UNITS

3.1.1 Mortar

Mix all cementitious materials and aggregates between 3 and 5 minutes in mechanical batch mixer with sufficient amount of water to produce workable consistency. Do not retemper after 2-1/2 hours.

3.1.2 Bond

Construct masonry in running bond pattern.

3.1.3 Hollow Units

ACI 530.1.

3.1.4 All Units

a. Place clean units while mortar is soft and plastic. Any unit disturbed to the extent that initial bond is broken shall be removed and relaid in fresh mortar.

b. Cut exposed edges or faces of masonry units smooth or position so that all exposed faces or edges are unaltered manufactured surfaces.

c. At end of each day, cover new work. Step back masonry; do not tooth.

3.1.5 Embedded Items and Accessories

a. Construct chases as masonry units are laid.

b. Coordinate installation of pipes and conduits passing through walls, piers, or beams as indicated. Use steel sleeves where indicated.

c. Install and secure anchors, flashing, weep holes, nailing blocks.

3.1.6 Bed and Head Joints

Joints shall be 3/8 inch thick, except that bed joint of starting course placed over foundations may be 1/4 inch to 3/4 inch thick.

3.1.7 Finishing Joints

a. In exposed and below grade masonry, fill holes created by line pins with mortar.

b. Tool joints with round or vee jointer when mortar is thumbprint hard. After joints are tooled, trim off mortar burrs with trowel.

3.2 REINFORCEMENT

3.2.1 Preparation

At time mortar or grout is placed, all reinforcement shall be free of mud, oil or other materials that might reduce bond.

3.2.2 Placing Tolerances

a. Place steel in walls and flexural elements within 1/2 inch when the distance (d) from centerline of steel to opposite face of masonry is equal to 8 inches or less, within 1 inch for d between 8 and 24 inches.

b. Place vertical bars in wall within 2 inches of indicated location along length of wall.

c. Bars may be moved as necessary to avoid interference with other reinforcing, conduits, or embedded items. If bars are moved more than specified tolerance, notify Officer-in-Charge for approval for resulting arrangement.

3.2.3 Securing Reinforcement

Support and fasten reinforcement to prevent displacement by construction loads or placement of grout or mortar. Lap or hook corner bars.

3.2.4 Details of Reinforcement

a. Clear distance between reinforcing bars and any face of masonry unit or formed surface, shall be as indicated but not less than 1/2 inch.

b. Get approval from the Engineer for all splices not indicated.

c. Do not bend embedded reinforcement.

d. Place joint reinforcement so that longitudinal wires are embedded in mortar with minimum cover of 1/2 inch when not exposed to weather or earth and 5/8 inch when exposed.

3.3 GROUTING

3.3.1 Preparation

Ensure that spaces to be grouted are free of mortar droppings, debris, loose aggregates and any material deleterious to masonry grout. Reinforcement and ties shall be in place before grouting.

3.3.2 Cleanouts

a. When grout pour exceeds 5 feet in height, provide cleanouts in bottom course of masonry in each grout pour.

b. Provide 3 inch minimum cleanout openings.

c. After cleaning, close cleanout openings and brace to resist grout pressure.

3.3.3 Placing Time

Place grout within 1-1/2 hours of introducing water to mixture.

3.3.4 Pour Height

ACI 530.1.

3.3.5 Lift Height

Place grout in lifts not exceeding 5 feet. For 8 inch block wall, maximum lift is 2 feet.

3.3.6 Consolidation

Consolidate grout at time of placement.

a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by pudding.

b. Consolidate pours exceeding 12 inches in height by mechanical vibration. Reconsolidate by mechanical vibration after initial water loss and settlement have occurred.

3.4 FIELD QUALITY CONTROL

3.4.1 Mortar Strength and Properties

ASTM C 780, for the first 3 consecutive days, and each third day thereafter.

3.4.2 Grout Strength

ASTM C 1019, for the first 3 consecutive days, and each third day thereafter, or each batch of ready mixed grout.

3.5 CLEANING

a. Keep exposed surfaces clean during construction. Avoid smearing mortar on face of units.

b. Clean masonry with potable water. *Detergents may be used.*

c. Do not use acid, caustic solutions, or sandblasting.

d. Masonry shall be free of stains, efflorescence, mortar or grout droppings, and debris.

PART 4 MEASUREMENT AND PAYMENT

Measurement for payment of concrete masonry units shall be by the square foot, linear foot, or lump sum as provided for an indicated in the proposal. Payment made at the bid price shall be full compensation for furnishing all labor, materials, tools, and equipment and performing all work involved in constructing such concrete masonry in place complete as shown on the plans.

-- End of Section --

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M016	(1989) ASD Manual of Steel Construction
AISC S303	(1992) Steel Buildings and Bridges
AISC S329	(1985) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts
AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1993; Rev. A) Structural Steel
ASTM A 53	(1993; Rev. A) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	(1993) Structural Bolts, Steel, heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	(1993) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1993) Carbon and Alloy Steel Nuts
ASTM C 1107	(1991; Rev. A) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F 436	(1993) Hardened Steel Washers

ASTM F 593	(1991) Stainless Steel Bolts, Hex, Cap Screws, and Nuts
ASTM F 594	(1991) Stainless Steel Nuts
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 3	(1989) Power Tool Cleaning
SSPC SP 6	(1991) Commercial Blast Cleaning
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer Without Lead and Chromate Pigments
SSPC PA 1	(1991) Shop, Field, and Maintenance Painting

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC M016 except as modified in this section.

1.3 MODIFICATIONS TO REFERENCES

In AISC M016, AISC S335, AISC S303, and AISC S329, except as modified in this section, shall be considered a part of AISC M016 and is referred to in this section as AISC M016.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Shop primer

1.4.2 SD-04, Drawings

a. Fabrication drawings

1.4.2.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Drawings shall not be reproductions of contract drawings. Include complete

information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols.

1.4.3 SD-08, Statements

a. Erection plan

b. Welding procedures and qualifications

1.4.3.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

1.4.3.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

1.4.4 SD-13, Certificates

a. Steel

b. Bolts, nuts, and washers

c. Shop primer

d. Welding electrodes and rods

e. Nonshrink grout

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A 36.

2.1.2 Stainless Steel

ASTM A 276, Type 304.

2.1.3 Structural Steel Tubing

ASTM A 500, Grade B.

2.1.4 Steel Pipe

ASTM A 53, Type E or S, Grade B, weight class as indicated.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel

2.2.1.1 Bolts

ASTM A 307, Grade A; ASTM A 325M, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A 563, Grade A, heavy hex style, except nuts under 1.5 inches may be provided in hex style.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436 washers for ASTM A 325.

2.2.2 Stainless Steel

2.2.2.1 Bolts

ASTM F 593, Group 2, 316 alloy.

2.2.2.2 Nuts

ASTM F 594, Group 2, 316 alloy.

2.2.2.3 Washers

ASTM F 436, stainless steel.

2.2.3 Foundation Anchorage

2.2.3.1 Bolts

ASTM A 307.

2.2.3.2 Washers

ASTM F 844.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1.

2.3.2 Nonshrink Grout

ASTM C 1107, with no ASTM C 827 shrinkage. Grout shall be non-metallic.

2.4 SHOP PRIMER

SSPC Paint 25, epoxy-polyamide, green primer type 1, except provide a Class B coating in accordance with AISC M016 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, reclean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A 123 or ASTM A 153, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded or on surfaces of weathering steels that will be exposed in the completed structure. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Engineer.

2.6.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

PART 3 EXECUTION

3.1 ERECTION

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC S335. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Engineer for further instructions.

3.2.2 High-Strength Bolts

ASTM A 325 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3 WELDING

AWS D1.1. Grind exposed welds smooth as indicated. Provide AWS D1.1 qualified welders, welding operators, and tackers.

3.3.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.4 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.6 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Engineer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.6.1 Welds

3.6.1.1 Visual Inspection

AWS D1.1. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.6.2 High-Strength Bolts

3.6.2.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC S329, Table 4, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.6.2.2 Inspection

Inspection procedures shall be in accordance with AISC S329, Section 9. Confirm and report to the Officer-in-Charge that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

3.6.2.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an

ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

PART 4 MEASUREMENT AND PAYMENT

Measurement for payment of structural steel shall be by the pounds, tons or lump sum as provided for an indicated in the proposal. Payment made at the bid price shall be full compensation for furnishing all labor, materials, tools and equipment and performing all work involved in the fabrication and constructing such steel structure in place complete as shown on the plans.

-- End of Section --

SECTION 05310

STEEL DECKS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-673	(1989; Errata 1990) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 611	(1992) Steel, Sheet, Carbon, Cold-Rolled, Structural Quality
ASTM A 792	(1993; Rev. A) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel
AWS D1.3	(1989) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDEI)

SDEI DMCDFDRD	(1992; Number 28) Design Manual for Composite Decks, Form Decks and Roof Decks
SDEI MCSD	(1992) Manual of Construction with Steel Deck

UNDERWRITERS LABORATORIES INC. (UL)

UL BMD	(1993) Building Materials Directory
UL 580	(1988; R 1989) Uplift Resistance of Roof Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-04, Drawings

a. Layout

1.2.1.1 Layout Drawings

Show location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, and other pertinent details.

1.2.2 SD-05, Design Data

a. Deck units

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

1.2.3 SD-08, Statements

a. Qualification of welders

1.2.4 SD-13, Certificates

a. Wind storm resistance

1.3 QUALITY ASSURANCE

1.3.1 Steel Deck

Deck and accessories shall be products of a manufacturer regularly engaged in manufacture of steel decking.

1.3.2 Qualification of Welders

Provide welder qualification procedures, welder qualifications, and duration of qualification period in accordance with AWS D1.1 and AWS D1.3.

1.3.3 Regulatory Requirements

1.3.3.1 Wind Storm Resistance

The roof construction assembly shall be capable of withstanding an uplift pressure of 90 pounds per square foot when tested in accordance with the uplift pressure test described in the FM D/S1-28 or as described in UL 580.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store and handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load shall not

exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Replace damaged material.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than 0.034 inch before coating, meeting the requirements of AISI SG-673, except as modified herein.

2.1.2 Steel Coating

ASTM A 792 designation AZ165, AZ55, aluminum-zinc alloy. Apply coating to both sides of sheet.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates of same thickness and configuration as decking. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.028 inch thick to close open ends at exposed edges of roof, and openings through deck.

2.3 FABRICATION

2.3.1 Deck Units

SDEI DMCDFDRD. Form non-cellular decking and accessories from ASTM A 792 coated steel sheets, Grade 33. Factory apply a standard, phosphatized and painted, baked-on enamel finish to underside of steel decking. Provide deck units having the depth and the minimum structural properties indicated.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the Engineer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Lap roof deck a minimum of 2 inches. Do not use unanchored deck units as a work or storage platform. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding or methods recommended by the Steel Deck Institute, subject to the Contracting Officer's approval. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3 using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.1 and AWS D1.3 make welds. Location, size, and spacing of fastening shall be as indicated. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of painted finish with the manufacturer's standard touch-up paint. Immediately recertify, or replace with qualified welders, welders that have passed qualification tests but are producing unsatisfactory welding.

3.2.2 Openings

Reinforce deck or frame openings through deck as necessary for rigidity and load carrying capacity. Cut or drill holes or other openings required for work of other trades. Deck manufacturer shall approve holes or openings larger than 6 inches in diameter prior to drilling or cutting.

3.2.3 Deck Damage

SDEI MCSD, for repair of deck damage.

3.2.4 Accessory Installation

3.2.4.1 Adjusting Plates

Install as shown on shop drawings.

3.2.4.2 End Closures

Provide end closure to close openings in deck.

3.2.4.3 Access Hole Covers

Provide to seal holes cut in decking to facilitate welding of decking to structural supports.

3.3 FIELD QUALITY CONTROL

3.3.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 1/16 inch; when gap is more than 1/16 inch, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

PART 4 MEASUREMENT AND PAYMENT

Measurement and payment of steel decks shall be by the square feet, or lump sum as provided and indicated in the proposal. Payment made at the bid price shall be full compensation for furnishing all labor, materials, tools, equipment and performing all work involved in constructing such steel decks in place complete as shown on the plans.

-- End of Section --

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 REFERENCE

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	(1981) Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws
ANSI B18.5.2.1M	(1981) Round Head Short Square Neck Bolts
ANSI B18.5.2.2M	(1982) Round Head Square Neck Bolts (ANSI/ASME B18.5.2.2M)
ANSI B18.6.1	(1981) Wood Screws (Inch Series)

AMERICAN PLYWOOD ASSOCIATION (APA)

APA	Plywood Specification and Grade Guide, Latest Edition

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.2	(1987) Square and Hex Nuts (Inch Series) (ASME/ANSI B18.2.2)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 687	(1989) High-Strength Nonheaded Steel Bolts and Studs

AMERICAN WOOD-PRESERVERS ASSOCIATION (AWPA)

AWPA C1	(1990) All Timber Products - Pressure Treatment (General Requirements)
AWPA C2	(1990) Lumber, Timbers, Bridge Ties and Mine Ties, Pressure Treatment
AWPA M2	(1990) Inspection of Treated Timber Products
AWPA M6	(1988) Brands Used on Forest Products

FEDERAL SPECIFICATIONS (FS)

FS FF-N-105	(Rev. B) (Valid Notice 1) Nails, Brads, Staples and Spikes: Wire, Cut and Wrought
FS FF-S-325	(Int Am. 3) Shield, Expansion; Nail Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

INTERNATIONAL CONFERENCE OF BUILDING MATERIALS (ICBO)

ICBO UBC	Uniform Building Code (UBC), Latest Edition

NATIONAL FOREST PRODUCTS ASSOCIATION (NFP)

NFP NDS	(1986; Supp. 1988) National Design Specification for Wood Construction and Supplement 1986 Design Values for Wood Construction
NFP WCD1	(1988) Manual for Wood Frame Construction Data No. 1

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS-20	(1970) American Softwood Lumber Standard

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 16	(1988) Standard Grading and Dressing Rules for Douglas Fir, Western Hemlock, Western Red Cedar, White Fir, Sitka Spruce Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA GRWL	(1988) Western Lumber Grading Rules

1.2 SUBMITTALS

1.2.1 Certificates of Grade

Submit certificates attesting that products meet the grade requirements specified in lieu of grade markings where appearance is important and grade marks will deface material.

1.2.2 Factory Test Report

Preservative-Treated Lumber.

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Remove defective and damaged materials and provide new materials.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

1.4.2 Preservative-Treated Lumber

The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide the Architect with the inspection report of an independent inspection agency, approved by the Architect, that offered products comply with applicable AWPA Standards. The AWPA C2 Quality Mark "C-2" on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.5 SIZES AND SURFACING

PS-20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

a. Structural Lumber, Framing Lumber and Boards - 19 percent maximum.

1.7 PRESERVATIVE TREATMENT

Treat lumber in accordance with AWPA C1 and AWPA C2. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the Quality Mark on each piece. Do not incise surfaces of lumber that will be exposed. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. All lumber shall be preservative treated.

PART 2 PRODUCTS

2.1 LUMBER

2.1.1 Structural Lumber

Structural lumber shall be Douglas Fir-Larch, Dense No. 2 or better, that have allowable unit stresses in pounds per square inch (psi) not less than 1450 Fb, 775 Ft, 1250 Fc, with 1,700,000 E. Use for joists, rafters, posts, and all other members indicated to be stress rated.

2.1.2 Framing Lumber

Framing lumber such as blocking, bracing, nailers. Minimum grade of species shall be as listed.

Table of Grades for Framing and Board Lumber

Grading Rules	Species	Framing Board	Lumber
WWPA GRWL standard grading rules	Douglas Fir-Larch Hem-Fir Mountain Hemlock -Hem-Fir Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2 x 4 size, 10 feet and shorter)	All Species: No. 3
WCLIB 16 standard grading rules	Douglas Fir-Larch Hem-Fir Mountain Hemlock Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2 x 4 size, 10 feet and shorter)	All Species: Standard

2.2 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. All rough hardware shall be zinc-coated.

2.2.1 Bolts and Nuts

ANSI B18.2.1, ANSI B18.5.2.1M, ANSI B18.5.2.2M, ASME B18.2.2, and ASTM A 687.

2.2.2 Expansion Shields

FS FF-S-325. Except as shown otherwise, maximum size of devices in Groups IV, V, VI, and VII shall be 3/8 inch.

2.2.3 Lag Screws and Lag Bolts

ANSI B18.2.1.

2.2.4 Wood Screws

ANSI B18.6.1.

2.2.5 Wire Nails

FS FF-N-105.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to NFP WCD1 unless otherwise indicated or specified. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICBO UBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight.

3.2 MISCELLANEOUS

3.2.1 Wood Blocking and Bracing

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.2 Wood Roof Nailers

Provide sizes and configurations indicated or specified and anchored securely to continuous construction. Provide at perimeter of roof and embedded in concrete, as shown.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.1 DESCRIPTION

a. Provide all finish carpentry work, complete, including, but not limited to, the following items:

(1) Adjustable shelving

(2) Millwork including all trim throughout

1.2 QUALITY ASSURANCE

1.2.1 Grading Marks

Factory mark each piece of lumber and plywood with type, grade, mill, and grading agency identification. Certificate of inspection and grading by a recognized agency may be submitted with each shipment in lieu of factory marking, at Contractor's option.

1.2.2 Wood Treatment

In accordance with Section 06311, "Preservative Treated Lumber."

1.3 SUBMITTALS

1.3.1 Shop Drawings

Submit shop drawings to the Officer-in-Charge showing location of each item, dimensioned plans and elevations, large scale details, attachment devices and other components. Submit shop drawings for the following:

a. Adjustable shelving

1.3.2 Product Data

Submit product data for shelving hardware for approval by the Officer-in-Charge to ordering.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

a. Protect finish carpentry materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

b. Do not deliver finish carpentry materials, until wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, finish carpentry material must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

PART 2 PRODUCTS

2.1 WOOD PRODUCT QUALITY STANDARDS

2.1.1 Softwood Lumber Standards

Comply with PS 20 and with applicable grading rules of the respective grading and inspection agency for the species and product indicated.

2.1.2 Plywood Standards

Comply with PS 1 for softwood plywood; PS 51 for hardwood plywood.

2.1.3 Architectural Woodwork Quality Standards

Comply with AWI Guide Specifications and Quality Certification Program. Display case shall be premium grade. All other opaque finished items shall be minimum custom grade.

2.2 MATERIALS

2.2.1 General

a. Nominal sizes are indicated, except as shown be detailed dimensions. Provide dressed or worked and dressed lumber, as applicable, manufactured to the actual sizes as required by PS 20 or to actual sizes and pattern as shown, unless otherwise indicated. All Douglas Fir shall be Coastal Variety.

b. Moisture Content of Softwood Lumber: Provide kiln-dried lumber having a moisture content from time of manufacture until time of installation not greater than values required by the applicable grading rules of the respective grading and inspecting agency for the species and product indicated.

2.2.2 Finish Carpentry

2.2.2.1 Solid Wood Trim

Douglas Fir, S4S, "C and Better" Grade, vertical grain; for paint finish.

2.2.2.2 Softwood Plywood for Paint Finish

Douglas Fir veneer plywood, Grade A-B. Use only one veneer species throughout project.

2.2.2.3 Hardware

255AL Standard, 256ALNAT shelf supports.

2.3 WOOD TREATMENT

2.3.1 Preservative Treatment

Following basic fabrication provide preservative treatment of finish carpentry items in accordance with Section 06311, "Preservative Treated Lumber."

2.4 FABRICATION

Millwork shall be fabricated at the shop in accordance with detailed drawings. All units when erected in place shall be straight, square, plumb, level and free from damage and tool marks; all units shall be shop finished. All joints shall be made up with waterproof glue. Nails and screws shall be placed in concealed surfaces to the maximum extent possible.

2.5 ADJUSTABLE SHELVING

2.5.1 Adjustable Shelving Fabrication

Fabricate as indicated conforming to approved shop drawings. Joints shall be tightly fitted, glued and doweled. Prefinish cabinet with clear finish as specified in Section 09900, "Painting."

2.5.2 Materials

2.5.2.1 Plywood for Exposed Exposure

Conforming to PS-1, Douglas Fir, A-C face veneers, Type II glue.

2.5.2.2 Concealed Framing Members and Nailers

Douglas Fir, KD, S4S.

2.5.2.3 Fabricating Glue

MMM-A-193C, Type II, clear water resistant.

2.5.2.4 Shelving Hardware

Standards and shelf supports aluminum as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

a. Install the work plumb, level, true and straight with no distortions.

b. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

c. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum lengths of lumber available) to the greatest extent possible. Sand smooth.

d. Anchor finish carpentry work to anchorage devices or blocking built-in or directly attached to substrates. Use fine finishing nail for exposed nailings, countersunk and filled flush with finished surface.

e. Wood Treatment: Apply brush coat on surfaces cut after treatment.

3.2 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

Repair damaged and defective carpentry work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace carpentry work. Adjust joinery for uniform appearance.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 06311

PRESERVATIVE TREATED LUMBER

PART 1 GENERAL

1.1 SUBMITTALS

a. A Certificate of Treatment shall be issued to the Engineer showing compliance with these specifications, both as to kiln drying and type of treatment performed, including dip treatment.

b. The Contractor shall submit a written certification to the Engineer that all wood used and left in place on this job was treated in accordance with these specifications and that all cuts and penetrations made subsequent to the treatment were coated with preservatives in compliance with Sub-section 3.04.

1.2 GUARANTY

a. The Contractor shall submit to the Engineer a written guaranty that he will replace all treated wood which is attacked by subterranean termites within a period of two years from the date of project acceptance up to a total cost of $5,000.00 as verified through a cost breakdown in accordance with Section 8.4(b), "Force Account Work" of the General Conditions or is attacked by dry wood termites or deteriorates due to dry rot within the first five years of the project acceptance date. The Surety shall not be held liable beyond two years of the project acceptance date.

PART 2 PRODUCTS

2.1 GENERAL

a. All wood treated with oil-borne preservatives shall be kiln-dried before treatment to an average moisture content of 12% to 15% per AWPA standards.

b. All wood treated with water-borne preservatives (with the exception of Hi-Bor (SBX) treated wood) shall be air dried or kiln-dried before treatment to an average moisture content of 20% or less per AWPA standards. Wood having a moisture content higher than 28% is acceptable when treating with Hi-Bor (SBX).

c. All wood shall be treated as noted below except all-heart redwood.

d. Lumber shall be milled to finish size and shape prior to treating, and it shall be treated before assembly. Plywood may be treated in regular panel sizes.

2.2 MATERIALS

2.2.1 Asbestos Prohibition

No asbestos containing materials or equipment shall be used under this section. The Contractor shall ensure that all materials and equipment incorporated in the project are asbestos-free.

2.2.2 Water-Borne Preservatives

a. Water-Borne preservatives shall be Wolman CCA, Osmose CCA, Supatimber CCA, Chemonite ACZA or Hi-Bor SBX in accordance with American Wood Preservers Association (AWPA) Standard P5 - Standards for Waterborne Preservatives. Preservatives shall be EPA registered.

b. Water-Borne preservatives used to coat end outs and penetrations in HI-BOR (SBX) treated wood shall be Clear-Bor F.T. or an equivalent solution of 10% inorganic boron. The end coating solution must be approved and labeled by the Environmental Protection Agency and must be accepted by the State of Hawaii, Department of Agricultural Pesticide Division for this purpose. The treatment solution shall have a colorant added which will tint the wood surface to indicate treatment.

2.2.3 Oil-Borne Preservatives

Oil-Borne preservatives shall be TRIB II (0.50% by weight chlorpyrifos, 0.75% by weight 3-iodo-2-propynyl butyl carbamate (IPBC), Pema-Clear 65 (Zinc Naphthenate and Permethrin) or DAP Inc. "Premium Woodlife" (for dip treatment only), manufactured to the manufacturer's quality control and EPA registered. The solvent used in formulating the preservative solution shall meet the requirements of AWPA hydrocarbon solvent Type C, Standard P9, Paragraph 3.1.

PART 3 EXECUTION

3.1 WOOD PRESERVATION WITH WATER-BORNE PRESERVATIVES

a. Unless otherwise stipulated, all lumber and plywood shall be pressure treated.

b. Lumber and plywood, except as stipulated in Paragraphs 3.02 and 3.03 below, shall be treated with Wolman CCA, Osmose CCA or Supatimber BBA in accordance with American Wood Preservers Bureau Standards AWPB approved (Hawaii Use only) or with Chemonite ACZA in accordance with American Wood Preservers Bureau Standards AWPB LP-2 or Hi-Bor (SBX), using the full cell pressure method in conformance with AWPA Standard C1-93. Lumber and plywood treated with Hi-Bor (SBX) shall attain the following penetration and retention requirements:

1. Lumber:

a. Penetration requirement for lumber under 5 inch nominal thickness: 0.40 inch in heartwood and 100% in sapwood.

b. Penetration requirement for lumber 5 inch nominal thickness and over: 0.50 inch in heartwood and 100% in sapwood.

c. Retention requirement for lumber shall be a minimum of 1.25% (by weight) or 0.35 pounds per cu. ft. in an assay zone of 0.0 - 0.6 inches.

2. Plywood:

a. Penetration requirement for plywood shall be identical to that noted in AWPA C9-90.

b. Retention requirement for plywood shall be a minimum of 1.25% (by weight) or 0.35 pounds per cu. ft. through the full thickness.

c. All 1" and 2" lumber and all plywood shall be dried to a moisture content of 19% or less after treatment.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 07220

TAPERED INSULATION

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Contour Taper Tile Roof Insulation System made from Expanded Polystyrene (EPS) for use with membrane roofing.

1.2 SUBMITTALS

1.2.1 Shop Drawings

Submit shop drawings for tapered system.

1.2.2 Product Data

Provide characteristics on material.

1.2.3 Samples

Submit two (2) samples 12 x 12 inches.

1.2.4 Manufacturer's Installation Instructions

Submit two (2) copies.

1.2.5 Manufacturer's Certificate

Certify that products meets or exceeds specified requirements.

1.2.6 Manufacturer's Material Safety Data Sheets

Submit two (2) copies.

1.3 STORAGE AND HANDLING

Store and protect products from damage in weather protected environment, clear of ground and moisture.

1.4 WARRANTY

Provide twenty (20) year RValue warranty.

PART 2 PRODUCTS

2.1 TAPERED INSULATION AND ASSOCIATED MATERIAL

a. Contour Taper Tile will be as manufactured by Pacific Allied Product, Ltd. or approved equal.

b. Contour Taper Tile will be Expanded Polystyrene (EPS) factory-tapered insulation with a surface slope of 1/4-inch.

Minimum thickness will be 1/4-inch. The minimum density will be 1.50 pounds per cubic foot. All insulation pieces will be marked to correspond with placement on the roof as shown on the approved shop drawings.

c. Coverboard will be a minimum 1/2-inch wood fiberboard insulation meeting ASTM C 208 (Superceding FS LLL-1-535A Class C or E). Roof tape for joint covering will be fibrous glass.

d. Adhesive will be INSTA-STIK Professional Roofing Adhesive or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

a. Verify that surfaces and site conditions are ready to receive work.

b. Verify deck surfaces are dry.

c. Verify roof openings and vents through roof are solidly set.

3.2 PREPARATION

Insulation must be applied to a sound, clean, and moisture free deck surface.

3.3 INSTALLATION

a. Install the Contour Taper Tile System per manufacturer's current CSI Ten Point Spec-Data Installation instructions and other printed instructions provided on the approved shop drawings.

b. When using adhesive the Contractor shall apply adhesive in conformance with the manufacturer's application rate table.

3.4 FIELD QUALITY CONTROL

Place Contour Taper Tile insulation blocks on the roof where shown by the approved shop drawings. Protect insulation from wind blow-off during all phases of construction. Temporary ballast and end-of-work-day water cut-offs must be used. Apply finish roofing membrane over coverboard as soon as practical.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 07500

MEMBRANE ROOFING

PART 1 GENERAL

1.1 DESCRIPTION

a. The project consists of installing Carlisle's Brite-Ply (white-on-black) or approved equal. Fully Adhered Roofing System concrete deck. Apply the Fully Adhered EPDM Roofing System over the new roof deck.

b. Apply the Fully Adhered EPDM Roofing System over H.P. recovery board the existing roofing with H.P. fastener or screw type fastener built-up.

c. Apply the Fully Adhered EPDM Roofing System in conjunction with Insulation Type over new metal deck.

1.2 EXTENT OF WORK

a. Provide all labor, material, tools, equipment, and supervision necessary to complete the installation of a .060 inch thick non-reinforced EPDM membrane Fully Adhered Roofing System including flashings and insulation as specified herein and as indicated on the drawings in accordance with the manufacturer's most current specifications and details.

b. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.

c. The roofing contractor shall confirm all given information and advise the building owner, prior to bid, of any conflicts that will affect their cost proposal.

1.3 SUBMITTALS

a. Prior to starting work, the roofing contractor must submit the following:

1. Shop drawings showing layout, details of construction and identification of materials.

2. Sample of the manufacturer's membrane System Warranty.

3. Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system and lists foremen who have received training from the manufacturer along with the dates training was received.

4. Certification of the manufacturer's warranty reserve.

b. Upon completion of the installed work, submit copies of the manufacturer's final inspection to the specifier prior to the issuance of the manufacturer's warranty.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

a. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.

b. Comply with the manufacturer's written instructions for proper material storage.

1. Store materials, except membrane, between 60°F and 80°F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60°F minimum temperature before using.

2. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.

c. Insulation must be on pallets, off the ground and tightly covered with waterproof materials.

d. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.5 WORK SEQUENCE

a. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.

b. Do not disrupt activities in occupied spaces.

1.6 USE OF THE PREMISES

a. Before beginning work, the roofing contractor must secure approval from the building owner's representative for the following:

1. Areas permitted for personnel parking.

2. Access to the site.

3. Areas permitted for storage of materials and debris.

4. Areas permitted for the location of cranes, hoists and chutes for loading and unloading materials to and from the roof.

1.7 EXISTING CONDITIONS

If discrepancies are discovered between the existing conditions and those noted on the drawings, immediately notify the owner's representative by phone and solicit the manufacturer's approval prior to commencing with the work. Necessary steps shall be taken to make the building watertight until the discrepancies are resolved.

1.8 SAFETY

The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state and federal requirements that are safety related. Safety shall be the responsibility of the roofing contractor. All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers and the occurrence of the general public on or near the site.

1.9 WORKMANSHIP

a. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.

b. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.

c. There shall be a supervisor on the job site at all times while work is in progress.

1.10 QUALITY ASSURANCE

a. The EPDM membrane roofing system must achieve a UL Class A rating.

b. The manufacturer must have a minimum of 20 years experience in the manufacturing of vulcanized thermal set sheeting.

c. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.

d. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide evidence of having at least five (5) years successful experience installing single-ply EPDM roofing systems and having installed at least one (1) roofing application or several similar systems of equal or greater size within one year.

e. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced superintendent on the job at all times roofing work

is in progress.

f. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the specifier's consideration.

g. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.

1.11 JOB CONDITIONS, CAUTIONS AND WARNINGS

Refer to Carlisle's Design "A" Fully Adhered Roofing System specification, Part II - Application, for General Job Site Considerations.

a. Material Safety Data Sheets (MSDS) should be on location at all times during the transportation, storage and application of materials.

b. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.

c. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.

d. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.

e. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.

f. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

g. New roofing shall be complete and weathertight at the end of the work day.

h. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.12 WARRANTY

a. Provide manufacturer's 10 year Membrane System Warranty covering both labor and material with no dollar limitation. The maximum wind speed coverage shall be peak gusts of 55 mph measured at 10 meters above ground level.

b. Pro-rated Membrane System Warranties shall not be accepted.

c. Evidence of the manufacturer's warranty reserve should be requested from the manufacturer and included as part of the project submittals for the specifier's approval.

PART 2 PRODUCTS

2.1 GENERAL

a. All components of the specified roofing system shall be products of Carlisle SynTec Systems or accepted by Carlisle SynTec Systems as compatible.

b. Unless otherwise approved by the specifier and accepted by the membrane manufacturer, all products (including insulation, fasteners, fastening plates and edgings) must be manufactured and supplied by the roofing system manufacturer and covered by the warranty.

2.2 MEMBRANE

Furnish Brite-Ply (white-on-black) .060 inch thick non-reinforced EPDM (Ethylene, Propylene, Diene Terpolymer) in the largest sheet possible. The membrane shall conform to the minimum physical properties of ASTM D 4637. When a 10 foot wide membrane is to be used, the membrane shall be manufactured in a single panel with no factory splices to reduce splice intersections.

2.3 ADHESIVES AND CLEANERS

All products shall be furnished by Carlisle and specifically formulated for the intended purpose.

a. Bonding Adhesive: B-500 Latex-Based

b. Splicing Cement: Brite-Ply Splicing Cement

c. Cleaning Solvent: Brite-Ply Splice Cleaner

d. External Seam Sealant: Brite-Ply Lap Sealant

2.4 FASTENERS AND PLATES

a. HP Fasteners: A threaded, black epoxy electro-deposition coated fastener used with steel, wood, and minimum 3,000 psi structural concrete roof decks. Note: For structural concrete roof decks, the fastener length shall not exceed 6 inches.

b. Termination Bar Nail-In: An expansion anchor with stainless steel drive pin used for fastening the Sure-Seal Termination Bar or Seam Fastening Plates to concrete, brick, or block walls.

c. Seam Fastening Plates: A 2-inch diameter FM approved metal plate used in conjunction with RUSS or with EPDM membrane for membrane securement.

d. The 6-inch wide RUSS shall be utilized horizontally or vertically (in conjunction with Seam Fastening Plates) below the EPDM membrane for additional membrane securement.

2.5 METAL EDGING AND MEMBRANE TERMINATIONS

a. Sure-Seal Termination Bar: A 1-inch wide and .098 inch thick extruded aluminum bar pre-punched 6 inches on center; incorporates a sealant ledge to support Lap Sealant and provide increase stability for membrane terminations.

PART 3 EXECUTION

3.1 GENERAL

a. Comply with the manufacturer's published instructions for the installation of the membrane roofing system including proper substrate preparation, jobsite considerations an weather restrictions.

b. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.2 MEMBRANE PLACEMENT AND BONDING

a. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.

b. Apply the Bonding Adhesive in accordance with the manufacturer's published instructions, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

1. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.

2. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.

c. Install adjoining membrane sheets in the same manner, overlapping edges approximately 4 inches. Do not apply bonding adhesive to the splice area.

3.3 MEMBRANE SPLICING (Adhesive Splice)

a. Fold the top sheet back and clean the dry splice area (minimum 3 inches wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Splice Cleaner.

b. Apply Splicing Cement and In-Seam Sealant in accordance with the manufacturer's specifications and roll the top sheet onto the mating surface.

c. Roll the splice with a 2-inch wide steel roller and wait at least 2 hours before applying Lap Sealant to the splice edge following the manufacturer's requirements.

d. Field splices without In-Seam Sealant must be overlaid with uncured flashing.

3.4 DAILY SEAL

a. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.

3.5 CLEAN UP

a. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.

b. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

-- End of Section --

SECTION 07600

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 SUMMARY

a. This section includes the following:

(1) Metal roofing edge.

b. Roofing accessories which are installed integral with roofing membrane are specified in Section 07500, "Membrane Roofing."

1.2 SUBMITTALS

1.2.1 Product Data, Sheet Metal and Accessories

Manufacturer's technical product data, installation instructions, and general recommendations for each specified sheet material and fabricated product.

1.2.2 Samples

Samples of the following flashing, sheet metal, and accessory items:

a. 8-inch square samples of specified sheet materials to be exposed as finished surfaces.

1.2.3 Shop Drawings

Shop drawings showing layout, profiles, methods of joining, and anchorages details, including major trim/fascia units. Provide layouts at 1/4 inch scale and details at 3 inch scale.

1.3 PROJECT CONDITIONS

Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM MATERIALS

2.1.1 Copper Sheet

Standard electrolytic tough pitch, ASTM B 370, cold rolled to what is known as "Cornice Temper" having a yield strength of not less than 20,000 psi as 5% extension under load. 16 oz. unless noted otherwise. Bright copper finish.

2.1.2 Miscellaneous Materials and Accessories

2.1.2.1 Solder

For use with copper, provide 50 - 50 tin/lead solder (ASTM B 32), with rosin flux.

2.1.2.2 Fasteners

Same metal as flashing/sheet metal or, other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.

2.1.2.3 Bituminous Coating

SSPC Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.

2.1.2.4 Mastic Sealant

Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

2.1.2.5 Metal Accessories

Provide sheet metal clips, straps, anchoring devices, and similar accessory units for installation of work, matching or compatible with material being installed, noncorrosive; size and gage required for performance.

2.2 FABRICATED UNITS

2.2.1 General Metal Fabrication

Shop-fabricate work to greatest extent possible. Comply with details and with applicable requirements of SMACNA "Architectural Sheet Metal Manual," "Copper and Brass Research Association," and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer's instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks; true to line and levels, with exposed edges folded back to form hems.

2.2.2 Seams

Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

2.2.3 Expansion Provisions

Where lapped or bayonet-type expansion provisions in work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1" deep, filled with mastic sealant (concealed within joints).

2.2.4 Sealant Joints

Where movable, non-expansion type joints are required for proper performance of work, form metal to provide for proper installation of elastomeric sealant, in compliance with SMACNA standards.

2.2.5 Separations

Provide for separation of metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator. Do not use bituminous coating in contact with roofing membrane or other noncompatible material.

PART 3 EXECUTION

3.1 INSTALLATION AND WORKMANSHIP

3.1.1 General

Comply with manufacturer's installation instructions and recommendations, SMACNA "Architectural Sheet Metal Manual" and "Copper and Brass Research Association." Anchor units of work securely in place by methods required, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level. Install work with laps, joints and seams which will be permanently watertight and weatherproof.

a. Surfaces to which sheet metal is to be applied shall be even, smooth, sound, thoroughly clean and dry, and free from defects that might affect the application. Report any unsatisfactory surfaces to the Officer-in-Charge. In the absence of such a report, the Contractor shall be held responsible for the finished product.

b. All accessories or other items essential for the completeness of the sheet metal installation, though not specifically indicated on the drawings or specified, shall be provided. All such items, unless otherwise indicated on the drawings or specified, shall be of the same kind of materials as the item to be applied. Nails, screws and bolts shall be of the type best suited for the purposed intended and shall be of a composition that is compatible with the metal to which it will contact.

c. Cleats for sheet metal work shall be provided where required, spaced approximately 12" on centers, unless otherwise indicated on the drawings. Cleats shall be not less than 2" wide by 3" long of the same material and weight as the metal being installed. Cleats for soldered seams shall be pretinned.

3.1.2 Roof Edge

Roof edge shall be formed from cold-rolled copper sheets, 8' or 10' long. Weight of copper shall be 16 oz. One edge shall extend onto roof at least 4" and shall terminate with 1/2" folded edge for cleating. Copper cleats, spaced 8" apart, shall be hooked into folded edge; free end of cleats shall be nailed to roof deck. Alternate method: Horizontal flange shall be

fastened to deck by copper or bronze nails spaced 3" apart.

Copper shall be bent to form gravel stop and extend down as fascia. For fascia less than 4" wide, lower edge shall be folded back on itself not less than 3/4" and bent out 45 degrees to form drip. Ends of each 8' or 10' length shall be lapped 3"; horizontal leg on roof shall be set in elastic cement. End joints on fascia shall be held tight together by copper clips soldered to underside of fascia. Ends of adjacent lengths are inserted between clips and fascia copper. Face nailing of end lap joints shall not be permitted.

3.2 CLEANING AND PROTECTION

a. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

b. Protection: Advise Contractor of required procedures for surveillance and protection of flashings and sheet metal work during construction, to ensure that work will be without damage or deterioration, other than natural weathering at time of substantial completion.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 07900
SEALANTS

PART 1 GENERAL

1.1 SCOPE

Completely close with sealant all joints indicated or specified to be sealed to a watertight condition.

1.2 SUBMITTALS

1.2.1 Manufacturer's Data

Submit copies of manufacturer's product data and specifications for type of sealant required, to the Engineer for approval.

1.2.2 Color Samples

Three (3) sets each of color finish samples of sealants.

1.3 JOB CONDITIONS

1.3.1 Joint Sealers

Examine joint surfaces and backing, and their anchorage to the structure, and conditions under which joint sealer work is to be performed, and notify Contractor in writing of conditions detrimental to proper completion of the work and performance of sealers. Do not proceed with joint sealer work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

1.3.2 Weather Conditions

Do not proceed with installation of sealants under adverse weather conditions. Proceed with the work only when weather conditions are favorable for proper cure and development of high early bond strength.

1.4 PRODUCT HANDLING

1.4.1 Delivery

Deliver sealants to the jobsite in sealed containers labeled to show the designated name, formula, or specification number, lot number, color, date of manufacture, shelf life, curing time, manufacturer's directions, and name of manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Sealant Backer Rod

Compressible rod stock of polyethylene foam, polyethylene-jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible,

permanent, durable, nonabsorptive material as recommended for compatibility with sealant by the sealant manufacturer to control the joint depth for sealant placement, to break bond of sealant at bottom of joint, to form optimum shape of sealant bead on back side, and to provide a highly compressible backer which will minimize the possibility of sealant extrusion when joint is compressed.

2.1.2 Bond-Breaker Tape

Polyethylene tape or other plastic tape as recommended by sealant manufacturer.

2.1.3 Masking Tape

Nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

2.1.4 Primer for Sealants

Nonstaining, as recommended by the sealant manufacturer.

2.1.5 Sealants

2.1.5.1 At Exterior Joints

One-part polyurethane-based sealant, conforming to FS TT-S-230A, Type I or II as applicable. Provide one of the following, or approved equal.

a. Dymonic; Tremco

b. Chem-Calk 900; Bostik Construction Products Div.

c. Sikaflex 1a; Sika Corp.

2.1.5.2 At Interior Joints

Non-Elastomeric Sealant; acrylic-emulsion type, conforming to ASTM C 834. Provide one of the following, or approved equal.

a. Acrylic Latex Caulk; Tremco

b. Chem-Calk 600; Bostik Construction Products Div.

2.1.5.3 At Horizontal Traffic-Bearing Joints

Two-part polyurethane based sealant, conforming to FS TT-S-00227C, Type I, Class A. Provide one of the following, or an approved equal:

a. Silflex 2c SL; Sika Corp.

b. THC-900; Tremco

2.1.5.4 At Perimeter of All Plumbing Fixtures, Etc.

One-part mildew-resistant silicone sealant, formulated with fungicide; intended for sealing interior joints with non-porous substrates. Provide one of the following or approved equal:

a. Dow Corning 786; Dow Corning Corp.

b. SCS 1700 Sanitary; General Electric Co.

c. Proglaxe White; Tremco Corp.

2.1.5.5 At Perimeter of Pipe Penetration in Generator Room

As specified on drawings.

a. Acoustic sealant by sheetrock.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

Comply with manufacturer's printed instructions except where more stringent requirements are shown or specified, and except where manufacturer's technical representative directs otherwise.

3.2 JOINT PREPARATION

a. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which could interfere with bond of sealant. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

b. Steel Surfaces in Contact with Sealant: Scrape and wirebrush to remove loose mill scale. Remove dirt, oil, or grease by solvent cleaning, and wipe surfaces with clean cloths.

c. Prime or seal joint surfaces where indicated, and where recommended by sealant manufacturer. do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.3 INSTALLATION

a. Set joint filler units at proper depth or position in joint to coordinate with other work, including installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between ends of joint filler units.

b. Install sealant backer rod for liquid elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for application shown.

c. Install bond breaker tape where indicated and where required by

manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

d. Employ only proven installation techniques, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

e. Install sealant to depths as shown or, if not shown, as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of bead:

(1) For sidewalks, pavements and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but neither more than 5/8" deep nor less than 3/8" deep.

(2) For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.

(3) For joints sealed with non-elastomeric sealants, fill joints to a depth in range of 75% to 125% of joint width.

f. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

g. Recess exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

3.4 CURE AND PROTECTION

Cure sealants in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Advise Contractor of procedures required for cure and protection of joint sealers during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of State's acceptance.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 08100

METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 WORK INCLUDED

This section includes but is not limited to:

a. Pressed metal frames.

b. Hollow metal doors.

c. Labeled frames and doors where required.

d. Section 07900, "Sealants": Joint sealants, forms a part of this section for materials and methods of installation, as if incorporated herein. Provide materials and workmanship conforming in all respects to applicable portions of Section 07900, "Sealants."

1.2 GENERAL REQUIREMENTS

1.2.1 Reference Specifications

ANSI/SDI 100, "Recommended Specifications Standard Steel Doors and Frames," and applicable portions of SDI Publications 105 through 119 shall govern the fabrication and installation of the steel doors and frames.

1.2.2 Submittals

Submit the following in accordance with Section 01300, "Submittals."

1.2.2.1 Manufacturer's Application Instructions

Submit two (2) copies, for the record, of the manufacturer's instructions for installation of the doors and frames.

1.2.2.2 Shop Drawings

Provide shop drawings to the General Contractor for coordination. Submit one copy to the Architect for the record.

1.2.3 Door Schedule

Refer to the Door Schedule on drawings for sizes, types and thicknesses of required doors and frames.

1.2.4 Hardware Installation

Hardware installation shall be subject to inspection and approval of the hardware supplier. Furnish a written statement from the hardware supplier, stating that the hardware has been installed in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Manufacture

Steel-Craft; Amweld; Ceco Steel Co.; Overly Manufacturing Co.; or approved equal complying with the referenced ANSI/SDI and SDI standards.

2.1.2 Steel

U.S. standard gage cold rolled, annealed, stretcher leveled steel, free from scale, pitting and surface defects.

2.1.3 Soundproofing and Fireproof Insulation

Soundproofing and fireproof insulation core is required for all hollow metal doors. Provide type complying with the referenced ANSI/SDI and SDI standards and Ul requirements as applicable.

2.2 FABRICATION

2.2.1 Pressed Metal Frames

a. Fabricate of 16 and 14 gage steel, unit type welded or interlocking construction, at Contractor's option, with integral stops, returns and mitered corners, with all weld beads ground smooth. Exterior frame shall be galvanized. 14 gage frames shall be provided fro doors and frames scheduled to be heavy duty.

b. Supply anchors with the frames; a minimum of 3 for each jamb; fixed or adjustable as required by conditions. Provide floor clips welded to each jamb and punched for anchoring to the floor.

(1) Frames requiring Underwriters' Labels: Provide 14 gage (minimum) anchors with yokes spot-welded to the inside of jambs not more than 24" o.c. Anchors shall be adjustable 6" vertically. Floor clips for labeled frames shall be adjustable.

c. Drill and tap frames to fit hardware templates furnished. Position lock strikes carefully to allow rubber door silencers to be fitted into the jamb door stops. Accurately locate silencers provided by hardware supplier: three for single doors two for pairs of doors.

d. Prepare frames for exterior doors for weatherstripping furnished under Hardware Section.

2.2.2 Hollow Metal Doors

Flush type formed of 18 gage (medium duty) and 16 gage (heavy duty) steel both sides with internal construction complying with the requirements of ANSI/SDI 100. Top and bottoms of doors shall have 18 gage continuous stiffener channels, full width of doors welded to face pans, with filler channel to close top of exterior doors. Exterior door panels and end

closures shall be galvanized. 16 gage doors shall be provided for doors scheduled to be heavy duty.

a. Cutouts for glazed openings shall have molding of 20 gage galvanized steel, with corners mitered and welded into an integral frame, removable from inside door and attached with countersunk sheet metal screws not over 10" on centers. Outside frame to be welded in place by concealed welds.

b. Provide louvers, where shown, as standard with the approved door manufacturer: inverted V-type stationary for interior doors, weatherproof if required for exterior doors.

c. Provide reinforcing for all door hardware. Mortise, (9 gage *reinforcing for* butts, 12 gage *for locksets*), drill and tap using reinforcement for cylinder locks and templates furnished by hardware supplier. Drilling and tapping for surface applied hardware shall be done in the field by the Installer.

d. Provide pairs of doors with astragals.

e. Weather Seals: Where scheduled, install weatherstripping furnished under Section 08710, "Finish Hardware", on heads and jambs.

2.2.3 Labeled Doors

Underwriters' Laboratories construction details and hardware application standards shall take precedence over any contradictory requirements of these specifications. Doors shall be flush type, formed of 16 gage or 18 gage steel both sides. Cores: A mineral wool insulation of not less than 3.00 lb./cu. ft. density for sound deadening and fireproofing. Provide Underwriters' labels with fire resistance ratings for all doors indicated to require same.

2.3 WORKMANSHIP

2.3.1 Shop Fabricate Doors and Frames

Required profiles, with arrises, edges sharp, straight, unless coved or bullnosed. Fit, fabricate accurately with corners, hairline joints, surfaces free from warp, wave, buckle or other defects.

2.3.2 Welding

Conform to American Welding Society standards for high grade hollow metal work with exposed beads ground smooth.

2.3.3 Hardware Reinforement

Provide as hereinbefore specified, for field installation. Manufacturer shall not be required to drill or tap for surface applied hardware, closures, push plates, etc.

2.4 FINISH AND PROTECTION

2.4.1 Cleaning

After assembly, clean thoroughly, removing all rust, scale, grease, oil, rough spots. Grind welds, joints smooth; fill flush with mineral filler to conceal seams. Use power washer to clean, rinse and phosphate coat (bonderize) all exposed surfaces.

2.4.2 Priming

Dip coat doors and frames with a zinc chromate primer at the factory. On arrival at the job provide all necessary touch-up of the shop coat.

2.4.3 Protection

Provide adequate covering and blocking to protect doors and frames from the elements during transit and storage at the site. Store under cover and resting on edge until installation.

PART 3 EXECUTION

3.1 INSTALLATION

a. Installation of all units must be plumb, true-to-line and secure to adjoining construction. Coordinate with Finish Hardware, Section 08700, "Concrete Work, Masonry, and Gypsum Board Sections."

b. Install frames with the provided anchors in strict accordance with the manufacturer's installation recommendations.

c. Install dcors complete with all hardware, furnished under Section 08710, "Finish Hardware." All hardware shall operate easily, and doors shall swing without binding.

d. Final Inspection: Upon completion, make a detailed inspection of the entire installation, arrange for the correction of any faulty workmanship and/or material in evidence, and supervise all remedial work occasioned thereby.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 08305

METAL ACCESS DOORS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Provide all metal access doors complete, in place, as shown on the Drawings and specified herein.

1.2 QUALITY ASSURANCE

1.2.1 Qualifications of Manufacturers

Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Officer-in-Charge.

1.2.2 Qualifications of Installers

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.3 SUBMITTALS

a. Manufacturers' Data: Submit 6 copies of manufacturer's specifications and other data required to demonstrate compliance with the specified requirements.

b. Shop Drawings showing all details of fabrication, anchorage, erection, and interface with the work of other Section.

c. Manufacturer's recommended installation procedures.

1.4 PRODUCT HANDLING

1.4.1 Protection

Use all means necessary to protect materials of this Section before, during, and after installation and to protect installed work and materials of all other trades.

1.4.2 Replacements

The event of damage, immediately make all repairs and replacements necessary to the approval of the Officer-in-Charge and at no additional cost to the State.

PART 2 PRODUCTS

2.1 METAL ACCESS DOORS

2.1.1 Ceiling Access Panels

Metal access doors for ceilings shall be continuous steel hinge with stainless steel pin, size as indicated, style DW, 16 gage steel frame and 14 gage reinforced steel panel, galvanized with factory prime coat finish, Karp DSC-214M, or approved equal. Locks shall be flush, screwdriver operated.

PART 3 EXECUTION

3.1 INSPECTION

Examine the areas and conditions under which work of this section will be installed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FABRICATION

Fabricate in strict accordance with the approved Shop Drawings and the original design, except where specifically otherwise approved by the Officer-in-Charge.

3.3 COORDINATION

At all times during progress of the work, coordinate as required with all other trades to ensure proper and adequate provision in the work of other trades for interface with the work required under this section.

3.4 INSTALLATION

Install the work of this section in strict accordance with the original design and the approved Shop Drawings, except as specifically otherwise approved by the Officer-in-Charge. Anchor all components firmly into position, in true alignment horizontally and vertically.

-- End of Section --

SECTION 08385

ACOUSTIC-RETARDANT DOORS AND FRAMES

PART 1 GENERAL

1.1 SCOPE

The work includes the furnishing and installation of all acoustic-retardant doors and frames, and all accessories as shown on the drawings and as specified herein.

All dimensions on the drawings shall be verified with actual field conditions. All related work and adjacent surfaces shall be checked and inspected to provide for proper installation of the doors and frames. All work shall be in strict accordance with the governing codes.

The finished items shall be rigid, neat in appearance, and free from defects, warp, or buckle. Molded members shall be sharp in detail, straight, and true. Corner joints shall be coped or mitered, well formed, and in true alignment. Exposed welded joints shall be dressed smooth.

1.2 CONTRACTOR SUBMITTALS

Submit seven copies of dimensioned shop drawings. Shop drawings shall indicate the location of each door and frame, elevation of each type of door and frame, details of construction, method of assembling sections, location and extent of hardware reinforcement, hardware locations, type and location of struts and anchors for frames, and thicknesses of metal. Shop drawings shall include catalog cuts or descriptive data for the weatherstripping.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

a. Section 07900, "Sealants."

b. Section 08710, "Finish Hardware."

PART 2 PRODUCTS

2.1 MATERIALS

a. Asbestos Prohibition: No asbestos containing materials shall be used under this section. The Contractor shall insure that all materials incorporated in the project are asbestos-free.

b. Acoustical Retardant Metal Doors and Frames: Metal doors and frames shall be the product of one manufacturer and tested as a unit for a minimum STC rating of 50 when tested in accordance with ASTM E 90-81, "Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions, Method for", and ASTM E 413-73 (Revised 1980), "Determination of Sound Transmission Class."

c. Doors and frames shall be as manufactured by Overly Manufacturing

Company, Krieger or approved equal, with a flush stainless steel threshold, perimeter and astragal sound seals, and automatic door bottom.

d. Doors, frames, and all fasteners shall be galvanized steel, satin finish.

e. Each door shall be 16 gage galvanized steel, flush hollow metal reinforced, stiffened and sound deadened with special cores which fill the interior space and are bonded to both faces. Edge seams shall be welded, filled, and ground smooth. Top and bottom shall be reinforced with welded i steel channels. Hinge reinforcing shall be 8 gage galvanized steel. Lock reinforcing shall be 12 gage galvanized steel.

f. Door frame shall be 14 gage galvanized steel with cross sections as detailed. Frame shall be equipped with adjustable neoprene seals. Hinge reinforcing shall be 16 gage galvanized steel. Wall anchors base anchors of steel bolts and expansion shields shall be provided according to manufacturer's standard.

PART 3 EXECUTION

3.1 INSTALLATION

a. Install doors and frames in strict accordance with manufacturer's printed instructions and approved shop drawings for specified STC value.

b. Door frame shall be securely anchored to the adjacent construction, plumb and square with the openings. Frame shall be grouted solid with mortar. Doors shall be erected and hardware shall be adjusted in accordance with the hardware manufacturer's instructions. Doors shall operate smoothly and freely; locks shall engage strikes cleanly; and no forcing shall be necessary for correction operation.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 08520

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SUMMARY

a. Type of aluminum window units required includes the following:

1. Fixed windows.

b. Applications of aluminum windows on the project include individual units set in conventional wall construction.

1.2 DEFINITIONS

a. Performance class number included as a part of the window designation system is the actual design pressure in pounds per sq. ft. used to determine the structural test pressure and water test pressure.

b. Structural test pressure, wind load test, is equivalent to 150 percent of the design pressure.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

Comply with structural performance requirements indicated in AAMA 101 for the type, grade, and performance class of window units specified.

a. Consult with the Officer-in-Charge for clarification needed to confirm required loading and test pressures.

b. Design wind velocity and the project site is 80 mph.

1.3.2 Testing

Test each type and size of required window unit through a recognized testing laboratory or agency, in accordance with ASTM E 330 for structural performance. Provide certified test results.

1.3.2.1 Structural Performance

Provide units with no failure or permanent deflection for a positive (inward) and negative (outward) test pressure of 30 lbf/sq. ft.

1.4 SUBMITTALS

1.4.1 Shop Drawings

Submit six (6) shop drawings for each type of window, including information not fully detailed in the manufacturer's standard product data and the following:

a. Elevations of continuous work at 1/4" scale.

b. Full size section details of every typical composite member.

c. Anchors.

d. Glazing details.

1.4.2 Product Data

Submit manufacturer's product specifications, technical product data, recommendations, and standard details. Include the following information:

a. Fabrication methods.

b. Finishing.

1.4.3 Samples

Submit samples of the specified finish on 12" lengths of window members.

1.4.4 Certification

Provide certification by the manufacturer showing that each type, grade, and size of window unit complies with requirements where the manufacturer's standard window units have been tested in accordance with specified tests and meet performance requirements specified. Where such testing has not been accomplished, perform required tests through a recognized testing laboratory or agency and provide certified test results.

1.5 QUALITY ASSURANCE

1.5.1 Standards

Requirements for aluminum windows, terminology and standards of performance, and fabrication workmanship are those specified and recommended in AAMA 101 and applicable general recommendation published by AAMA and AA.

1.5.2 Single Source Responsibility

Provide aluminum windows produced by a single manufacturer capable of showing prior production of units similar to those required.

1.5.3 Design Criteria

Drawings indicate sizes, profiles, and dimensional requirements of aluminum windows based on Kawneer Company, Inc., "Trifab II 450" system or Fleetwood Aluminum Products. Window units having minor deviations from dimensions and profiles may be accepted, subject to the Officer-in-Charge's approval, provided such deviations do not materially detract from the design concept or intended performance.

1.6 PROJECT CONDITIONS

1.6.1 Field Measurements

Where possible, check actual window openings in construction work by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress as directed by the Contractor to avoid delay of work. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit of window units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Available Manufacturers

Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

a. Fixed Windows:

Kawneer Company, Inc.
Fleetwood Aluminum Product

2.2 MATERIALS

2.2.1 Aluminum Extrusions

Provide alloy and temper recommended by the window manufacturer for the strength, corrosion-resistance, and application of required finish, but not less than 22,000 psi ultimate tensile strength and not less than 0.062" thickness at any location for main frame and sash members.

2.2.2 Fasteners

Provide aluminum, non-magnetic stainless steel or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum window members, trim, anchors, and other components of window units. Do not use exposed fasteners.

2.2.2.1 Reinforcement

Where fasteners screw-anchor into aluminum less than 0.125" thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standards non-corrosive pressed - in splined grommet nuts.

2.2.3 Anchors and Clips

Fabricate anchors and clips of aluminum, non-magnetic stainless steel, or hot-dip zinc coated steel or iron complying with the requirements of ASTM A 386; provide sufficient strength to withstand design pressure specified.

2.2.4 Compression Type Glazing Strips and Weather-Stripping

At the manufacturer's option, provide compressible stripping for glazing such as molded EPDM or neoprene gaskets complying with AAMA SG-1 or with ASTM D 2000 Designation 2BC415 to 3BC620, or molded PVC gaskets complying with ASTM C 509, Grade 4.

2.2.5 Sealant

For sealants required within fabricated window units, provide type recommended by the manufacturer for joint size and movement. Sealant shall remain permanently elastic, non-shrinking and non-migrating. Comply with Division 7 - Joint Sealers section of these specifications for selection and installation of sealants.

2.3 WINDOW GRADE AND PERFORMANCE CLASSIFICATION

2.3.1 Commercial Windows

Provide window units complying with requirements of AAMA Grade and Performance Class C20.

2.4 WINDOW TYPE

2.4.1 General

The following paragraphs define the operating arrangement for the types of sash required in window units and specify minimum provisions for each type.

Fixed windows are window units consisting of a glazed frame installed into one opening and are not operable.

2.5 FABRICATION

2.5.1 General

Except to the extent that more specific or stringent requirements are necessary, provide manufacturer's standard fabrication that complies with specified standards and that produces units that are reglazeable without dismantling sash framing. Include a complete system for assembly of components and anchorage of window units, and prepare sash for glazing.

2.5.1.1 Details

Details are based upon standards by one or more manufacturers. Similar details by other manufacturers will be acceptable, provided they comply with size requirements, minimum/maximum profile requirements, and performance standards as specified.

2.5.2 Weepholes

Provide weepholes and internal water passages to conduct infiltrating water at exterior windows.

2.5.3 Subframes

Provide subframes with anchors, for window units where required, of proper profile and dimensions, but not less than 0.062" thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units.

2.5.4 Glazing Stops

Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system required. Finish glazing stops to match window units.

2.6 FINISH

2.6.1 Exterior Windows

Kynar 500 for exterior windows.

2.6.2 Natural Anodized Finish

NAAMM AA-C22A32, Class I (minimum thickness of 0.7 mils), natural aluminum color for interior windows.

PART 3 EXECUTION

3.1 INSTALLATION

a. Inspect openings before beginning installation. Verify that rough opening is correct and the sill plate is level.

   (1) Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.

b. Set units plumb, level, and true to line, without warp or rack of frames. Provide proper support and anchor securely in place.

   (1) Separate aluminum and other corrodible surfaces from sources of corrosion of electrolytic action at points of contact with other materials by complying with the requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101.

c. Set sill members and other members in a bed of compound or with joint fillers or gaskets to provide weather tight construction. Refer to the Division 7 for compounds, and fillers, to be installed concurrently with window units.

3.3 CLEANING

Clean aluminum surfaces promptly after installation of windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances.

3.4 PROTECTION

Initiate and maintain protection and other precautions required through the remainder of the construction period, to ensure that, except for normal weathering, window units will be free of damage or deterioration at the time of substantial completion.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 08710

FINISH HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A156.1	(1988) Butts and Hinges
ANSI A156.2	(1989) Bored and Preassembled Locks and Latches
ANSI A156.4	(1992) Door Controls - Closers
ANSI A156.5	(1992) Auxiliary Locks and Associated Products
ANSI A156.7	(1988) Template Hinge Dimensions
ANSI A156.8	(1988) Door Controls - Overhead Holders
ANSI A156.13	(1987) Mortise Locks & Latches
ANSI A156.16	(1989) Auxiliary Hardware
ANSI A156.18	(1993) Materials and Finishes

1.2 DESCRIPTION OF WORK

1.2.1 Definition

"Finish Hardware" includes items known commercially as finish hardware which are required for swing doors.

1.2.2 Types of Finish Hardware

Types of finish hardware required include the following:

a. Hinges

b. Lock and latch sets

c. Bolts

d. Closers

e. Overhead holders

f. Miscellaneous door control devices

g. Weatherstripping for exterior doors

1.2.3 Silencers

Silencers for interior door frames are included integral with hollow metal frames are specified with door frames in Section 08110, "Ssteel Doors and Frames."

1.3 QUALITY ASSURANCE

1.3.1 Manufacturer

Obtain each type of hardware (latch and locksets, hinges, closers, etc.) for a single manufacturer, although several may be indicated as offering products complying with requirements.

1.3.2 Supplier

A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware in the project's vicinity for a period of not less than 2 years, and who is, or who employs an experienced architectural hardware consultant who is available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to Officer-in-Charge, and Contractor.

1.4 SUBMITTALS

1.4.1 Product Data

Submit manufacturer's technical product data for each item of hardware. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.

1.4.2 Hardware Schedule

Submit final hardware schedule in manner indicated below. Coordinate hardware with doors, frames and related work to ensure proper size, thickness, hand, function and finish of hardware.

1.4.2.1 Final Hardware Schedule Content

Based on finish hardware indicated, organize hardware schedule into "hardware sets"indicating complete designations of every item required for each door or opening. Include the following information:

a. Type, style, function, size and finish of each hardware item.

b. Name and manufacturer of each item.

c. Fastenings and other pertinent information.

d. Location of hardware set cross-referenced to infications on

drawings both on floor plans and in door schedule.

e. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.

f. Mounting locations for hardware.

g. Door and frame sizes and materials.

1.4.2.2 Submittal Sequence

Submit earliest possible date particularly where acceptance of hardware schedule must precede fabrication of work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardwae, and other information essential to the coordinated review of hardware schedule.

1.4.2.3 Keying Schedule

Submit separate detailed schedule indicating clearly how the Officer-in-Charge's final instructions on keying of locks has been fulfilled. Coordination and approval of the final keying system shall be coordinated with the Officer-in-Charge.

1.4.3 Certificates of Compliance

Certificates of compliance attesting that hardware items conform to the ANSI or BHMA standards under which the items are specified shall be submitted. A statement that the proposed hardware items appear int he current applicable BHMA Certified Products Directory may be submitted in lieu of certificates.

1.4.4 Samples

Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one of each type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.

a. Samples will be returned to the supplier. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

1.4.5 Templates

Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

1.5 PRODUCT HANDLING

a. Tag each item or package separately, with identification related to final hardwae schedule, and include basic installation instructions with each item or package.

b. Packaging of hardware, is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

c. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfaied that count is correct.

d. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

PART 2 PRODUCTS

2.1 SCHEDULED HARDWARE

Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware is indicated in the Hardware Schedule at the end of this section. Products are identified by using hardware designation numbers of the following:

a. ANSI/BHMA designations to describe hardware items or to define quality or function are derived from the following standards. Provdie products complying with these standards.

(1) Butts and Hinges: ANSI A156.1 (BHMA 101).

(2) Locks and Lock Trim: ANSI A156.2 (BHMA 601).

(3) Door Control-Closers: ANSIA156.4 (BHMA 301).

(4) Auxiliary Locks: ANSI A156.5 (BHMA 501).

(5) Template Hinge Dimensions: ANSI A157.7.

(6) Door Controls-Overhead Holders: ANSI A156.8 (BHMA 311).

(7) Mortise Locks and Latches: ANSI A157.13 (BHMA 621).

(8) Auxiliary Hardwre: ANSI A156.16 (BHMA 1201).

(9) Materials and Finishes: NANDI A156.18 (BHMA 1301).

2.2 MATERIALS AND FABRICATION

2.2.1 General

2.2.1.1 Hand of Door

Drawings show direction of swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

2.2.1.2 Base Metals

Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commerically recognized) quality than specified for applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

2.2.1.3 Fasteners

Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

2.2.1.4 Screws

Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

2.2.1.5 Fasteners

Provide concealed fasteners for hardware units which are exposed when door is closed, except to extend no standard units of type specified are available with concealed fasteners. Do not use thru bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

2.2.1.6 Tools and Maintenance Instructions for Maintenance

Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment maintenance, and removal and replacement of finish hardware.

2.3 HINGES

2.3.1 Templates

Provide only template-produced units.

2.3.2 Ball Bearing Hinges

Use ball bearing hinges on doors equipped with door closers and as scheduled.

2.3.3 Screws

Furnish Phillips flat-head or machine screws for installation of units. Finish screw heads to match surface of hinges.

2.3.4 Hinge Pins

Except as otherwise indicated, provide hinge pins as follows:

2.3.4.1 Steel Hinges

Steel pins.

2.3.4.2 Non-Ferrous Hinges

Stainless steel pins.

2.3.4.3 Exterior Doors

Non-removable pins.

2.3.4.4 Interior Doors

Non-rising pins.

2.3.4.5 Tips

Flat button and matching plug, finished to match leaves.

2.3.4.6 Number of Hinges

Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.

2.4 LOCK CYLINDERS AND KEYING

2.4.1 General

Supplier will meet the Officer-in-Charge to finalize keying requirements and obtain final instructions in writing.

2.5 KEYING

a. All locks to be keyed to existing Grand Master and Master Key system for the facilities. Allow for 100% expansion. All

cylinders shall be keyed at the factory where permanent records shall be established and maintained.

b. During construction, all cylinders shall be keyed alike. The Contractor shall receive 10 copies of this key. Under no circumstances shall the Contractor receive any of the permanent building master keys or change keys. The permanent keys will be sent to the Officer-in-Charge as directed.

c. All cylinders shall be manufactured of either brass or bronze maintaining close tolerances to reduce excessive wear. All keys shall be paracentric and manufactured of nickel-silver material. All ball end bottom tumbler pins which come in contact with key shall be nickel-silver. All master and driver pins shall be brass. Driver springs shall be stainless steel. Cam screws to be secured with a nylon patch to help prevent loosening.

d. Furnish:

(1) 2 master keys

(2) 6 construction masterkeys

(3) 2 keys per lockset

(4) 1 extra key blank for each lock

e. All keying shall be thoroughly checked with the Officer-in-Charge before the finish hardware scheduled are submitted for approval.

f. All master keys shall be delivered to the Officer-in-Charge's Representative.

g. Equip locks with Officer-in-Charge's special 6-pin tumbler cylinder, with construction master key feature, which permits voiding of construction keys without cylinder removal.

h. Comply with Officer-in-Charge's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

(1) Permanently inscribe each key with number or lock that identifies cylinder manufacturer key symbol, and notation "DO NOT DUPLICATE" and "STATE PROPERTY."

i. Office and storage separate system. All other keyed alike.

2.6 LOCKS, LATCHES AND BOLTS

2.6.1 Strikes

Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.

2.6.2 Locks and Latches

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. Mortise-type locks and latches for doors 1-3/4 inches thick and over shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

2.6.2.1 Mortise Locks and Latches

Locks and latches shall conform to ANSI Standard A156.13, Grade 1.

2.6.2.2 Locksets

Locksets must be listed in the current BHMA Directory of Certified Locks and Latches.

2.6.3 Lock Throw

Provide 5/8" minimum throw of latch and deadbolt used on pairs of doors.

2.7 CLOSERS AND DOOR CONTROL DEVICES

2.7.1 General

Closers shall be rack and pinion construction with both rack and pinion of heat treated steel. They shall be non-sized with adjustable spring power to accommodate size 1 thru 6, with option PC-4C. Closers shall be certified as meeting the ANSI A156.4 Grade 1 requirements, be listed in the current BHMA Directory of Certified Door Closers, and carry a five (5) year limited warranty. A copy of the warranty shall be furnished with hardware schedule.

2.7.2 Surface Type Closers

Surface type closers shall be Series 2000. Mounting details fro the type closers specified shall be in accordance with paragraph Hardware Sets. Closers for outswinging exterior doors shall have parallel arms.

a. Insofar as practical, provide arms and/or brackets as required to install closers on the room side of the doors. Provide proper arms and/or brackets required for use in conjunction with other hardware items, i.e., overhead stops.

b. Provide sex nuts and bolts for all overhead closers.

2.7.3 Access-Free Manual Closers

Where manual closers are indicated for doors reuired to be accessible to the physically handicapped, provide adjustable units complying with AMSO A117.1 provisions for door opening force and delayed action closing.

2.7.4 Grey Resilient Parts

Provide grey resilient parts for exposed bumpers, other exposed parts of closers to be shop prime coated for field finish painting. Cloer shall be painted to match adjacent hollow-metal door frames.

2.8 DOOR STOPS

a. Stops shall be supplied for all doors not equipped with a holding or stay device.

b. They shall control the desired limit of opening, helping to prevent damage to damage to adjacent walls, columns, equipment, the door or its hardware.

c. Floor stops shall be used except in areas where their location would impeded traffic. Stops of correct height shall be used on all doors.

d. Overhead stops shall be used where scheduled in the hardware sets, or shere floor stops are not practical.

2.9 WEATHERSTRIPPING

2.9.1 General

Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.

2.9.2 Replaceable Seal Strips

Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

2.9.3 Weatherstripping at Jambs and Heads

Provie bumper-type resilient insert and metal retainer strips, surface-applied unless shown as mortised or semi-mortised of following metal, finish and resilient bumper material.

a. Flexible, hollow neoprene bulb or loop insert, conforming to MIL R 6055, Class Grade 40.

2.10 HARDWARE FINISHES

a. Provide matching finishes for hardware units at each door or opening, to the greatest extend possible, and except as otherwise indicated. Reduce differences in color and textures as much as commerically possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.

b. Provide finishes which match those established by BHMA or, if non-established, match the Officer-in-Charge's sample.

c. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than specified for the applicable units of hardware by referenced standards.

d. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze and aluminum, except as otherwise indicated.

e. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI A156.18 "Materials and Finishes Standard," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 EXECUTION

3.1 INSTALLATION

a. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, including handicap accessibility (ADA), and except as may be otherwise directed by the Officer-in-Charge.

b. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finish work specified in the Division 9 sections. Do not install surface-mounted items until finishes have been completed on the substrate.

c. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

d. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

3.2 ADJUST AND CLEAN

a. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.

b. Clean adjacent surfaces oiled by hardware installation.

c. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.

d. Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

e. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the project and re-adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.3 HARDWARE SCHEDULE

3.3.1 General

The following is a general listing of hardware requirements and is not intended for use as a final hardware schedule. Any item of hardware required by established standards or practices, or to meet State and Local codes shall be furnished whether or not specifically called out in the following listed groups.

HW-1

PR D1, D2 - ELEC. EQUIP. RM

6	Hinges	FBB191	4.5 x 4.5	630	Stanley
1	Lockset	8105 LNL		630	Sargent
2	Flush Bolts	1358		626	Quality
2	Closers	7801		689	Dorma
2	Stops	144		626	Quality
1	Seal	S88W		628	Pemko
2	Auto Door BTM	4131CR		628	Pemko
1	Threshold	See Detail on Drawing			

HW-2

SGL D3, D6 - OFFICE, AC RM

3	Hinges	FBB191	4.5 x 4.5	630	Stanley
1	Lockset	8105 LNL		630	Sargent
1	Closer	7801		689	Dorma
1	Stop	144		626	Quality

HW-3

SGL D4, D8 - JANITOR, STORAGE

3	Hinges	FBB191	4.5 x 4.5	630	Stanley
1	Lockset	8104 LNL		630	Sargent
1	Wall Bumper	W302	(@ D4)	626	Quality
1	Stop	144	(@ D8)	626	Quality

HW-4

SGL D5 - TOILET/LOCKER

3	Hinges	FBB191	4.5 x 4.5	630	Stanley
1	Privacy	8165 LNL		630	Sargent
1	Closer	7801		689	Dorma
1	Wall Bumper	W302		626	Quality

HW 5

PR D7 - AC RM

6	Hinges	FBB191	4.5 x 4.5	630	Stanley
1	Lockset	8105 LNL		630	Sargent
2	Flush Bolts	1358		626	Quality
2	Closers	7801		689	Dorma
2	Stops	144		626	Quality
1	Threshold	171SS	Type 316SS		Pemko
2	Door BTM	315BN		628	Pemko
1	Seal	S88W		---	Pemko

HW-6

SGL D9 - DISCHARGE PLENUM A

3	Hinges	FBB191	5 x 4.5	630	Stanley
1	Passage	8115 LNL		630	Sargent
1	Stop	144		626	Quality

HW-7

SGL D10 - DISCHARGE PLENUM B

6	Hinges	FBB191	5 x 4.5	630	Stanley
1	Lockset	8105 LNL		630	Sargent
1	Closers	7801		689	Norma
1	Threshold	171SS	Type 316SS		Pemko
1	Door BTM	315B			Pemko
1	Seal	888W			Pemko

HW-8

SGL D11 - GENERATOR RM

1	Lockset	8105 LNL	630	Sargent
1	Closer	7601	689	Dorma
1	Stop	144 @ D12	626	Quality
1	Threshold	See Detail on Drawing		
1	Door BTM	By Manufacturer		
1	Seal	By Manufacturer		

HW-9

PR D12, D13 - GENERATOR RM

1	Lockset	8105 LNL	630	Sargent
2	Flush Bolts	1358	626	Quality
1	Threshold	See Detail on Drawing		
1	Astragal	By Manufacturer		
2	Door BTM	By Manufacturer		
1	Seal	By Manufacturer		

SGL ED1 - ELEC. EQUIP. RM

1	Auto Door BTM	4131CR	628	Pemko

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by te provision of this section.

-- End of Section --

SECTION 08800

GLAZING

PART 1 GENERAL

1.1 SCOPE

Provide all glass and glazing work. The General Provisions as specified in Section 01010 are a part of this Section as if incorporated herein.

1.2 WORK INCLUDED

This Section includes but is not limited to:

a. Providing glass in:

(1) Wood doors.

(2) Hollow metal doors.

(3) Aluminum store front construction.

1.3 GENERAL REQUIREMENTS

1.3.1 Reference Standards

"Glazing Manual" of the Flat Glass marketing Association, 1325 Topeka Avenue, Topeka, Kansas 66612, Federal Specification DD-G-451, "Glass, Float or Plate, Sheet, Figured (Flat, for Glazing, Mirrors and Other Uses)", and the Consumer Product Safety Commission Standard 16 CFR 1201.

1.3.2 Grading and Labeling

Grade mark all glass in accordance with FS-DD-G-451. State quality, grade and manufacturer's name and brand designation. Do not remove labels until approval to do so is given by the Architect.

1.3.3 Guaranty

Guaranty all work in writing for a period of one year in compliance with Section 01700.

1.3.3.1 Exception

Guaranty colored heat-absorbing glass fading, defective materials and workmanship, (but not including breakage), for five years.

1.3.4 Inspection

Examine all surfaces to which work is installed. Notify the Contractor of any defects or unsatisfactory conditions that might adversely affect the work, and arrange for their satisfactory correction. Starting of the work shall imply acceptance of conditions as suitable to receive the work and

assumption of the guaranty.

1.3.5 Code Requirements

Code requirements shall take precedence over glass thicknesses and materials indicated on drawings and/or specified herein. Take responsibility that all glass to be installed complies with Codes, and

PART 2 PRODUCTS

2.1 MATERIALS

Insofar as practicable, all glass shall be the products of one manufacturer, labeled and graded as specified above. Comply with the referenced standards.

2.1.1 Glass

Glass shall be the products of A.S.G. Industries, Inc., C-E Glass (Combustion Engineering), Libbey-Owens-Ford Co., Pittsburgh Plate Glass Co., or approved equal, as follows:

2.1.1.1 Safety Glass

a. Laminated clear glass 1/4" thick.

b. Laminated bronze glass 1/4" thick.

2.1.2 Glazing Blocks and Spears

Approved plastic types recommended by the glazing sealant manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

a. Accurately cut and install glass in accordance with manufacturer's instructions and with requirements of the referenced "Glazing Manual." Set glass in rebates, using manufacturer's standard glazing fittings, chairs, channels, stops and glazing gaskets. Place all setting blocks at quarter points of glass panels. Be responsible for on-the-job checking the sizes of all openings into which glass is to be placed.

b. Glaze openings with glass of type and thickness scheduled.

c. Glaze openings with stops provided with the opening. Openings will be prepared by the respective manufacturer who will also supply the required stops. Make sure rabbets and stops are properly primed before glass is set. Priming is specified with the material to be glazed.

d. Glaze aluminum framing systems and doors with glazing gaskets and aluminum stops provided by the aluminum supplier.

3.2 CLEAN-UP

a. Remove trimmings from sash, sills, and ledges. Replace all broken, chipped, scratch or otherwise defective glass. Complete entire glazing in an approved neat, clean and acceptable condition.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09110

NON-LOAD BEARING WALL FRAMING SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Provide all non-load bearing metal wall framing systems. The General Provisions as specified in Section 01010, are a part of this section as if incorporated herein.

1.2 SUBMITTALS

1.2.1 Manufacturer's Installation Instructions

Submit two (2) copies, for the record, of the manufacturers instructions for installation of the metal stud system.

1.3 MATERIALS

1.3.1 Metal Studs

Roll-formed 25 gauge and 20 gauge as indicated, hot dip galvanized steel "C" channel type as manufactured by U.S. Gypsum, National Gypsum and approved equal, designed for screw attachment. Widths as indicated.

1.3.2 Metal Floor and Ceiling Runners

Hot dip galvanized steel channel type in gauges and widths to receive studs, as manufactured by stud supplier.

1.3.3 Fastener Screws

3/8" Type S-12 pan head screws for securing metal studs to runners. 1/2" Type S-12 pan head screws for securing studs to metal door frames.

1.3.4 Sealants

Comply with the requirements specified in Section 07900, "Sealants."

1.4 INSTALLATION

a. Install stud framing in accordance with the designated code references indicated on the drawings and in compliance with the manufacturer's installation recommendations.

b. Accurately aline all partitions according to drawings. Where stud partitions extend from slab to underside of structure, make adequate provision to avoid face panel "cupping" in the event of building settlement.

c. Runners: Securely attach floor and ceiling runners 24" o.c. to concrete slabs with concrete stub nails or power driven anchors and to suspended ceilings with toggle or molley bolts.

d. Sealants: Where scheduled, apply sealants to both sides of runner tracks and end studs adjoining other materials in accordance with the requirements specified in Section 07900, "Sealants."

e. Position studs vertically in the runners, at spacing indicated on the drawings and secure in place with screws. Where indicated, weld studs to runners in accordance with the AWS standards. Anchor all studs adjacent to door frames, partition intersections, and corners to runner flanges with USG Metal Lock Fastener, by positive screw engagement through each stud flange and runner flange, or by welding. Splice studs only when necessary, by nesting two studs with a minimum lap of 8" and attaching flanges together with two screws in each flange or by welding.

f. Locate reinforcing studs with flanges of studs touching at all door frame jambs, abutting partitions, partition corners and other construction. Securely anchor to the jamb and head anchor clips of each door frame by bolt or screw attachment. Over door frames install a cut-to-length section of runner with the flange slit and web bent to allow flanges to overlap adjacent vertical studs and securely screw-attach or weld to adjacent studs.

g. Install all necessary metal backing plates, channels or angles. Secure in place with screws or by welding as required.

h. Check all metal and steel stud framing for stability, plumbness, and alinement. Framing shall not vary more than 1/8" in 10 feet from a true plane.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09200

LATH AND PLASTER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM C 91	(1993) Masonry Cement
ASTM C 150	(1994) Portland Cement
ASTM C 206	(1984; R 1992) Finishing Hydrated Lime
ASTM C 207	(1991; R 1992) Hydrated Lime for Masonry Purposes
ASTM C 847	
ASTM C 897	
ASTM C 926	
ASTM C 932	
ASTM C 1063	(1994) Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement - Based Plaster

1.2 SUMMARY

This section covers exterior lath and plaster.

1.3 SUBMITTALS

1.3.1 Product Data

Manufacturer's specifications and installation instructions.

1.3.2 Samples

12 inches square of finish and texture indicated.

PART 2 PRODUCTS

2.1 EXPANDED METAL LATH

ASTM C 847, fabricated from zinc-coated (galvanized) steel sheet or uncoated steel sheet painted after fabrication into lath of type and configuration indicated.

2.1.1 Diamond Mesh Lath

3.4 lbs. per sq. yd.; flat or self-furring

2.1.2 Rib Lath

3.4 lbs. per sq. yd.

2.1.2.1 Configuration

Flat, rib depth of not over 1/8 inch.

2.2 Lath Attachment Devices

Devices of material and type required by referenced standards and recommended by lath manufacturer for secure attachment of lath to framing members and of lath to lath.

2.3 Plastering Accessories

Provide type shown or as recommended by lath manufacturer, including corner beads, casing beads, base screeds, cornerite, stripite and control joints. Coordinate depths with depths of plaster indicated.

2.3.1 For Portland Cement Plaster

Comply with material provisions of ASTM C 1063, fabricated of zinc alloy unless otherwise indicated.

2.4 Water for Mixing and Finishing Plaster

Drinkable, free of substances capable of affecting plaster set or of damaging plaster, lath or accessories.

2.5 Bonding Agent for Portland Cement Plaster

ASTM C 932.

2.6 Portland Cement Plaster Materials

a. Portland cement, ASTM C 150, Type I or II, finish coat.

b. Masonry cement, ASTM C 91, Type N.

c. Lime: ASTM C 206, Type S, for finishing or ASTM C 207, type S.

d. Sand Aggregate: ASTM C 897, manufactured or natural sand.

e. Fiber for Base Coat: Alkaline-resistant (AR) glass or polypropylene fibers, 1/2-inch long, free of contaminates, manufactured for use in portland cement plaster.

f. Factory-Prepared Finish Coat: Exterior finish stucco manufactured by La Habra or Merlex, color as indicated.

2.7 Portland Cement Plaster Proportions and Mixing

Comply with ASTM C 926. Proportion materials by volume. Adjust mix proportions within limits specified to attain workability.

2.7.1 Bases for Three-Coat Plaster

2.7.1.1 Scratch Coat

1 part portland cement, 0 to 3/4 parts lime, 2-1/2 to 4 parts sand.

2.7.1.2 Brown Coat

1 part portland cement, 3/4 to 1-1/2 parts lime, 2 to 3 parts sand.

2.7.1.3 Fiber Content

Add fiber to base coat mixes after ingredients have mixed at least 2 minutes. Comply with fiber manufacturer's directions but to not to exceed 2 lbs. per cu. ft. of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

2.7.1.4 Factory-Prepared Finish Coats

Add water only; comply with finish coat manufacturer's directions.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Metal Lath and Furring

Install metal lath and furring to comply with referenced standards and applicable requirements of ML/SFA "Specifications for Metal Lath and Furring".

3.1.1.1 Exterior

ASTM C 1063.

3.1.1.2 Furring Channels to Receive Metal Lath

Space furring channels not over 16 inches o.c. for 3.4 lb. diamond mesh lath, 19 inches o.c. for 3.4 flat rib lath.

3.2 PLASTER ACCESSORIES

Install plaster accessories to comply with referenced standards. Provide casing beads at terminations of plaster work. Locate control joints at spacings and locations indicated, and to comply with standards and plaster manufacturer's recommendations.

3.3 PLASTER APPLICATION, GENERAL

a. Prepare monolithic surfaces for bonded base coats and use bonding compound or agent to comply with requirements of referenced plaster application standards for conditioning of monolithic surfaces.

b. Tolerances: Not more than 1/8 inch in 10'-0" from a true plane in finished plaster surfaces.

c. Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

d. Plaster flush with metal frames and other built-in metal items or accessories which act as a plaster ground, unless otherwise indicated. Where plaster is not terminated at metal by casing beads cut base coat free from metal before plaster sets and groove finish coat at the junctures with metal.

e. Apply thickness and number of coats of plaster as indicated or as required by referenced standards.

3.4 PORTLAND CEMENT PLASTER APPLICATION

a. Standard: ASTM C 926.

b. Apply three-coat work over the following plaster bases:

(1) Metal lath.

c. Apply two-coat work over the following plaster bases:

(1) Concrete unit masonry.

(2) Concrete, when surface complies with ASTM C 926 for plaster bonded direct to solid base.

d. Finish Coat: Floated finish unless otherwise indicated; match Architect's sample for medium fine texture.

e. Moist cure portland cement plaster base and finish coats to comply with ASTM C 926, including recommendations for time between coats and curing in "Annex A2 Design Considerations."

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09250

GYPSUM BOARD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM C36	(1993) Gypsum Wallboard
ASTM C475	(1993) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C630	
ASTM C840	(1994) Application and Finishing of Gypsum Board

1.2 WORK INCLUDED

This Section includes but is not limited to:

a. Finish gypsum board partitions as indicated, fire-rated where indicated.

b. Suspended gypsum board ceilings.

c. Metal framing for suspended gypsum board ceilings.

d. Metal trim and reinforcing at all outside corners and at intersections with masonry and concrete.

e. Taping and sealing of all exposed joints.

1.3 GENERAL REQUIREMENTS

a. Reference Standards: ASTM C840, "Application and Finishing of Gypsum Board."

b. Cooperate with those whose work connects with, is affected, or concealed by, gypsum board work. Before proceeding, make certain that all proper and required installations and inspections have been made.

(1) Mechanical work and electrical work which will be concealed in partitions shall have been inspected and approved prior to installing covering panels.

c. Provide a material list and brochures showing manufacturer's

installation instructions, to the General Contractor for coordination and for use during installation.

d. Preliminary Inspection: Inspect stud framing systems and other areas to receive gypsum board. Do not start work until areas are acceptable. Starting work under this section shall imply acceptance of the area.

e. Deliver all manufactured materials in the original packages and containers bearing the manufacturer's name and brand. Use only one make of each material throughout the job.

f. Installation and workmanship shall be done in accordance with the referenced ASTM Specifications. Finish surfaces straight, true and free from defects of any kind.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Gypsum Board

Comply with ASTM C36. Except as otherwise specified below: 5/8" thick, 4 ft. wide by longest practical lengths, eased edges, standard paper finish as manufactured by U.S. Gypsum, National Gypsum "Gold Bond," Domtar Gypsum or approved equal.

2.1.1.1 Gypsum Board in Wet Areas

Water resistant board complying with ASTM C630. U.S.G. "Sheetrock W/R", Domtar "Moisture-Guard", Gold Bond "MR Board", or approved equal. Use on all walls behind plumbing fixtures and were scheduled.

2.1.1.2 Gypsum Board in Fire-Rated Partitions

5/8" thick unless otherwise noted. U.S.G. "sheetrock Fire Code Board", Domtar "Null-A-Fire (Type X)", Gold Bond "Fire-Shield", or approved equal. Where required in wet areas: 5/8" unless otherwise noted. U.S. G. "W/r Fire (Type X), Gold Bond "Fire-Shield", or approved equal. Where required in wet areas: 5/8" unless otherwise noted. U.S.G. "W/R Fire Code Board", Domtar "Moisture-Guard Null-A-Fire", Gold Bond "MR Fire Shield", or approved equal.

2.1.2 Furring Channels

7/8" deep, roll-formed, hat-shaped sections of hot dip galvanized steel.

2.1.2.1 Furring Brackets

20 gauge hot dip galvanized steel with serrated edges, adjustable.

2.1.3 Carrying Channels

Cold rolled steel, 1-1/2" channels weighing not less than 475 pounds per 1,000 lineal feet and 2" channels weighing not less than 629 pounds per

1,000 lineal feet, as indicated, hot dip galvanized. Also provide Unistrut framing where indicated, in sizes and profiles required.

2.1.4 Wire

Galvanized, double annealed steel wire as follows:

a. Hanger wire: 8 gage minimum but in any case in conformance with U.B.C., current edition.

b. Tie wire for attaching furring channels to runners: 18 gauge and 16 gauge.

2.1.5 Fasteners

Minimum 7/8" Type S bugle head self-tapping screws for gypsum board to metal framing. All other fasteners as recommended by gypsum board manufacturer.

2.1.6 Corner Reinforcing

Preformed vinyl with minimum 1" flange, by manufacturer of gypsum board.

2.1.7 Vinyl Trim

Vinyl "U" shaped edge trim at intersections of gypsum board with concrete block and concrete surfaces. Vinyl corner bead at all outside corners of gypsum board.

2.1.8 Joint Treatment

ASTM C 475. Asbestos-free, quick-drying, non-shrinking type powdered compound and perforated fiber tape with beveled edges, as standard with the gypsum board manufacturer. Use water-resistant compound at water resistant board.

2.1.9 Sealants

As specified in Section 07900, "Sealants."

PART 3 EXECUTION

3.1 EXECUTION

3.1.1 Suspended Ceiling, Soffit, and Fascia Framing

3.1.1.1 Ceiling

a. Secure hanger wires to overhead structure by approved fastenings. Space wires not over 3'-0" o.c. along main runner direction, not over 4'-0" o.c. in opposite direction, and 6" from boundary walls. Wires shall be long enough to provide proper anchorage to main channels.

b. Space runner channels 4'-0" o.c. parallel to the long dimension of

the ceiling unless otherwise indicated. Wrap hanger wire twice around the runner channel, draw up taut, and wrap twice around itself. At splices, lap channels at least 12" and secure with a double wrap of 18 gage tie wire 2" from each end of splice.

c. Space furring channels not more than 24" o.c. and saddle-tie to each runner channel with at least two strands of 16 gage tie wire, or use manufacturer's standard furring clips. At splices, lap furring channels at least 8" and secure with a double wrap of 18 gage tie wire 1" fro end of splice.

3.2 WALLBOARD INSTALLATION

a. Apply boards in strict accordance with the referenced ASTM Standards. Reinforce all corners and intersections with other materials, using the specified metal trim.

b. At water-resistant (W/R) gypsum board, treat cut edges and tape joints with the specified W/R joint compound.

c. At fire rated partitions, seal the entire perimeter of the partitions with sealant in accordance with the manufacturer's installation instructions.

d. Cut gypsum board to fit neatly around all pipes, outlets, switch boxes, and other built-in items.

3.3 JOINT TREATMENT

a. Tape joints as recommended by manufacturer. Tape all wall angles and inside corners with folded tape to form straight, true angles. Use quick-drying compound and do all work in one operation.

b. Apply joint compound under and over tape using tool or machine. Clean off excess immediately. Form compound over joints to smooth slight crown. Cover all metal reinforcing, trim, joints, nailing dimples, etc.

c. Sand joint compound to a smooth, even surface. Finished work shall show no joint lines or irregularities of any kind.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09300

TILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A118.1	(1992) Dry-Set Portland Cement Mortar (Available only as part of ANSI A108.1)
ANSI A118.4	(1992) Latex-Portland Cement Mortar (Available only as part of ANSI A108.1)
ANSI A137.1	(1988) Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM C144	(1993) Aggregate for Masonry Mortar
ASTM C150	(1994) Portland Cement
ASTM C206	(1984; R 1992) Finishing Hydrated Lime
ASTM C207	(1991; R 1992) Hydrated Lime for Masonry Purposes

1.2 SCOPE

Provide all tile work. The General Provisions as specified in Section 01010, are a part of this section as if incorporated herein.

1.3 WORK INCLUDED

This section includes but is not limited to:

a. Ceramic Mosaic Tile Floor

b. Ceramic Tile Walls

c. Matching Trim Shapes

1.4 GENERAL REQUIREMENTS

1.4.1 Reference Standards

"Handbook for Ceramic Tile Installation" of the Tile Council of America, Inc.

1.4.2 Samples

Submit samples of each kind and color of tile and each color of grout for approval as specified in Section 01300, "Submittals," before proceeding with any work. mark samples with the name of the manufacturer and the project name.

1.4.3 Installation Instructions

Provide copies of the referenced Handbook for Ceramic Tile Installation for use and reference during installation of the work, with the required installation methods marked therein.

1.4.4 Master Grade Certificate

Before proceeding with the tile work, provide the manufacturer's Master Grade Certificate signed by the manufacturer and the Contractor, certifying to the grade, type and quantity of tile.

1.4.5 Delivery

Deliver all manufactured materials in their original, unbroken packages, and containers bearing the manufacturer's name, brand, and grade seals. Keep all materials dry and clean and properly protected against deterioration in any form.

1.4.6 Workmanship

All tile shall be set by expert journeymen tile setters in conformance with the indicated installation system in the referenced handbook.

1.4.7 Guaranty

Guaranty all work in writing in accordance with Section 01700, to be free from defects in materials and workmanship for a period of one year.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Glazed Wall Tile

Dust pressed, machine made, white body, cushion edge, Standard Grade in accordance with ANSI A137.1 as manufactured by U.S. Ceramic Tile, Huntington/Pacific Ceramics, American Olean, Florida Tile, or approved equal. Field tiles shall have two lugs, equally spaced from the corners on each edge, to assure a uniform joint. Tile shall be satin glazed.

2.1.1.1 Size

4-1/4" x 4-1/4" x 5/16".

2.1.1.2 Glazed Tile Trim

Manufacturer's standard shapes. Provide internal corners with integral 7/16" radius cove and external corners with integral 3/4" radius bullnose trim as indicated, of size to conform to adjacent wall tile.

2.1.2 Ceramic Mosaic Floor Tile

Porcelain type, machine made, in pattern as selected, consisting of 1" x 1", 1" x 2", and 2" x 2" tile. A product of one of the above manufacturers.

2.1.3 Cement

ASTM C150, Type I, plain or plastic.

2.1.4 Lime Hydrated

High calcium type, ASTM C206 or ASTM C207, Type S.

2.1.5 Dry-Set Mortar

Complying with ANSI A118.1.

2.1.6 Latex Portland Cement Mortar

Complying with ANSI A118.4.

2.1.7 Sand

ASTM C144, washed clean and graded. Use fine sand for grout. Use white sand for white cement.

2.1.8 Water

Potable.

2.1.9 Integral Waterproofing Admixtures for Setting Beds and Mortar

Larsen Products "Acrylic Admix 101", Anti-Hydro Waterproofing "Anti-Hydro", Protex "Aquapel", or approved equal. Use in strict accordance with manufacturer's instructions.

2.1.10 Grouting Material

Commercial Portland cement with waterproof admixture nonshrinking grout: H.B. Fuller "TEC Joint Filler", Custom Building Products "Tile Grout", UPCO "Hydroment", or approved equal, in colors as selected.

PART 3 EXECUTION

3.1 PREPARATION

a. Thoroughly inspect all surfaces which are to receive tile and do not start until acceptable. All grounds, metal frames, bucks, rough electrical, mechanical and plumbing work and other fixtures shall be properly installed. Trenches, chases and other openings in floors and walls shall be properly closed. Starting of work will imply acceptance of the surfaces. Millwork shall be in place.

b. Lay out the work to insure symmetry about center lines of area or room in patterns as approved, and be solely responsible for its accuracy. Avoid use of less than half tiles. Verify all measurements and cooperate with all other trades whose work adjoins or connects with the tile work. Bring all finished surfaces to the lines and levels established by the drawings or by shop drawings of applicable other trades.

c. Ventilate closed rooms and areas during installation.

d. Close rooms and spaces to traffic until the tile has set. Protect the work from damage caused by the work of other trades.

3.2 INSTALLATION

a. Preparation of surfaces, setting of tile, and workmanship shall be in accordance with "American National Standard Specifications for the Installation of Ceramic Tile" published by the Tile Council of America, Inc.

b. The referenced "Handbook for Ceramic Tile Installation" installation methods shall be used in the following locations.

(1) Wall Tile: Method W243, Dry-Set Mortar or Latex-Portland Cement Mortar on gypsum board and Method W202 Dry-Set Mortar or Latex-Portland Cement Mortar over masonry.

(2) Floor Tile on Concrete Floors: Method F113, Dry-Set Mortar or Latex-Portland Cement Mortar. Slope floor tile toward floor drains where applicable.

c. Workmanship: Cut and drill tile without damaging it for proper fit around all equipment, pipes, and other items. Fit closely around outlets, pipes, fixtures and fittings so that plates, escutcheons and collars will overlap cuts. Rub down exposed sharp edges with abrasive stone. Use of thin pieces, chipped, spalled or otherwise disfigured tile will not be permitted.

(1) Accurately set tile with flush, well fitted joints, in true planes, plumb, square, graded or level as required, neatly cut to close fit against abutting work. Accurately form intersections and returns.

(2) Cut, drill and repair as required for the work of other trades

that is connected or applied to the tile work.

(3) Provide expansion and control joints at spacings recommended by the Tile Council of America, installed in accordance with referenced "Handbook for Ceramic Tile Installation" method EJ711, and with materials and details in accordance with Section 07900, "Sealants."

3.3 PROTECTION AND CLEANING

3.3.1 Ceramic Tile and Ceramic Mosaic Tile

Upon completion of work, thoroughly clean the finished surface. Do not use acid solution on glazed tile. Do not permit traffic on tile floors for 24 hours after laying. Thereafter permit no traffic unless floors are covered with heavy paper. Leave finished work clean. Replace cracked, chipped, or broken tile. Protect all work until acceptance of project.

3.5 CLEAN-UP

Do not allow debris to accumulate. Comply with the clean-up requirements specified in Section 01500, "_____."

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09500

ACOUSTICAL TREATMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 423	(1990; Rev. A) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

1.2 SCOPE

The acoustical treatment includes the sound absorptive insulation applied to all walls and underside of ceiling. Finish treatment includes the expanded metal wainscot and taping of panel joints and edges.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

a. Section 07900, "Sealants."

b. Section 09550, "Ventilation Duct and Flowways; Acoustic Silencers."

1.4 SUBMITTALS

1.4.1 Manufacturer's Data

Submit seven (7) copies of manufacturer's descriptive literature on insulation materials, fasteners, and related accessories for securing insulation to walls and ceiling.

PART 2 PRODUCTS

2.1 ASBESTOS PROHIBITION

No asbestos containing materials shall be used under this section. The Contractor shall insure that all materials incorporated in the project are asbestos-free.

2.2 MATERIALS

2.2.1 Insulation Board

Semi-rigid type, unfaced, of fiberglass for use a inner layer of acoustical treatment with the following characteristics.

a. Board Size: 24" x 48" x 2" thick.

b. Edges: Square.

c. Density: Minimum 3.0 lbs. per cubic foot.

d. NRC Rating: NRC of 1.00 with tested in accordance with ASTM C423 on Mounting a (formerly Mounting No. 4.) for 2" thickness.

e. Reference Product: Owens-Corning semi-rigid Fiberglas Type 703, Industrial Insulation Board, or approved equal.

2.3 ACOUSTICAL PANELS

Armstrong 2910 or equal, film faced, lay-in type ceiling panels of fibreglass, for use as outer layer of acoustical treatment, with the following characteristics:

2.3.1 Panel Size

24" x 48" x 5/8" thick.

2.3.2 Edges

Square.

2.3.3 Finish

White vinyl film facing, perforated, random fissured pattern.

2.3.4 Light Reflectance

LR-1 (75% and over).

2.3.5 Flame Spread

25.

2.3.6 NRC Rating

Range of 0.70 to 0.80.

2.3.7 Reference Product

Armstrong No. 2910 Standard Fiberglass Ceiling, Panels, "Random Fissured", or approved equal.

2.4 MISCELLANEOUS MATERIALS

2.4.1 C-Z Furring Channels

Minimum 18 gage stainless steel for use in mechanically attached insulation board and acoustical panels to wall and ceiling surfaces. size 4-1/8". Manufacturer: U.S. Gypsum, or approved equal channel system.

2.4.2 Adhesive

Of type recommended by insulation manufacturer, to secure inner layer of acoustic treatment to substrate and edges of acoustic panels and as otherwise required. Apply adhesive in accordance with manufacturer's recommendations.

2.4.3 Impaling Pins

Shall consist of 12 gauge stainless steel wire spindles with 1-1/4" diameter stainless steel retaining washers and plastic caps to cover exposed ends of spindle shafts. Pins shall be of sufficient length to secure inner layer of insulation board and outer protective layer of acoustical panels to walls and ceiling.

2.4.4 Surface Protective Barrier

Provide a wainscot of stainless steel expanded metal 1/2" - #13 gauge.

2.4.5 Tape

White-faced, adhesive-backed stick-on tape, #471 Plastic Film Tape, 3" minimum width, as manufactured by 3M Company or approved equal. (Adhesive shall be compatible with surfaces of lay-in panel.)

PART 3 EXECUTION

3.1 INSTALLATION

a. Wall and ceiling acoustical treatment shall consist of double layers of panels. Install inner and outer layers of acoustical treatment using C and Z-furring metal channels, adhesive and/or impaling pins. The outer acoustical panel shall be adhered to the inner insulation board with 90% coverage of adhesive, and all edges and all transverse joints shall be coated with corner joints. the top pieces shall be supported at the edges by the side pieces. Follow manufacturer's recommendations for securing channels and impaling pins to substrate. Arrange panels in neat pattern, covering all exposed ceiling and walls (floor or ceiling). Outer panel edges shall be protected by metal channels as shown in the Plans.

b. Install tape at finish joints of acoustical panels and wrap all free edges of acoustical panels" (except at wainscot).

c. Provide stainless steel washers of adequate size at wainscot surface protective barrier impaling pin caps to hold expanded metal in place.

3.2 SEALANTS

Provide sealants to free edge joints to other building surfaces.

3.3 CLEANING AND REJECTION

a. The Contractor shall exercise all necessary precautions to avoid damaging or soiling the units. All damaged units shall be replaced with new units by the Contractor.

b. The flowing defects shall also be cause for rejection or replacement at the Contractor's expense:

(1) Crooked or open joints.

(2) Soiled tiles not cleaned to original condition.

(3) Fractures, cracks, or corner chips.

(4) Color variation.

(5) Loose or fallen tiles.

(6) Warped tiles.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09510

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM E84 (1994) Surface Burning Characteristics of Building Materials

FEDERAL SPECIFICATIONS (FS)

FS SS-A-118

1.2 SCOPE

Provide all acoustical ceilings. The General Provisions as specified in Section 01010, are a part of this section as if incorporated herein.

1.3 WORK INCLUDED

This section includes but is not limited to:

a. Ceiling Suspension System, lay-in grid type.

b. Lay-in Acoustical Panel Units.

c. Refer to Reflected Ceiling Plans and to Room Finish Schedule for locations of suspended acoustical ceilings.

1.4 GENERAL REQUIREMENTS

1.4.1 Reference Standards

"Architectural Acoustical Materials" of the Acoustical and Insulating Materials Association and FS SS-A-118."

1.4.2 Job Conditions

Install acoustical materials under temperature and humidity conditions closely approximating those which will exist when the building is occupied; do not install when building is damp and cold or dry and hot. Concrete and masonry shall be completed and dry before the installation of acoustical work. All windows and doors shall be in place and glazed.

1.4.3 Coordination

Coordinate with other trades whose work affects or is affected by this work in order to avoid delays, omissions or damage to any part of the work.

a. Refer to Architectural, Structural, Mechanical, and Electrical drawings. Coordinate them with work under this section.

b. Where recessed lighting fixtures, provided under Section 16100, are installed in suspension systems erected under this section, consult with the fixture supplier so that this work and that of the recessed lighting fixtures is properly coordinated.

c. Where wide air conditioning ducts above suspended ceilings interfere with suspension hangers, provide, under this section, independent framing below the ductwork to support the ceiling. Support framing from structure above in an approved manner. In no case attach to the ductwork.

d. At metal decking fasten no suspended ceiling materials to the metal decking. Fasten to structural framing members only.

1.4.4 Delivery

Deliver all materials in original packages and containers bearing manufacturer's name and brand. Use only one make of each type of material throughout the job.

1.4.5 Installation and Workmanship

Do all work in accordance with the recommendations of the Acoustical Materials Association and the manufacturers of the ceiling systems. Finish surfaces plumb, straight, true and free from defects of any kind.

1.4.6 Material List

Provide copies of a material list, and copies of brochures showing manufacturer's installation instructions to the General Contractor for coordination and use during installation.

1.4.7 Guaranty

Guaranty all work in writing for a period of one year in compliance with Section 01700.

PART 2 PRODUCTS

2.1 MATERIALS

Conform with the referenced Federal Specification and Acoustical Materials Association Bulletin.

2.1.1 Suspension System, Exposed Grid Non-Rated System

Chicago metallic Corp. No. 800 System, or approved equal, factory finished white.

2.1.2 Acoustical Tile

Class 25 (non-combustible) under the flame spread index of the referenced Federal Specification, UL labeled, and Class I Flame Spread Rating according to ASTM E84. NCR Range .60 - .70, STC Range 35-39. Light reflection "A" (.75 or over). Factory finished with white paint.

2.1.2.1 Panels for Exposed Grid Non-Rated System

Fissured design, 24" x 48" x 5/8", lay-in edge; Armstrong "Minaboard," USG "Auratone," or approved equal.

2.1.3 Wall Edge Mouldings and Other Exposed Trim

Manufactured specifically for acoustical tile trim, and factory finished white.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Grid System

Install grid system in strict accordance with the manufacturer's written installation instructions.

a. Install wall edge mouldings and other exposed trim pieces at all perimeters and around all ceiling penetrations which would not otherwise afford concealment for cut edges.

3.1.2 Acoustical Units

Install acoustical units in strict accordance with manufacturer's installation instructions.

a. Exercise precautions as necessary to avoid damaging or soiling the units. Replace all damaged units with new units.

b. Cause for Rejection: The following defects are cause for rejection and replacement.

(1) Uneven joints or unaligned surfaces.

(2) Soiled tiles not cleaned to original condition.

(3) Fractures, cracks or corner chips.

(4) Color variation.

(5) Loose or fallen tiles.

3.2 CLEAN-UP

Do not allow debris to accumulate. Comply with the cleanup requirements specified in Section 01500"

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09650

RESILIENT FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS SS-T-312

FS SS-W-40

1.2 QUALITY ASSURANCE

1.2.1 Manufacturer

Provide each type of resilient flooring and accessory as produced by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

1.3 SUBMITTAL

1.3.1 Product Data

Submit manufacturer's technical data for each type of resilient flooring and accessory.

1.3.2 Samples for Verification Purposes

Submit the following samples of each type, color, and pattern of resilient flooring required, showing full-range of color and pattern variations.

a. Full size tile samples.

b. 2-1/2 inch long samples of resilient base.

c. Other materials as requested.

1.3.3 Maintenance Instructions

Submit 2 copies of manufacturer's recommended maintenance practices for each type of resilient flooring and accessory required.

1.4 PROJECT CONDITIONS

Install resilient flooring and accessories after other finishing operations including painting, have been completed. Do not install resilient flooring over concrete slabs until the slabs have been cured and are sufficiently dry to achieve bond with adhesive as determined by resilient flooring

manufacturer's recommended bond and moisture test.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Available Manufacturers

Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

2.1.1.1 Manufacturers of Vinyl Composition Tile

a. Armstrong World Industries, Inc.

b. Azrock Floor Products Div., Azrock Industries, Inc.

c. Tarkett Inc.

2.1.1.2 Manufacturers of Rubber Wall Base

a. Burke Flooring Products

b. Flexco Div., Textile Rubber Co.

c. R. C. Musson Rubber Co., Inc.

d. Roppe Rubber Corp.

2.2 COLORS AND PATTERNS

Provide colors an patterns as scheduled.

2.3 TILE FLOORING

2.3.1 Vinyl Composition Tile

FS SS-T-312, Type IV; 12" x 12", and as follows:

a. Composition 1 - asbestos-free.

b. Gage: 1/8".

2.4 ACCESSORIES

2.4.1 Rubber Wall Base

Provide rubber base complying with FS SS-W-40, Type I, with matching end stops and preformed or molded corner units, and as follows:

a. Height: 4".

b. Thickness: 1/8" gage.

c. Style: Standard top-set cove.

d. Finish: Matte.

2.4.2 Resilient Edge Strips

1/8" thick, homogeneous vinyl or rubber composition, tapered or bullnose edge, color as selected by Officer-in-Charge from standard colors available; not less than 1" wide.

2.4.3 Adhesives (Cements)

Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.

2.4.4 Concrete Slab Primer

Non-staining type as recommended by flooring manufacturer.

2.4.5 Leveling and Patching Compounds

Latex type as recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

a. Require Installer to inspect subfloor surfaces to determine that they are satisfactory. A satisfactory subfloor surface is defined as one that is smooth and free from cracks, holes, ridges, coatings preventing adhesive bond, and other defects impairing performance or appearance.

b. Perform bond and moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry, as well as to ascertain presence of curing compounds.

c. Do not allow resilient flooring work to proceed until subfloor surfaces are satisfactory.

3.2 PREPARATION

a. Prepare subfloor surfaces as follows:

(1) Use leveling and patching compounds as recommended by resilient flooring manufacturer for filling small cracks, holes, and depressions in subfloors.

(2) Remove coatings from subfloor surfaces that would prevent adhesive bond, including curing compounds incompatible with resilient flooring adhesives, paint, oils, waxes, and sealers.

b. Broom clean or vacuum surfaces to be covered, and inspect subfloor.

c. Apply concrete slab primer, if recommended by flooring

manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.3 INSTALLATION, GENERAL

a. Install resilient flooring in strict compliance with manufacturer's printed instructions.

b. Scribe, cut, and fit resilient flooring to permanent fixtures, pipes, outlets and permanent columns, walls, and door frames.

c. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.

d. Tightly cement resilient flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections. Hand roll resilient flooring at perimeter of each covered area to assure adhesion.

3.4 INSTALLATION OF TILE FLOORS

a. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis.

b. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged, if so numbered. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.

(1) Lay tile in "checkerboard" fashion with grain reversed in adjacent tiles.

c. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.5 CLEANING AND PROTECTION

a. Perform following operations immediately upon completion of resilient flooring:

(1) Sweep or vacuum floor thoroughly.

(2) Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed to allow resilient flooring to become well-sealed in adhesive.

(3) Damp-mop floor being careful to remove black marks and excessive soil.

(4) Remove any excess adhesive or other surface blemishes, using appropriate cleaner recommended by resilient flooring manufacturers.

b. Protect flooring against damage during construction period to comply with resilient flooring manufacturer's directions.

(1) Apply protective floor polish to resilient flooring surfaces free from soil, excess adhesive, or surface blemishes. Use commercially available metal cross-linked acrylic product acceptable to resilient flooring manufacturer.

(2) Protect resilient flooring against damage from rolling loads for initial period following installation by covering with plywood or hardboard.

(3) Cover resilient flooring with undyed, untreated building paper until inspection for substantial completion.

c. Clean resilient flooring not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Clean resilient flooring by method recommended by resilient flooring manufacturer.

(1) Strip protective floor polish, which was applied after completion of installation, prior to cleaning.

(2) Reapply floor polish after cleaning.

3.6 EXTRA STOCK

a. Deliver stock of maintenance materials to State. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.

(1) Tile Flooring: Furnish not less than one box for each 50 boxes or fraction thereof, for each type, color, pattern, and size installed.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 09900

PAINTING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

a. Work includes painting and finishing of all new and existing interior and exterior exposed items and surfaces throughout project, except as otherwise required.

   1. Surface preparation, priming, and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.

b. Work includes field painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise required.

c. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

d. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces, whether or not colors are designated in "schedules." Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Officer-in-Charge will select these from standard colors or finishes available.

e. Repaint existing surfaces in Electric Equipment Room, Generator Room and Discharge Air Plenum A & B.

f. Following categories of work are not included as part of field-applied finish work.

   (1) Pre-Finished Items: Unless otherwise required, do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) stone, toilet partitions and accessories, hardware, and finished mechanical and electrical equipment, including light fixtures, and distribution cabinets.

   (2) Concealed Surfaces: Painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, enclosed area above ceilings, furred areas, and pipe spaces.

   (3) Finished Metal Surfaces: Metal surfaces of Kyna 500 finished aluminum, and similar finished materials will not require finish painting.

(4) Operating Parts: Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.

f. Following categories of work are included under other sections of these specifications:

(1) Shop Priming: Shop priming of ferrous metal items is included under various sections for metal fabrications, hollow metal work, and similar items.

(2) Shop priming of fabricated components such as factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.

g. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nonenclature plates.

h. Existing Painted Surfaces: Existing surfaces have not been tested for lead-containing paint. The Contractor shall test paint where preparation will require sanding, grinding, or other procedure that would cause lead to become airborne or contaminate the surfaces below. If tested and found to contain lead, test results shall be given to the Officer-in-Charge for determination of preparation procedures. Preparation of existing lead-containing paint surfaces shall be in conformance with all federal, state, and local regulations, standards and codes.

1.2 QUALITY ASSURANCE

1.2.1 Single Source Responsibility

Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

1.2.2 Coordination of Work

Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

1.3 SUBMITTALS

1.3.1 Product Data

Submit manufacturer's technical information, including paint label analysis and application instructions for each material proposed for use.

1.3.2 Samples

Prior to beginning work, submit samples for Officer-in-Charge's review of colors and textures only. Provide a listing of material and application for each coat of each finish sample.

a. On 12" x 12" hardboard, provide two samples of each color and material. Resubmit samples as requested by Officer-in-Charge until acceptable sheen and color is achieved.

b. On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. Provide full-coat finish samples on at least 100 sq. ft. of surface, a directed, until required sheen, color, and texture is obtained.

(1) Final acceptance of colors will be from samples applied on the job.

1.3.3 Manufacturer's Material Safety Data Sheets

Manufacturer's Material Safety Data Sheets for coatings, solvents, and other hazardous materials shall be submitted to the Officer-in-Charge.

1.4 DELIVERY AND STORAGE

a. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:

(1) Name of title of material.

(2) Manufacturer's stock number and date of manufacturer.

(3) Manufacturer's name.

(4) Contents by volume, for major pigment and vehicle constituents.

(5) Thinning instructions.

(6) Application instructions.

(7) Color name and number.

b. Store materials, not in actual use, in tightly covered containers. maintain containers, used in storage of paint, in a clean condition, free of foreign materials and residue.

(1) Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing, and application of paints.

1.5 JOB CONDITIONS

a. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are below 90°F, unless otherwise permitted by paint manufacturer's printed instructions.

b. Apply solvent-thinned paints only when temperature of surfaces to be painted surrounding air temperatures are below 90°F, unless otherwise permitted by paint manufacturer's printed instructions.

c. Do not apply paint in rain, fog, or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

(1) Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed within temperature limits specified by paint manufacturer during application and drying periods.

1.6 SPECIAL REQUIREMENTS

1.6.1 Codes

The Contractor shall comply with the State OSHL (Occupational Safety and Health Law) and all pollution control regulations of the State Department of Health.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Manufacturer

Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limit to, the following:

a. Sinclair Paint

b. Benjamin Moore and Co.

c. Pittsburgh Paints

d. Pratt and Lambert

e. The Sherwin-Williams Company

f. Fuller O'Brien Paint

2.2 MATERIALS

2.2.1 Material Quality

Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not

displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

a. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

2.2.2 Color Pigments

Pure, non-fading, applicable types to suit substrates and service required.

2.2.3 Mildewcide

Except for metal primers all paint shall contain the maximum amount of mildewcide per gallon of paint permitted by the mildewcide manufacturer without adversely affecting the quality of the paint.

a. The supplier shall submit a signed certificate indicating the amounts of mildewcide added by both the paint manufacturer and the paint supplier.

PART 3 EXECUTION

3.1 INSPECTION

a. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.

b. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

c. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION

3.2.1 General

Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions, and as herein specified, for each particular substrate condition.

a. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Officer-in-Charge in writing of any anticipated problems in using the specified coating systems with substrates primed by others.

b. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not be finish-painted, or provide surface-applied protection prior to

surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

c. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

d. Remove all mildew stain from surface by applying Clorox, Purex, Jomax Remover, or equal with strength adjusted as required. After treating thoroughly rinse with potable water.

e. Wash all existing surfaces with a solution of T.S.P. and water or other appropriate solution to remove any accumulated film of wax, oil, grease, smoke, dust, dirt, chalking or other foreign matter which will impair bond of, or bleed through new finish. After washing, rinse with potable water and allow to dry thoroughly.

3.2.2 Cemetitious Materials

Prepare cementitious surfaces of concrete and concrete block to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.

a. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

b. Seal all cracks hairline to 1/8" on concrete surface with concrete patching compound. All cracks over 1/8" in width shall be sealed with Tuff patch (Fibre-Glass Cloth System) or equal method before paint application. All patching shall be done in accordance with manufacturer's recommended specifications.

c. All holes 1/4" in diameter or greater shall be sealed with Tuff Patch (Fibre-Glass Cloth System) or equal method before paint application. All patching shall be done in accordance with manufacturer's recommended specifications.

3.2.3 Ferrous Metals

Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning.

a. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications.

b. Clean and touch-up with same type shop primer.

c. Remove all rust to bare metal.

3.2.4 Galvanized Surfaces

Clean free of oil and surface contaminants with non-petroleum based solvent.

3.2.5 Wood Surfaces

Fill nail holes, cracks, open joints and other imperfections with appropriate compound and allow to set (door and trim included). Caulk all openings which will permit the entrance of water.

3.3 MATERIALS PREPARATION

a. Mix and prepare painting materials in accordance with manufacturer's directions.

b. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

c. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.4 APPLICATION

3.4.1 General

Apply paint in accordance with manufacturer's directions. use applicators and techniques best suited for substrate and type of material being applied.

a. Paint colors, surface treatments, and finishes, are indicated in "schedules" of the contract documents.

b. Provide finish coats which are compatible with prime paints used.

c. Apply additional coats when undercoats, or other conditions show through final coat of paint, until
paint film is of uniform finish,
color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

d. Finish doors on tops, bottoms, and side edges same as exterior faces.

e. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted.

3.4.2 Scheduling Painting

Apply first-coat material to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

a. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3.4.3 Minimum Coating Thickness

Apply materials at not less than manufacturer's recommended spreading rate, to establish a minimum total dry film thickness as recommended by coating manufacturer.

3.4.4 Electrical Work

Painting of electrical work is limited to those items which are exposed in the finished construction. Touch-up damaged factory finished surfaces of new equipment. Electrical items to be painted include exposed conduits and waterproof outlets.

3.4.5 Mechanical Items

Mechanical items to be painted include: Exposed pipe, pipe hangers, and supports.

3.4.6 Prime Coats

Apply prime coat to material which is required to be painted or finished, and which has not been prime coated by others.

a. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

3.4.7 Pigmented (Opaque) Finishes

Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

3.4.8 Completed Work

Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.5 CLEAN-UP AND PROTECTION

3.5.1 Clean-Up

During progress of work, remove from site discarded paint materials, rubbish, cans, and rags at end of each work day.

a. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

3.5.2 Protection

Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Officer-in-Charge.

a. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

b. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.6 PAINT SCHEDULE (EXTERIOR AND INTERIOR)

3.6.1 General

Provide the following paint systems for the various substrates except where indicated as elastomeric deck coating or elastomeric acrylic coating. Provide alkyd based primer over existing enamel and other non-compatible paint systems. Repainting shall be in accordance with the manufacturer's instructions and include a minimum of two (2) finish coats over prepare substrate.

3.6.2 Interior and Exterior Concrete

Two (2) coats with total dry film thickness not less than 2.5 mils.

a. First and Second Coats: Semi-gloss Acrylic Emulsion

3.6.3 Ferrous Metal

Semi-Gloss Epoxy: 3 Finish coats

a. First, Second, and Third Finish Coats: Semi-Gloss Amerock 400 Hi-Build Epoxy or approved equal.

3.6.4 Zinc-Coated Metal

One (1) finish coat over primers.

a. First and Second Coats: Semi-Gloss Amerlock 400

b. One Finish Coat: Semi-Gloss Amershield Hi-Build Epoxy or approved equal.

3.6.5 Interior Concrete Masonry Units

Semi-Gloss Acrylic Finish: 2 coats with total dry film thickness not less than 2.5 mils.

a. Filler Coat: Solvent Thinned Block Filler for Porous Surfaces

b. First and Second Coats: Semi-Gloss Acrylic Emulsion

3.6.6 Interior Gypsum (Toilet/Locker only)

a. Prime Coat: Latex Wall Primer

b. First and Second Finish Coats: Alkyd Eggshell Enamel

3.6.7 Interior Gypsum

Prime coat enamel under coater.

a. Prime Coat: Latex Wall Primer

b. First and Second Finish Coats: Acrylic Emulsion

3.6.8 Interior Wood

Two (2) finish coats with a dry film thickness of not less than 2.5 mils over prime coat.

a. Prime Coat: Enamel Undercoater

b. First and Second Finish Coats: Alkyd Eggshell Enamel

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 10100

MARKERBOARD TACKBOARD

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Provide marker tackboard as shown and as specified herein.

1.2 SUBMITTALS

a. Submit 6 copies of manufacturer's brochures with specifications and shop drawings with construction and installation details.

b. Manufacturer's samples of facing material for color and material selection.

1.3 QUALITY ASSURANCE

1.3.1 Manufacturer's Standard of Quality

To establish type and standard of quality, the specified product is manufactured by Claridge Products and Equipment, Inc.

1.4 PRODUCT HANDLING

Materials shall be delivered and stored with adequate protection against damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Claridge Products and Equipment. Factory built unit, Type BR Series 4 or approved equal.

2.2 MATERIALS

2.2.1 Asbestos Prohibition

No asbestos containing materials or equipment shall be used under this section. The Contractor shall ensure that all materials and equipment incorporated in the project are asbestos-free.

2.2.2 Markerboard

2.2.2.1 Face Sheet

24 ga. porcelain enamel steel writing surface manufactured in accordance with performance specifications of Porcelain Enamel Institute.

2.2.2.2 Core

1/2" fiberboard.

2.2.2.3 Backing Sheet

.005 aluminum foil or .015 aluminum sheet.

2.2.2.4 Laminating Adhesive

Manufacturer's standard moisture resistant thermostatic type adhesive.

2.2.3 Map Hooks

Aluminum map hooks with spring clip to slide on map rail. Provide one (1) hook for each three (3) feet of map rail, with a minimum four hooks per rail.

2.2.4 H-Bar

Aluminum joint extrusion, with exposed surface in color matching that of markerboard.

2.2.5 Trims and Tray

Aluminum 6063-T5 anodized satin finish in extruded shapes of approved design and shapes.

2.2.6 Tackboard

1/4" thick resilient cork composition with vinyl fabric face with washable surface.

2.2.7 Finish and Color

Markerboard and tackboard finish and color shall be selected from manufacturer's standard color range, consisting of minimum 5 different available colors for each markerboard and tackboard.

PART 3 EXECUTION

3.1 INSPECTION

The Installer shall examine the areas and conditions under which markerboards and tackboards are to be installed. Should any condition be found unsuitable, no work shall be done until the unsatisfactory conditions have been corrected and are acceptable to the Installer. Proceeding with work will imply acceptance of the conditions by the Installer.

3.2 INSTALLATION

a. Deliver factory built markerboard and tackboard units completely assembled without joints whenever possible. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery and make final joints at

site. Use splines at joints to maintain surface alignment.

b. Install units at locations and mounting heights indicated in accordance with manufacturer's instructions. Keep perimeter lines straight, plumb and level.

Surfaces shall be absolutely flat without any buckling, bending, sagging or looseness.

c. Markerboards shall be installed in single lengths up to 12". Longer boards shall be divided into 2 equal lengths. Joining shall be done in accordance with manufacturer's standards. Tackboards shall be installed in single lengths.

d. Provide all grounds, clips, backing materials, adhesives, brackets, anchors, trims and accessories necessary for a complete installation.

3.3 ADJUST AND CLEAN

a. Verify that accessories required for each unit have been properly installed and that operating units function properly.

b. Clean units in accordance with manufacturer's instructions. Break in markerboards only as recommended by the manufacturer.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 10160

TOILET PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 84

1.2 SUMMARY

a. Types of toilet compartments include:

(1) Solid Phenolic Core

b. Styles of toilet compartments include:

(1) Overhead braced floor and wall anchored.

c. Styles of screens include:

(1) Wall-hung.

d. Toilet accessories are specified in Section 10800, "Toilet Accessories."

1.3 SUBMITTALS

1.3.1 Product Data

Submit manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings, and accessories.

1.3.2 Shop Drawings

Submit shop drawings for fabrication and erection of toilet partition assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.

1.3.3 Samples

Submit 6" square samples of each color and finish on same substrate to be used in work, for color verification after selections have been made.

1.4 QUALITY ASSURANCE

1.4.1 Field Measurements

Take field measurements prior to preparation of shop drawings and fabrication where possible, to ensure proper fitting of work. However, allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay work.

1.4.2 Coordination

Furnish anchorages which must be built into other work for installation of toilet partitions and related work; coordinate delivery with other work to avoid delay.

PART 2 PRODUCTS

2.1 MANUFACTURERS

2.1.1 Available Manufacturers

Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

a. Accurate Partitions Div., ITR Industries, Inc.

b. Bobrick Washroom Equipment, Inc.

c. Global Steel Products Corp.

2.2 MATERIALS

2.2.1 General

Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.

2.2.2 Concealed Anchorage Reinforcement

Minimum 12-gage galvanized steel sheet.

2.2.3 Concealed Tapping Reinforcement

Minimum 14-gage galvanized steel sheet.

2.2.4 Anchorages and Fasteners

Manufacturer's standard exposed fasteners of stainless steel, chromium-plated steel, or brass finished to match hardware, with theft-resistant type heads and nuts. For concealed anchors, use hot-dip galvanized, cadmium-plated, or other rust-resistant protective-coated steel.

2.3 FABRICATION

2.3.1 General

Furnish standard doors, panels, screens, and pilasters fabricated for partition system. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as required.

2.3.2 Door Dimensions

Furnish 36" wide door at stall equipped for use by handicapped.

2.3.3 Phenolic Plastic Doors, Stiles, and Pilasters

a. Shall be fabricated with a solid phenolic core of multiple resin-impregnated kraft paper sheets with a matte finish melamine surface fused under high temperature and pressure.

b. The exposed finish surfaces shall be self-lubricating; smooth; waterproof; non-absorbent; stain, chemical and graffiti resistant.

c. Phenolic plastic shall have a Class A or B Flame Spread Rating and a maximum Smoke Developed Rating of 450 in conformance with ASTM E 84.

d. Edges shall be machined smoothed with 1/16-inch radius corners.

2.3.4 Doors

a. Doors shall be of solid phenolic plastic a minimum of 3/4-inch thick.

b. Unless otherwise noted on the drawings, a minimum clear door opening width of 36 inches shall be provided at the door leading to a handicap accessible toilet stall. This clear width shall be measured between the edge of the door bumper/keeper and the face of the door when opened 90 degrees.

2.3.5 Stiles and Pilasters

Stiles and pilasters shall be of solid phenolic plastic having stiles and pilasters a minimum of 3/4-inch thick.

2.3.6 Headrails

Headrails for overhead-braced compartments shall be of anodized, extruded aluminum alloy with end-caps, of anti-grip design or as standard with the manufacturer; or solid wood core surfaced with plastic laminate and having minimum cross-sectional dimensions of 1-1/4 in. x 2 in.

2.3.7 Urinal Screens

a. Shall be of the types and sizes shown on drawings.

b. Screens shall be of solid phenolic plastic a minimum of 3/4-inch thick for wall-hung installations.

2.3.8 Hardware and Fittings

2.3.8.1 Doors, Pilasters and Screens

Doors, pilasters and screens shall be furnished with the necessary hardware and fittings to provide a complete installation. They shall be pre-cut to facilitate erection and minimize field errors.

2.3.8.2 Materials

Hardware and fittings shall be satin-finish stainless steel. Non-ferrous alloys such as Zamac castings shall not be used.

2.3.8.3 Door Hinges

Either spring or cam-action type and adjustable to hold the door open about 12 inches in a pre-set position. All parts shall be non-rusting such as stainless steel pintles; nylon or delrin cams; nylon delrin or self-lubricating bronze bushings; and housings of anodized extruded aluminum alloy or satin-finish stainless steel.

2.3.8.4 Latches

The latch shall be of a shape which is easy to grasp with one hand and which does not require tight grasping, tight pinching or twisting of the wrist to operate and shall be operable by a person on the outside in the event of an emergency. Mechanisms such as slide bolts with a projecting handle on the inside of the stall which can be opened by a person the outside reaching over the door with a stick are acceptable.

2.3.8.5 Door Pulls

Handicap accessible toilet stall doors shall be furnished with a grab bar/door pull, 18 inches long, mounted horizontally on the inside face of the door adjacent to the hinge to facilitate closing of the door upon entry.

2.3.8.6 Coat Hook/Door Bumper

Furnish one each per door.

2.3.8.7 Shoe

All pilasters and stiles shall have a 3 inch high minimum trim cover or shoe of Type 302 or 304 stainless steel, chrome plated brass or anodized extruded aluminum at the floor.

2.3.8.8 Hardware Mounting Heights

The highest part of any handle, pull, grab, bar, latch or operating mechanism shall be at 36 inches maximum above the finished floor.

2.3.8.9 Fasteners

Hardware and fittings shall be fastened with theft-resistant one-way stainless steel or chrome plated brass through-bolts or machine screws in factory installed steel inserts.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Comply with manufacturer's recommended procedures and installation sequence. Install partitions rigid, straight, plumb, and level. Provide clearances of not more than 1/2" between pilasters and panels, and not more than 1" between panels and walls. Secure panels to walls with not less than two stirrup brackets attached near top and bottom of panel. Secure panels to pilasters with not less than two stirrup brackets located to align with stirrup brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.

3.1.2 Overhead Braced Partitions

Secure pilasters to supporting structure, and level, plumb, and tighten installation with devices furnished.

3.1.3 Screens

Attach with concealed anchoring devices, as recommended by manufacturer to suit supporting structure. Set units to provide support and to resist lateral impact.

3.2 ADJUST AND CLEAN

3.2.1 Hardware Adjustment

Adjust and lubricate hardware for proper operation. Set hinges on inswinging doors to hold open approximately 12 inches from closed position when unlatched. Set hinges on outswinging doors to return to fully closed position.

3.2.2 Exposed Surfaces of Partition Systems

Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 10200

LOUVERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM B 221

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 12

1.2 SUMMARY

This section includes the following:

a. Standard extruded aluminum louvers.

Related Sections: The following sections contain requirements that relate to this section.

a. Division 7 Section - Joint Sealers for sealants installed in perimeter joints between louver frames and adjoining construction.

1.3 DEFINITIONS

1.3.1 Louver Terminology

Refer to AMCA Publication 501 for definitions of terms for metal louvers not otherwise defined in this section or referenced standards.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

1.4.1 Structural Performance

Design, engineer, fabricate, and install exterior metal wall louvers to withstand the effects of loads and stresses from wind and normal thermal movement, without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; and permanent damage to fasteners and anchors:

a. Wind Load: Uniform pressure (velocity pressure) of 20 lbf per sq. ft. acting inwards or outwards.

b. Normal thermal movement is defined as that resulting from the following maximum change (range) in ambient temperature. Base

design calculations on actual surface temperatures of metals due to both solar heat gain and night time sky heat loss.

(1) Temperature Change Range: 100 deg. F.

1.5 SUBMITTALS

a. Product data for each product specified.

b. Shop drawings of louver units and accessories. Include plans, elevations, sections, and details showing profiles, angles, spacing of louver blades; unit dimensions related to wall openings and construction; free areas for each size required; and profiles of frames at jambs, heads, and sills.

c. Product test reports evidencing compliance of units with performance requirements.

1.6 QUALITY ASSURANCE

1.6.1 Single Source Responsibility

Obtain louvers from a single source where alike in one or more respects with regard to type, design, and factory-applied color finish.

1.7 PROJECT CONDITIONS

1.7.1 Field Measurements

Check actual louver openings by accurate field measurements before fabrication; show recorded measurements on final shop drawings. coordinate fabrication schedule with construction progress to avoid delay of the Work.

a. Where field measurements cannot be made without delaying the Work, guarantee opening dimensions and proceed with fabrication of louvers without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to guaranteed dimensions.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Extrusions

ASTM B 221, Alloy 6063-T5 or T-52.

2.1.2 Fastenings

Of same basic metal and alloy as fastened metal. Do not use metals which are corrosive or incompatible with materials joined.

a. Use types, gages, and lengths to suit unit installation conditions.

b. Use Phillips round head Type 316 Stainless Steel screws for exposed

fasteners.

2.1.3 Bituminous Paint

SSPC Paint 12 (cold-applied asphalt mastic).

2.2 FABRICATION, GENERAL

a. General: Fabricate louvers to comply with requirements for design, dimensions, materials, joinery, and performance.

b. Preassemble louvers in shop.

c. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

d. Fabricate frames, to fit in openings of size(s) required with allowances made for fabrication and installation tolerances of louvers, adjoining construction, and perimeter sealant joints.

2.3 STANDARD MULLION LOUVERS

2.3.1 Available Manufacturers

Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, Model No. 4097 as manufactured by Construction Specialties, Inc.

2.3.2 Frame and Blades

Frame and blades shall be minimum .125" thick aluminum extrusions with reinforcing bosses. Heads, sills, and jambs shall be one-piece structural members and have integral caulking slot and retaining bead.

2.3.2.1 Louver Depth

4".

2.3.2.2 Free Area

55.0%.

2.4 LOUVER SCREENS

2.4.1 General

Provide each exterior louver with louver screens complying with the following requirements:

2.4.1.1 Screen Location for Louvers

Exterior face.

2.4.1.2 Screening Type

Bird screening.

2.4.2 Screens

Secure screens to louver frames with stainless steel machine screws, spaced at each corner and at 12-inch o.c. between.

2.4.3 Louver Screen Frame

Fabricate screen frames with mitered corners to louver sizes and to comply with the following requirements:

2.4.3.1 Metal

Same kind and form of metal as louver frames to which screens are attached.

a. Reinforce extruded aluminum screen frames at corners with clips.

2.4.3.2 Finish

Same finish as louver frames to which louver screens are attached.

2.4.4 Louver Screening for Aluminum Louvers

Fit aluminum louver screen frames with screening covering louver openings and complying with the following requirements:

2.4.4.1 Bird Screening

1/2 inch square mesh formed with 0.063 inch diameter aluminum wire.

2.5 FINISHES, GENERAL

a. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

b. Kynar 500 Finish: A minimum 1.0 mil thick full strength 70% resin flouropolymer coating for louver screen frame and bird screen.

PART 3 EXECUTION

3.1 INSTALLATION

a. Locate and place louver units plumb, level and in proper alignment with adjacent work.

b. Use concealed anchorages where possible.

c. Form closely fitted joints with exposed connections accurately located and secured.

d. Provide perimeter reveals and openings of uniform width for sealants and joint fillers.

e. Repair finishes damaged by cutting, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items which cannot be refinished in field to shop, make required alterations, and refinish entire unit, or provide new units.

f. Protect galvanized and nonferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with masonry or dissimilar metals.

g. Install joint fillers as louver installation progresses where required to make louver joints weathertight. Comply with Division 7 Section - Joint Sealers for sealants applied during installation of louvers.

3.2 ADJUSTING AND PROTECTION

a. Protect louvers from damage of any kind during construction period, including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.

b. Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by Owner's Representative, remove damaged units and replace with new units.

3.3 CLEANING

a. Periodically clean exposed surfaces of louvers, which are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until finish cleaning.

b. Before final inspection, clean exposed surfaces with water and with a mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

PART 4 - MEASUREMENT AND PAYMENTS

The total lump sum amount paid for the bid item(s) listed on the bid scheule under whic this section is a part of shall include full payment for all costs covered by the provisions of this Section.

-- End of Section --

SECTION 10440

SIGNAGE

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Provide all room signage as shown and as specified herein.

1.2 SUBMITTALS

Submit six (6) sets of the following for approval by the *Officer-in-Charge*.

1.2.1 Product Data

Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

1.2.2 Shop Drawings

Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and other components. Show anchors, layout, and installation details.

a. Provide message list for each sign required, including large-scale details of wording and layout of lettering.

1.2.3 Samples

Provide the following samples of each sign component for initial selection of color and finish as required and for verification of compliance with requirements indicated.

a. Samples for initial selection of color and finish.

(1) Melanine Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

b. Samples for verification of color and finish selected, and compliance with requirements indicated.

1.3 CODE COMPLIANCE

American Disability Act Accessibility Guidelines (ADA).

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General Requirements

Character proportion, color contrast, dimension, depth, and heights of symbols and letters, location, and mounting heights shall be in accordance with the requirements noted in the American's With Disabilities Act Accessibility Guidelines (ADA).

2.1.2 Room Signs

As scheduled at the end of this section.

a. Sign plaques shall be melamine plastic laminate, approximately 1/8" thick, with contrasting core color, non-static, fire-retardant and self-extinguishing. Plastic laminate shall have a contrasting core color and shall be impervious to most acids, alkali's, alcohol, solvents, abrasives and boiling water. Where three colors are desired, the third color shall be painted in accordance with the signage manufacturer's recommendations. Finish color to be selected by Officer-in-Charge.

b. Letters, symbols and borders shall be raised 1/32 inch. Individual cutout letters and symbols which are applied to the sign plaque shall not be used.

c. Where a white or light colored background (core color) is selected, the background surface shall be coated with a white or clear graffiti resistant coating as approved by the signage manufacturer. The coating shall provide a finish which is resistant to pencils, pens and felt tip markers.

d. Unless otherwise noted signs shall be mounted with double stick tape, 3M - 1/32" Neoprene tape (black) #4962 and silicone adhesive.

e. Sign plaques shall be Best ES Plastic series as manufactured by Best Manufacturing Company, or approved equal. Color to be selected by Engineer from manufacturer's 25 color selections.

f. Size for toilet/locker shall be 6" x 7 3/4" and room size 3" high x varies length.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

a. Installation of all signage shall be in strict accordance with manufacturer's printed instructions and approved shop drawings. Installation shall be accomplished by experienced mechanics and in a workmanlike manner.

b. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

c. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance in accordance to ADA requirements.

3.1.2 Wall Mounted Panel Signs

Attach panel signs to wall surfaces using one-way, tamper-proof fasteners. shields shall be provided as required to suit the mounting conditions. Double-stick tape or adhesives shall not be used.

3.2 CLEANING AND PROTECTION

At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Officer-in-Charge. Remove all tools, equipment, debris, and surplus materials.

3.3 SIGNAGE SCHEDULE

Signage Schedule

Room Name (5/8" high, Caps Times Roman, 1/32" raised letters	Pictogram (1/32" raised)	International Symbol of Accessibility (1/32" raised)	Grade 2 Braille Letters
Toilet/Locker	X	X	X
Office	X		X
Janitor	X		X
A/C Room	X		X
Storage	X		C

NOTE: Mounting height shall be 5'-0" to the center of the sign, on the wall nearest the latch sigde of theer.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 10501

LOCKER ACCESSORIES AND LOCK

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Provide six (6) metal lockers as shown on drawing.

1.2 SUBMITTALS

Manufacturer's Catalog Data.

1.3 DELIVERY AND TOUCH-UP

a. Lockers shall not be delivered to site until building is ready for the installation, unless Contractor has allocated storage space in a protected area within a building.

b. Any chips or minor scratches in the finish may be repaired on the job with material similar to original finish applied in approved manner. Warped units or units with major dents, gouges or abrasions shall be returned to the factory for replacement or repair.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Available Manufacturer

Subject to compliance with requirements, manufacturers offering lockers which may be incorporated in the work include, but are not limited to, the following:

a. Lyon Metal Products

b. Republic Berger Manufacturing Company

2.2 MATERIALS

2.2.1 Type

Single tier, 12" w. x 18" d. x 72" h., without legs for installation on concrete base.

2.2.2 Frame

Frame to be constructed of 1" x 1 x 12 gauge steel angle uprights and heavy gauge steel cross members, with four projection welds at each of the four corners. Upright members to extend to the floor. Tops, bottoms, and interbottoms of lockers to be bolted to cross members, as well as to body of locker. Cross member is not to lap over the face of the upright. The frame is to present a flush exterior and it to have a smooth finish. Omit

legs for curb installation.

2.2.3 Doors

Semi-flexible type, 16 gauge steel, with full 1" flange on all four sides. Doors are ventilated with modular banks of inverted louvers, providing flush exterior door surface.

2.2.4 Locking Device

Positive automatic pre-locking type, whereby locker may be locked while door is open, then closed without unlocking and without damaging mechanism. Provide live rubber silencers at top and bottom of latching bar, secured with rivets having the heads moulded into the rubber; handles to be straight lift type, with padlock strike. Two locking points for each door. Lockers shall be designed for padlocks, but padlocks not furnished.

2.2.5 Number Plates

Shall be corrosive-resistant with 3/8" black figures, numbering system as directed.

2.2.6 Handles

Stationary handle case to be secured to door at six points. The handle slide must be fully protected at top and bottom by the stationary case to minimize abuse. Any blow directed to this handle will thereby be absorbed by the stationary case and cannot be transmitted to the handle slide, or latching mechanism. The handle must not provide openings or surfaces where leverage can be applied to force handle upward when in a locked position. Handle to be cast zinc alloy, with a bright chrome finish. Handle must provide a padlock eye for 5/16" shackle padlock, and provide a padlock strike to protect finish of door.

2.2.7 Hinges

Heavy duty 2" tight pin, full loop, five knuckle, butt type hinges. Riveted to frame with two 3/16" truss-head rivets, and bolted to door with two 3/16" x 7/16" slotless bolt and shakeproof locking nuts - NOT SPOT welded. Hinge pin must not be embossed in door where it can be easily disengaged by removing hinge clip. Hinge pin must be so constructed that it cannot be removed.

2.2.8 Backs, Sides, Ends, Tops, and Closures

a. Standard material shall be 24 gauge steel. Backs shall have 3/4" flanges.

b. Recessing trim shall be 16 gauge, securely bolted to locker frames.

2.2.9 Nuts and Bolts

Shall be cadmium or zinc plated with shakeproof locking nuts.

2.2.10 Finish

Shall be bonderized with 5 step process and baked-on enamel finish, 1.5 mils dry thickness. Color to be selected by the Officer-in-Charge from standard selection.

2.2.11 Installation

Lockers shall be assembled into units and securely anchored to wall and base with approved fastenings, as expansion bolts with shields or toggle bolts; wood screws not acceptable. Fastenings shall be applied through suitable reinforcing plates, approximately 48" o.c.

2.2.12 Shelves and Hooks

Shelves and hooks are required.

PART 3 EXECUTION

Not used.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 10800

TOILET ACCESSORIES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

Types of toilet accessories required include the following:

a. Combination paper tower dispenser and waste receptacle.

b. Grab bars.

c. Toilet tissue dispenser.

d. Mirror.

e. Soap dispenser.

f. Robe hook.

g. Shower seat.

h. Shower rod.

i. Shower curtain/hooks.

1.2 QUALITY ASSURANCE

1.2.1 Accessory Locations

Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.

1.3 SUBMITTALS

1.3.1 Product Data

Submit manufacturer's technical data and installation instructions for each toilet.

1.3.2 Samples

Submit full-size samples of units to Officer-in-Charge for review of design and operation. Acceptable samples will be returned and may be used in the work.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

2.1.1 Available Manufacturers

Subject to compliance with requirements, manufacturers offering toilet accessories which may be incorporated in the work include, but are not limited to, the following:

a. Bobrick Washroom Equipment, Inc.

b. Bradley Corporation

2.1.2 Departures from Scheduled Designations

The use of one manufacturer's numerical designation system of the toilet accessory items does not imply that another manufacturer's products will not be acceptable, unless they are not acceptable in design or not equal in size, weight, finish, function or other quality of significance. However, no substitutions will be allowed after acceptance of accessory supplier's submittals.

2.2 MATERIALS, GENERAL

2.2.1 Stainless Steel

AISI Type 302/304, applicable finish and minimum gage as specified.

2.2.2 Chromium Plating

Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

2.2.3 Galvanized Steel Mounting Devices

ASTM A 153, hot-dip galvanized after fabrication.

2.2.4 Fasteners

Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

2.3 COMBINATION TOWEL DISPENSER AND WASTE RECEPTACLE

Recessed unit of 22 age Type 304 satin finish stainless steel. Paper towel dispenses 600 C-fold or 800 multifold paper towels, waste receptacle shall have a capacity of 12 gallons or more. Unit equal to Bobrick No. 3944.

2.4 GRAB BARS

a. Wall mounted grab bars shall be 18 gage, type 304 satin finish stainless steel bars with flanges and concealed mountings; 1-1/2" o.d.; 1-1/2" wall clearance; equal to Bobrick No. B6806 x 42" and x 36" a indicated.

b. Wall and floor mounted grab bars shall be 18 gage, type 304 satin finish stainless steel bars with flanges and concealed mountings; 1-1/2" o.d.; equal to Bobrick No. B-6819 and 6818 x 48" long x 35"

high as indicated.

2.5 TOILET TISSUE DISPENSER

Surface mounted unit of cast aluminum with satin finish. Spindles shall be molded and extruded ABS and shall be equipped with retractable pin and concealed locking mechanism. Unit shall accommodate two standard core toilet tissue rolls up to 2000 sheets. Units shall be equal to Bobrick No. B-2740.

2.6 MIRROR

Stainless steel 1/2 inch by 1/2 inch by 1/2 inch channel frame with polished frame with No. 1 quality, 1/4 inch float glass mirror, and concealed galvanized wall hangers. Units shall be equal to Bobrick No. B-165 size 1836 unless otherwise noted.

2.7 SOAP DISPENSER

Surface mounted brightly polished chrome plated ABS Vandal-resistant. Translucent polyethylene visible soap level capacity 24 fl. oz. Bobrick B-155.

2.8 ROBE HOOK

Equal to Bobrick B-2116.

2.9 SHOWER SEAT

Frame fabricated of 1" dia. Type 304 (18-8) 18 gage stainless steel tubing. Wall bracket fabricated of 16 gage stainless steel with stainless steel piano hinges. Seat of blow-molded polyethylene. Unit equal to Bradley No. 956.

2.10 SHOWER ROD

Flanges and tubing of Type 304 (18-8) stainless steel equal to Bradley No. 9538.

2.11 SHOWER CURTAIN/HOOKS

Shower curtain 6 gage vinyl material with hemmed top edges and aluminum grommets on 6" centers. Beige color equal to Bradley No. 9533. Shower curtain hooks stainless steel spring wire with snap fasteners equal to Bradley No. 9536.

2.12 FABRICATION

2.12.1 General

No names or labels are permitted on exposed faces of toilet accessory units. On either interior surface, not exposed to view, or on back surface, provide identification of each accessory item by either a printed, waterproof label or a stamped nameplate indicating manufacturer's name and product model number.

PART 3 EXECUTION

3.1 INSTALLATION

Install accessory units in quantities required and in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights required.

3.2 ADJUSTING AND CLEANING

a. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.

b. Clean and polish all exposed surfaces after removing temporary labels and protective coatings.

PART 4 MEASUREMENT AND PAYMENT

The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part of shall include full payment for all costs covered by the provisions of this section.

-- End of Section --

SECTION 15011

MECHANICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993) Motors and Generators
NEMA MG 10	(1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to Division 16, "Standby Diesel-Electric Generators" and all sections of Division 15, "Mechanical" of this project specification, unless specified otherwise in the individual section.

1.3 QUALITY ASSURANCE

1.3.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and

materials under similar circumstances and of similar size.

1.3.2 Service Support

The equipment items shall be supported by service organizations in the State of Hawaii. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 SAFETY REQUIREMENTS

1.5.1 Equipment Safety

Provide positive means of locking out equipment so that equipment cannot be accidentally started during maintenance procedures. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of the type specified.

1.5.2 Warning Sign

Provide a permanent placard or sign at the entrance to confined spaces contained in the equipment. The sign shall warn personnel not to enter the space until the atmosphere inside has been tested and systems have been de-energized.

1.5.3 Lockout of Energy Sources

Provide appropriate lockout devices for energy isolating valves and for machines or other equipment to prevent unexpected start-up or release of stored energy.

1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors shall conform to and have electrical connections provided under Section 16402, "Interior Wiring Systems." Furnish internal wiring for

components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120 volt control circuits, and shall have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 16402, "Interior Wiring System."

1.6.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 16, except internal wiring for components of package equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.6.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 16.

1.6.3 High Efficiency Motors

1.6.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.6.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.7 INSTRUCTION TO OPERATING AND MAINTENANCE PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety

requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF NEW EQUIPMENT

Equipment painting, factory applied or shop applied, shall be as specified herein, and provided under each individual section.

3.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with ASTM B 117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, submit certifications that the manufacturer's standard factory painting system conforms to the heat resistance requirement in addition to other certifications.

3.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F shall receive two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

PART 4 MEASUREMENT AND PAYMENT

No direct measurement is taken of work performed in accordance with this section. Payment for work performed in accordance with this section is considered incidental to the various contract items in the porposal.

-- End of Section --

SECTION 15200

NOISE AND VIBRATION CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 471	(1979; R 1991) Rubber Property - Effect of Liquids
ASTM D 2240	(1991) Rubber Property - Durometer Hardness

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(1994) Structural Welding Code Steel

SHEET METAL & AIR CONDITIONING CONTRACTOR'S NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA APIDC	(1975) Accepted Industry Practice for Industrial Duct Construction
SMACNA ASMM	(1987) Architectural Sheet Metal Manual
SMACNA DCS	(1985) HVAC Duct Construction Standards - Metal and Flexible
SMACNA SRM	(1991) Seismic Restraint Manual Guidelines for Mechanical Systems

1.2 RELATED REQUIREMENTS

The provisions of Section 15011, "Mechanical General Requirements," Section 09500, "Acoustical Treatment," and Section 15895, "Ductwork and Ductwork Accessories" apply to this section.

1.3 SYSTEMS DESCRIPTION

1.3.1 Acoustical Treatments

a. Ventilation Openings: Treat discharge and intake air openings in the Generator Room with acoustic duct silencers.

b. Diesel Engine Generator: Treat engine exhaust with Type I and Type II silencers in series.

1.3.2 Vibration Isolator

Install isolators under Diesel Engine Generator and Radiator.

1.4 RELATED REQUIREMENTS

The provisions of the following sections apply to this section.

a. Section 15011, "Mechanical General Requirements."

b. Section 09500, "Acoustical Treatment."

c. Section 15840, "Sheetmetal Ductwork."

d. Section 16202, "Diesel Electric Generators 2,000 KW."

1.5 SUBMITTALS

1.5.1 SD-02, Manufacturer's Catalog Cuts

a. Acoustical duct silencer

b. Diesel engine exhaust pipe, flexible joint and silencers

c. Spring and neoprene vibration isolator

1.5.2 SD-04, Shop Drawings

a. Acoustic duct silencer

(1) Construction details, sections, dimensions

(2) Performance: Dynamic insertion loss, vs. frequencies and aerodynamic pressure drop vs. air volume, and self-noise data sheet

(3) Installation details

b. Air Conditioning Ductwork

Ductwork showing mounting devices, supports, metal gages, protective coating and typical joint details.

c. Diesel engine exhaust pipe and silencers

(1) Construction Details: Submit drawings showing muffler construction, section, dimensions, weights, fitting, mounting and fabrication details, including location and composition of all acoustic fill materials. Submit drawings for exhaust pipe insulation, roof penetration and suspension systems.

(2) Sound Attenuation Performance: Submit manufacturer's catalog cuts for muffler, including dynamic insertion loss, and aerodynamic pressure drop vs. air volume vs. air temperature and exhaust system pressure drop calculation.

d. Spring vibration isolator installation

Provide manufacture's catalog cuts for spring isolator which includes spring diameter, deflection vs. load, compressed spring height, and solid spring height. Provide drawings and calculations showing height saving bracket (if used), point loads, and spring model number and spring static deflection.

1.5.3 Certificates of Performance and Test Data

a. Acoustic Duct Silencer

b. Diesel Engine Exhaust Silencer

c. Spring and Neoprene Vibration Isolator

d. Neoprene Mountings

PART 2 PRODUCTS

2.1 CORROSION PROTECTION FOR STEEL PARTS

ASTM A 123 hot-dipped galvanized, or equivalent manufacturer standard coatings. Where steel parts are exposed to the weather, provide galvanized coating of at least 2 ounces of zinc per square foot of surface. Coat springs with neoprene.

2.2 NEOPRENE

ASTM D 471 and ASTM D 224, Grade Durometer 40, 50, or 60, and oil resistant.

2.3 FLOOR-MOUNTED ISOLATORS

2.3.1 Neoprene Isolation Pads

Provide pads at least 1/4 inch thick with cross-ribbed or waffle design. For concentrated loads, provide steel bearing plates bonded or cold cemented to the pads.

2.3.2 Neoprene Mounting Isolators

Provide molded neoprene mounting isolators under the remote radiator. The isolators shall have steel base plates with mounting holes and, at the top, steel mounting plates with mounting holes or threaded inserts. Provide elements of type and size coded with molded letters or color-coded for capacity identification. Embed metal parts completely in neoprene.

2.4 SPRING ISOLATORS AND PROTECTED SPRING ISOLATORS

Provide spring isolators with height saving bracket under the diesel engine generator. Isolators shall be adjustable and laterally stable with free-standing springs of horizontal stiffness at minimum 80 percent of the vertical (axial) stiffness. For machine-attached and floor-attached

restraining elements, separate from metal-to-metal contact by neoprene cushions 1/8 inch thick minimum. Provide neoprene acoustic friction pads at least 1/4 inch thick.

2.4.1 Springs

Provide springs with base and compression plates, to keep spring ends parallel during and after deflection to operating height. Provide outside coil diameters at least 0.8 of the operating height. At operating height, springs shall have additional travel to complete (solid) compression equal to at least 50 percent of the operating deflection. Each spring isolator shall be sized for a minimum static deflectio nof 2 inches.

2.4.2 Mounting and Adjustment

Provide base and compression plates with mounting holes or threaded fittings. Bolt leveling adjustment bolts to machinery or base.

2.5 SUSPENSION ISOLATORS

Provide hangers with suspension isolators encased in open steel brackets. Isolate hanger rods from isolator steel brackets with neoprene-lined opening.

2.5.1 Suspension Neoprene Isolators

Provide double-deflection elements with minimum 3/8 inch deflection.

2.5.2 Suspension Spring Isolators

Provide hangers with springs and molded neoprene elements in series. Provide isolators with adjustable spring-preloading devices where required to maintain constant pipe elevations during installation and when pipe operational loads are transferred to the springs.

2.6 MACHINERY BASES

ASTM A 36/A 36M and AISC S342L.

2.7 FLEXIBLE CONNECTORS FOR PIPING

Straight or elbow flexible connectors rated for temperatures, pressures, and fluids to be conveyed. Provide flexible connectors with the strength 4 times operating pressure at highest system operating temperature. Provide elbow flexible connectors with a permanently set angle.

2.7.1 Elastomeric Flexible Connectors

Fabricated of multiple plies of tire cord fabric and elastomeric materials with integral reinforced elastomeric flanges with galvanized malleable iron back up rings.

2.7.2 Metal Flexible Connectors

Fabricated of Grade E phosphor bronze, monel or corrugated stainless steel tube covered with comparable bronze or stainless steel braid restraining and pressure cover.

2.8 FLEXIBLE DUCT CONNECTORS

Provide flexible duct connectors fabricated in accordance with SMACNA APIDC and SMACNA DCS.

2.9 PIPE GUIDES

Factory-fabricated. Weld steel bar guides to the pipe at a maximum radial spacing of 60 degrees. The outside diameter around the guide bars shall be smaller than the inside diameter oft he guide sleeve in accordance with standard field construction practice. For pipe temperatures below 60 degrees F, provide metal sleeve, minimum one pound per cubic foot density insulation.

2.10 THRUST RESTRAINTS

Adjustable spring thrust restraints, able to resist the thrust force with at least 25 percent unused capacity. The operating spring deflection shall be not less than 50 percent of the static deflection of the isolation supporting the machinery.

2.11 ACOUSTIC DUCT SILENCERS

a. Similar construction to and performance of Industrial Acoustics Company Type MS series, or approved equal, with special order construction features as indicated.

b. Dimensions: Each module 5 feet in length, and with face dimensions of 45 inches x 30 inches and 42 inches x 36 inches without flanges.

c. Casing and Splitter Facing Materials: Constructed of 18 gauge stainless steel; ASTM A 167-90 outer casings and stainless steel perforated splitter facings, both not less than 22 gauge. Metal components held in place by spot welding not more than 3 inches on center.

d. Acoustical Fill Material: Inorganic glass fiber, compressed to not less than 4 pounds per cubic foot density, packed behind splitter facings under not less than 10 percent compression so as to eliminate voids caused by settling.

e. Casing Construction: Leakproof when subjected to a differential pressure of 8 inches of water gauge between the inside and outside of the sealed module.

f. Static Pressure Drop:

(1) Inlet Air Silencer: Less than 0.07 inches water gauge at 7,076 or greater cubic feet per minute of air for a module

with 9.4 sf of face area.

(2) Discharge Air Silencer: Less than 0.21 inches water gauge at 11,710 or greater cubic feet per minute of air for a module with 10.5 s.f. of free area.

g. Dynamic Insertion Loss: For the operating conditions indicated in the plans, sound attenuators shall provide the following minimum insertion losses (in dB) at the following:

Octave Band	1	2	3	4	5	6	7	8
Frequency (Hz)	63	105	250	500	1K	2K	4K	8K
Silencer Face Velocity = ± 2000 FPM	6	10	18	30	42	34	23	14

h. The Contractor shall bear all costs of adapting the structure to acoustic silencer of other equal manufacturers.

2.12 FLEXIBLE CONNECTOR

a. Flexible connector shall be Dupont Hypalon-coated 26-ounce glass fabric conforming to Metaledge Ventlon by Ventfabrics, Inc. or approved equal. Glass fabric shall be UL approved and heat resistant to 300 degrees F.

2.13 SCREEN

a. Stainless steel expanded metal screens shall be provided as specified in Section 05505 and as indicated in the Plans.

b. After installation, remove any cutting scraps and foreign material remaining in the Generator and Discharge Air Plenum.

2.14 ENGINE GENERATOR EXHAUST SILENCERS

a. Similar construction, dimensions and performance to Industrial Acoustic Company Power-Flow Tubular Silencers Type I and Type II, or approved equal.

b. Tubular Shell and Baffles fabricated with stainless steel with flanged connections.

c. Silencer Performance:

(1) For the operating conditions indicated in the plans, Type I Silencer(s) shall provide the following minimum insertion losses (in dB) at the following standard Octave Band Center Frequencies (in Hz): 15 dB @ 31.5 Hz; 20 dB @ 63 Hz; 21 dB @ 125 Hz; 21 dB @ 250 Hz; 19 dB @ 500 Hz; 17 dB @ 1,000 Hz; 16 dB @ 2,000 Hz; 15 dB @ 4,000 Hz; and 14 dB @ 8,000 Hz. Sound attenuation performance ratings shall be determined in accordance with the latest revision of ASTM Standard E477.

(2) For the operating conditions indicated in the plans, Type II

Silencer(s) shall provide the following minimum insertion losses (in dB) at the following standard octave Band Center Frequencies (in Hz): 19 dB @ 31.5 Hz; 24 dB @ 63 Hz; 25 dB @ 125 Hz; 25 dB @ 250 Hz; 23 dB @ 500 Hz; 21 dB @ 1,000 Hz; 19 dB @ 2,000 Hz; 18 dB @ 4,000 Hz; and 17 dB @ 8,000 Hz. Sound attenuation performance ratings shall be determined in accordance with the latest revision of ASTM Standard E477.

(3) Installed sound attenuation shall exceed 50 dBA when the Type I and Type II Silencers are connected in series and used with the engine specified. Total pressure drop across the silencers shall not exceed 0.5 i.w.g. (inches of water) with flow of 16,000 cfm (6,680 FPM face velocity) at 1000°F.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Acoustic Duct Silencers

Install in accordance with the recommendations of the attenuator manufacturer. Follow manufacturer's recommendations when grouping individual modules to form an airtight sound attenuator bank. Support sound attenuators as indicated in the plans and provide blocking as required. Seal cracks between attenuator and building shell with non-hardening acoustical sealant.

Attenuator bank shall be fabricated and installed in accordance with the SMACNA Low Velocity Duct Standards except where detailed otherwise. Edges and slips shall be hammered to provide a smooth interior finish. Supports shall be provided as detailed or as required to provide a rigid, vibration-free assembly.

3.1.2 Building Acoustical Treatments

Acoustical treatment on intake air plenum concrete ceilings, concrete masonry walls, and interior partitions shall be as shown on the plans and specified in Section 09500, "Acoustical Treatment."

3.1.3 Flexible Connector

Flexible connector shall be installed between the generator radiator and discharge air plenum as indicated on the plans to prevent the transmission of vibration through the duct. The flexible duct connector fabric used shall be properly fitted to render it relatively tight. Fabric shall be a minimum of 2" wide between connection points to sheetmetal.

3.1.4 Air Deflector

Perforations shall be round and diagonally centered with a maximum diameter of 3/32 in diameter on 3/16 inch staggered centers with open area of approximately 23%. The curved air deflector in the Discharge Air Plenum shall be fabricated from stainless steel perforated panels not less than 16 gage thickness. The deflector shall be supported by steel framing with supports spaced to present sagging or vibrating when subjected to the air

flow with estimated temperature of 140 degrees F.

3.1.5 Roof Penetration

The engine exhaust pipe penetration through the roof shall be constructed to minimize the transmission of engine noise from the Generator Room. The exhaust piping, silencer and stack shall be insulated as indicated under Section 15250, "Mechanical Insulation."

3.1.6 Pipe Penetrations

Provide galvanized Schedule 40 pipe sleeves and tightly pack annular space between sleeves and pipe with insulation having a flame spread rating not more than 25 and a smoke developed rating not more than 50 when tested in accordance with ASTM E 84, maximum effective temperature 1000 degrees F, bulk density 6 pounds/cu. ft. minimum. Seal each end with an weather resistant acoustic sealant. Provide sealant a flame spread rating not more than 25 and a smoke developed rating not more than 50 when tested in accordance with ASTM E 84.

3.1.7 Duct Penetrations

Pack openings around ducts with mineral fiber insulation the full length of the penetration.

3.1.8 Anchor Bolts and Grout

Secure machinery to foundations and inertia bases with anchor bolts. Grout equipment with baseplates, the full area under baseplates with premixed non-shrinking grout. After grout has set, remove wedges, shims, and jack bolts and fill spaces with grout.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Inspections

Prior to initial operation, inspect the vibration isolators for conformance to drawings, specifications, and manufacturer's data and instructions. Check for vibration and noise transmission through connections, piping, ductwork, and walls. Check connector alignment before and during operation. Correct misalignment without damage to connector and in accordance with manufacturer's recommendations.

3.2.2 Spring Isolator Inspection

After installation of spring isolators, the machinery shall rock freely on its spring isolators within limits of stops. Eliminate or correct interferences.

PART 4 MEASURMENT AND PAYMENT

Measurement for Payment for work under this section shall be by unit or lump sum basis as provided for and indicated in the bid proposal. Payment made at the bid price shall be full compensation for furnishing all labor, materials, equipment in providing the noise and vibration control systems in place complete.

-- End of Section --

SECTION 15250

MECHANICAL INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 90A	(1980; Addenda 1987) Energy Conservation in New Building Design (Section 1 through 3)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1994) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240	(1994) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessel
ASTM C 195	(1990) Mineral Fiber Thermal Insulating Cement
ASTM C 533	(1985; R 1990) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 547	(1977) Mineral Fiber Preformed Pipe Insulation
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 916	(1985; R 1990) Adhesives for Duct Thermal Insulation
ASTM E 84	(1991; Rev. A) Surface Burning Characteristics of Building Materials

MILITARY SPECIFICATIONS (MIL)

MIL-A-3316	(Rev. C; Am. 2) Adhesives, Fire-Resistant, Thermal Insulation

1.2 QUALITY ASSURANCE

Provide new field-applied insulation for cooling (HVAC) air distribution system, refrigerant piping system, diesel engine exhaust silencers and piping, and for plumbing systems.

1.2.1 Air Distribution Systems

Obtain Officer-in-Charge's written approval of air distribution system testing and balancing before applying field insulation to air distribution system.

1.2.2 Piping Systems

Obtain Officer-in-Charge's written approval of HVAC refrigerant piping systems after pressure testing before applying field-applied insulation to HVAC refrigerant piping systems. Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device. For refrigerant and hot water piping systems, seal ends of pipe insulation and space between ends of pipe insulation and piping with waterproof vapor barrier sealant. After systems are tested and balanced, insulate control valves and devices.

1.2.3 Diesel Engine Exhaust Piping and Silencers

Obtain Officer-in-Charge's written approval of an insulated pipe section before beginning insulation of the exhaust piping system.

1.2.4 Packaging and Labeling

Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have manufacturer's stamp or label attached giving name of manufacturer, brand and description of material. Insulation packages and containers shall be asbestos-free.

1.2.5 Surface Burning Characteristics

Material shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E 84 or UL 723.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Adhesives, sealants, and coating compounds

b. Duct insulation

c. Refrigerant piping insulation

d. Piping insulation jackets

e. Diesel engine exhaust and silencer insulation and jacket

PART 2 PRODUCTS

2.1 PIPING INSULATION

Insulation material shall conform to Table 1. Insulation thickness shall be as listed in Table 2. Insulation thickness as specified in Table 2 shall be 1/2 inch greater for insulated piping systems located outside. In lieu of Table 2, minimum thickness may be calculated in accordance with _____. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling.

2.1.1 Piping Insulation Jackets

2.1.1.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire retardant jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting.

2.1.1.2 Metal Jackets

a. Stainless Steel Jackets: ASTM A 167 or ASTM A 240; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges.

b. Piping, Fittings, Flanges, and Valves in Outside Locations: Finish elbows and curved piping with factory-fabricated metal covers. Finish tees, flanges, and valves with metal covers. Covers shall be same thickness and material as jackets on adjacent piping.

2.2 HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS INSULATION

2.2.1 Duct Insulation

Provide insulation with factory applied insulation manufacturer's standard reinforced fire-retardant vapor barrier jacket.

2.2.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature 400 degrees F, 3 pcf average, one inch thick.

2.2.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3, 3/4 pound per cubic foot (pcf) nominal, 2.0 inches thick.

2.2.2 Duct Insulation Jackets

2.2.2.1 All-Purpose Jackets

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with integral vapor barrier. In exposed locations, provide jacket with a white surface suitable for field painting.

2.2.2.2 Metal Jackets

a. Stainless Steel Jackets: ASTM A 167 or ASTM A 240; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges.

2.3 DIESEL ENGINE AND COMBUSTION TURBINE EXHAUST SYSTEM INSULATION

ASTM C 592 Class I or ASTM C 612 Class 3 or ASTM C 533, Type I. Insulation and minimum thickness shall comply with Table 3. Fill joints in the block insulation with mineral wool or equivalent insulation cement. For equipment operating at surface temperatures above 600 degrees F, apply block in double layer construction with staggered joints.

2.3.1 Equipment

Insulate equipment and accessories as specified in Table 3. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface.

2.4 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

2.4.1 Insulation and Vapor Barrier Adhesive

Provide ASTM C 916, Type I adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior.

2.4.2 Lagging Adhesive

MIL-A-3316, Class 1, for bonding fibrous glass cloth to unfaced fibrous glass insulation; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation, or Class 2, for attaching fibrous glass insulation to metal surfaces. Provide for pipe and duct insulation.

2.4.3 Mineral Fiber Insulation Cement

ASTM C 195.

2.4.4 Vapor Barrier Coating

Provide in accordance with insulation manufacturers' recommendations.

2.4.5 Weatherproof Coating

For outside applications provide in accordance with insulation and jacket manufacturer's recommendations.

2.5 ACCESSORY MATERIALS

2.5.1 Staples

ASTM A 167, Type 304 or 316 stainless steel outside-clinch type.

2.5.2 Insulation Bands

1/2 inch wide; 26 gage stainless steel.

2.5.3 Metal Bands

3/8 inch minimum width; 26 gage stainless steel.

2.5.4 Anchor Pins and Speed Washers

Provide in accordance with insulation manufacturer's recommendations.

2.5.5 Fibrous Glass Cloth and Tape

Fibrous glass cloth and tape; 20 by 20 maximum size mesh. Tape shall be 100 mm (4 inch) wide rolls. Class 3 tape shall be 0.15 kg per square meter (4.5 ounces per square yard). In lieu of glass cloth and tape, open weave glass membrane may be provided.

2.5.6 Wire

Soft annealed stainless steel, 16 gage.

2.5.7 PVC Pipe Fitting Cover and Its Vapor Barrier Tape

Provide PVC fitting covers with insulation inserts of same material and thickness as pipe insulation.

2.5.8 Vapor Barrier Materials

ASTM C 1136. Resistant to flame, moisture penetration, and mold growth, color white.

PART 3 EXECUTION

3.1 PREPARATION

Clean and test mechanical systems prior to application of insulation. Obtain Officer-in-Charge's written approval of HVAC, and air distribution systems, applying field-applied insulation to mechanical systems.

3.2 DUCTWORK AND DUCTWORK ACCESSORIES

Provide rigid type duct insulation in mechanical rooms (AC and Generator Rooms); provide blanket type insulation in all other locations. Provide field-applied insulation to exterior of supply ducts. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handles, safety reliefs, and other such items. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Apply insulation and sound deadening materials on outside rather than inside of ductwork.

3.2.1 Duct Sleeves and Pipe Sleeves

Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at manufacturer's recommended coverage per gallon.

3.2.2 Moisture Seal

Provide a vapor (moisture) seal where insulation terminates against metal hangers, anchors and other projections through insulation on surfaces for which a vapor seal is specified. Keep insulation dry during application of finish. Bevel and seal edges of exposed insulation.

3.2.3 Exemptions

Unless otherwise indicated, do not insulate the following:

a. Access plates of fan housings;

b. Cleanouts or handholes;

c. Components within factory preinsulated HVAC equipment;

d. Factory preinsulated flexible ductwork;

e. Factory preinsulated HVAC equipment;

f. Manufacturer's nameplates;

g. Vibration isolating connections.

3.3 PIPE INSULATION

3.3.1 Pipe Insulation (Except Cellular and Calcium Silicate Insulation)

Place sections of insulation around pipe and joints tightly butted into place. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on center and 1/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to jacket material. Overlap

longitudinal laps of jacket material not less than 1 1/2 inches. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

a. Vapor Barrier Jacket: When a vapor barrier jacket is required, as indicated in Table 1, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating or manufacturer's weatherproof coating for outside service unless pipe is supplied with factory-applied self-seal lap. Apply vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1 1/2 inches past the break in both directions. At penetrations by pressure gages and thermometers, fill voids with vapor barrier coating for outside service. Seal with a brush coat of the same coating. Do not use staples to secure jacket laps on pipes carrying fluid medium at temperatures below 35 degrees F.

b. Roof: Where pipe penetrates, insulate piping to a point flush with top of flashing and seal with vapor barrier coating. Butt top of flashing and interior insulation tightly to exterior insulation. Extend exterior metal jacket 2 inches to fold down beyond end of insulation. Seal flashing and counterflashing underneath with vapor barrier coating.

3.3.2 Cellular Glass Insulation

Provide in accordance with manufacturer's printed instructions.

3.3.3 Hangers and Anchors

Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide galvanized steel shields and protection saddles. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, minimum 8 pcf, other approved material of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable. Where protection saddles are used, fill voids with same insulation material as used on adjacent pipe.

3.3.4 Flanges, Unions, Valves and Fittings for Piping

Provide insulation for refrigerant suction piping and hot piping of 110 degrees F or higher. Factory fabricated removable and reusable insulation covers may be used except with flexible cellular. When nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2 1/2 inches, elbows insulated using segments shall not have less than three segments per elbow. Place and joint segments with manufacturer's recommended water-vapor resistant, fire retardant, and adhesive appropriate

for the temperature limit of the service. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. Total dry film thickness shall not be less than 1/16 inch. Provide finish coating as follows:

a. Coating with Embedded Glass Tape: Coat insulation and all purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. Total dry film thickness shall not be less than 1/16 inch. Where unions are indicated not to be insulated, taper insulation to union at a 45 degree angle. For cold piping, seal insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to cold pipe for a sufficient distance to prevent condensation but not less than 6 inches from insulation surface.

b. PVC Fitting Covers: Factory premolded one-piece PVC fitting covers may be provided in lieu of two coats of adhesive with tape embedded between coats. Provide factory premolded field-fabricated segment or blanket insert insulation under fitting covers. Install factory premolded one-piece PVC fitting covers over insulation. Secure covers with stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not provide PVC fitting covers where exposed to weather. Provide PVC fitting covers only in ambient temperatures below 150 degrees F.

3.3.5 Piping Exposed to Weather

3.3.5.1 Metal Jackets

Provide over insulation. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with metal bands at not more than 9 inch centers. Overlap longitudinal joints down to shed water. Seal circumferential joints with a coating recommended by insulation manufacturer for weatherproofing.

3.3.5.2 Flanges, Unions, Valves, Fittings, and Accessories

Insulate and finish as specified hereinbefore for applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch and the adjoining metal jacket not less than 2 inches. Factory preformed metal jackets may be provided as alternate for hot service.

3.4 HVAC DUCTS INSULATION

3.4.1 Rigid Insulation

Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches o.c. and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces.

Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be capable of supporting a 20 pound load. Cut off protruding ends of pins, after clips are sealed with coating compound for inside work or manufacturer's recommended weatherproof coating for outside work, and reinforced with open weave glass membrane.

3.4.2 Flexible Blanket Insulation

Apply insulation with joints tightly butted. Secure insulation to ductwork with adhesive in 6 inch wide strips on 12 inch centers. Staple laps of jacket with outward clinching staples on 4 inch centers. Sealing shall be in accordance with paragraph entitled "Insulation Finishes and Joint Sealing." Provide pins, washers and clips at 18 inches on center and not more than 4 inches from duct edge for duct surfaces greater than 24 inches across except for top surfaces of horizontal ducts. For vertical ducts with surfaces less than 24 inches across, provide pins no more than 4 inches from duct edge at 18 inches on center. Carry insulation over standing seams and trapeze-type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation shall not be permitted. Cut off protruding ends of pins after securing and sealing clips with coating compound for inside work. In cold air ducts, vapor seal joints and staple as specified.

3.4.3 Insulation Finishes and Joint Sealing

Fill breaks, punctures, and voids with vapor barrier coating compound for inside work or manufacturer's recommended weatherproof coating for outside work. Vapor seal joints by embedding a single layer of 3 inch wide open weave glass membrane, maximum 20 by 20 mesh per linear inch between two 1/16 inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1 1/2 inch overlap. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in insulation with vapor barrier coating. Brush a coat of vapor barrier coating where required on HVAC ducts. Provide vapor barrier jacket continuous across seams, reinforcements, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over projection.

3.4.4 Access Plates and Doors

On acoustically lined ducts, plenums, and casings, provide insulation on access plates and doors. On externally insulated ducts, plenums, and casings, provide insulation-filled hollow steel panels and doors for access openings. Bevel insulation around access plates and doors.

3.5 ENGINE EXHAUST PIPING AND STACK INSULATION

Inside mechanical Room, bevel insulation neatly around openings and provide sheet metal insulation stop strips around such openings. Apply a skim coat of hydraulic setting cement directly to insulation. Apply a flooding coat of adhesive over hydraulic setting cement, and while still wet, press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat glass cloth with adhesive. When dry, apply a finish coat of adhesive at can-consistency so that when dry no glass weave shall be

observed. Provide stainless steel metal jackets for stacks and exhaust pipes that are located above finished floor and spaces outside mechanical room. Apply metal jackets directly over insulation and secure with 3/4 inch wide metal bands spaced on 18 inch centers. Do not insulate name plates.

3.6 DIESEL ENGINE EXHAUST SILENCER INSULATION

Apply insulation suitable for temperature and service in rigid block as closely as possible to equipment. Groove or score insulation where necessary to fit contours of equipment. Stagger end joints where possible. Bevel edges of insulation for cylindrical surfaces to provide tight joints. Join sections of cellular glass insulation with bedding compound. After cellular glass insulation is in place on areas to be insulated, except where metal-encased, fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface. Bevel insulation around name plates. Protect exposed insulation corners with corner angles under wires and bands.

3.7 FIELD QUALITY CONTROL

Visually inspect to ensure that materials provided conform to specifications. Inspect installations progressively for compliance with requirements.

TABLE 1
Insulation Material For Piping

Service	Material	Spec.	Type	Class	Vapor Barrier Required
Hot Domestic Water Supply and Recirculating Piping (Maximum) 200°F)	Mineral Fiber	ASTM C 547		1	No
	Cellular Glass	ASTM C 552	II	2	No
Refrigerant Suction Piping (35°F nominal)	Mineral Fiber	ASTM C 547		1	Yes
Drinking Fountain, Drain Piping (to sewer tie in)	Mineral Fiber	ASTM C 547		1	Yes
	Cellular Glass	ASTM C 552	II	2	No
	Flexible Cellular	ASTM C 534	I		No

Service	Material	Spec.	Type	Class	Vapor Barrier Required
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicap Personnel	Flexible Cellular	ASTM C 534	I		No
A/C Condensate Drain Located Inside Bldg.	Mineral Fiber Cellular Glass	ASTM C 547 ASTM C 552	 II	1 2	Yes No

TABLE 2
Piping Insulation Thickness (inch)

Service	Material	Tube And Pipe Size (Inches) 1/4-1 1/4	1 1/2-3
Hot Domestic Water Supply and Recirculating Piping (Maximum) 200°F)	Mineral Fiber Cellular Glass Urethane	1 1.5 0.75	1 1.5 0.75
Refrigerant Suction Piping (35°F nominal)	Cellular Glass	1.5	1.5
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicap Personnel	Flexible Cellular	0.5	0.5
A/C Condensate Drain Located Inside Bldg.	Mineral Fiber Cellular Glass	0.75 1.5	1 1.5

TABLE 3
Insulation and Thickness (Inches) for
Boiler Stack and Diesel Engine Exhaust Pipe

Service & Surface Temperature Range (Degrees F)	Material	Outside Diameter (Inches) 11-36
Diesel Engine Exhaust (Up to 1000°F)	Calcium Silicate ASTM C 533 Type I or II	4
	Cellular Glass ASTM C 552 Type II	6

PART 4 MEASUREMENT AND PAYMENT

Measurement for Payment for work in this section shall be by square foot of insulation or lump sum as provided for an indicated in the bid proposal. Payment made at the bid price shall be full compensation for furnishing all labor, materials, equipment in providing mechanical insulation in place complete.

-- End of Section --

SECTION 15400

PLUMBING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTES (ANSI)

ANSI A112.36.2M	(1991) Cleanouts
ANSI B16.18	(1984) Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B16.23	(1992) Cast Copper Alloy Solder Joint Drainage Fittings - DWV

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(1984) Drinking-Fountains, and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.6.1M	(1988) Supports for the Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.18.1M	(1989) Plumbing Fixture Fittings
ASME A112.19.2M	(1990) Vitreous China Plumbing Fixtures
ASME A112.21.1M	(1991) Floor Drains
ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.22	(1989) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME/ANSI B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI/ASME B16.29	(1986) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(1981) Water Pressure Reducing Valves for Domestic Water Supply Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1993; Rev. A) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	(1993) Cast Iron Soil Pipe and Fittings
ASTM A 536	(1984; R 1993) Ductile Iron Castings
ASTM B 32	(1993) Solder Metal
ASTM B 42	(1993) Seamless Copper Pipe, Standard Sizes
ASTM B 88	(1993; Rev. A) Seamless Copper Water Tube
ASTM B 306	(1992) Copper Drainage Tube (DWV)
ASTM C 564	(1993) Rubber Caskets for Cast Iron Soil Pipe and Fittings
ASTM D 2665	(1993; Rev. A) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2846	(1993) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM F 441	(1994) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	(1993) Metal-Seated Gate Valves for Water Supply Service
AWWA C651	(1992) Disinfecting Water Mains
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service

BUILDING OFFICIALS & CODE ADMINISTRATORS INTERNATIONAL, INC. (BOCA)

BOCA NPC	(1990; Am. 1991) National Plumbing Code

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI HSN	(1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
CISPI 301	(1990) Hubless Cast Iron Soil Pipe and

	Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1990) Couplings Joint for Use in Connection with Hubless Cast Iron Soil Pipe and Fitting

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-USC	(1992) List of Approved Backflow Prevention Assemblies

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO UPC	(1991) Uniform Plumbing Code

MILITARY SPECIFICATIONS (MIL)

MIL-V-18433	(Rev. C) Valve, Temperature-Regulating (Thermostatically Controlled)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1990) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS (NAPHCC)

NAPHCC NSPC	(1990; Supp. 1991 and 1992) National Standard Plumbing Code - Illustrated

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH201	(1983) Water Hammer Arrestors

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

Provide new and modify existing plumbing systems, complete and ready for operation. Plumbing systems including manufacturer's products shall be in accordance with the required and advisory provisions of the Plumbing Code of the City and County of Honolulu. Plumbing systems include piping less than 5 feet outside of building walls including connections to existing exterior distribution systems.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Valves

b. Plumbing fixtures

c. Water heaters

d. Water meters

e. Water hammer arresters

f. Backflow preventers

g. Electric water coolers

1.4.2 SD-19, Operation and Maintenance Manuals

a. Water heaters

b. Electric water coolers

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

Plumbing systems including fixtures, equipment, materials, installation, and workmanship shall be in accordance with the Uniform Plumbing Code except as modified herein. In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the Contracting Officer. Capacity of equipment shall be not less than that indicated.

PART 2 PRODUCTS

2.1 DRAIN, WASTE, AND VENT (DWV) PIPE AND FITTINGS

Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.

2.1.1 Buried Piping

Provide piping up to but not more than 6 inches aboveground or floor slab on grade.

2.1.1.1 Cast-Iron Hubless Pipe and Fittings

CISPI 301 with CISPI 310 couplings.

2.1.1.2 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.1.3 Plastic Pipe, Fittings, and Solvent Cement

a. Polyvinyl Chloride (PVC) System: ASTM D 2665.

2.1.2 Aboveground Piping

2.1.2.1 Cast-Iron Hubless Pipe and Fittings

CISPI 301 with CISPI 310 couplings.

2.1.2.2 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.2.3 Plastic Pipe, Fittings, and Solvent Cement

a. Polyvinyl Chloride (PVC) System: ASTM D 2665.

2.1.2.4 Copper Tubing

ASTM B 306, with ANSI B16.23, ANSI/ASME B16.29, or ANSI/ASME B16.32 solder joint fittings using ASTM B 32, 95-5 tin-antimony or Grade Sn96 tin-silver solder, and flux containing not more than 0.2 percent lead.

2.1.3 Cleanouts

ANSI A112.36.2M; provide threaded bronze or thermoplastic or PVC plastic cleanout plugs.

2.1.3.1 Floor Cleanouts

Provide cast-iron or ductile-iron floor cleanout with anchor flange, adjustable height polished bronze, nickel bronze, stainless steel, or chromium-plated copper alloy rim and scoriated floor plate with "CO" cast in the plate, and countersunk screws for installing floor plate flush with finished floor.

2.1.3.2 Wall Cleanouts

Provide polished stainless steel or chromium-plated copper alloy cover plate and secure to cleanout plug with countersunk stainless steel screw.

2.1.3.3 Cleanouts Exterior to Buildings

Provide cast-iron cleanouts and countersunk plugs. Provide 24 by 24 by 4 inch thick concrete slab with top one inch above grade with cleanout located in center of slab. Provide cleanouts flush with finished grade or concrete slab.

2.1.4 Drains

ASME A112.21.1M; provide cast-iron or ductile-iron drains and clamping rings for use with membrane waterproofing. Provide P-traps for each floor drain.

2.1.4.1 Flush Strainer Floor Drains

Provide with double drainage flange, slotted cast bronze or nickel bronze, strainer, and adjustable collar. Drains of sizes 2, 3, and 4 inches shall have strainers with minimum free drainage area of 5, 11, and 18 square inches, respectively.

2.1.4.2 Shower Floor Drains

Provide as specified for flush strainer floor drains, except that finish shall be polished stainless steel.

2.2 DOMESTIC WATER PIPING

2.2.1 Buried Piping and Aboveground Piping

2.2.1.1 Copper Tubing

ASTM B 88M (ASTM B 88), Type L or M for aboveground piping, Type K for buried piping, with ANSI B16.18 or ASME/ANSI B16.22 solder joint fittings. Provide ASTM B 42 copper pipe nipples with threaded end connections. Provide ASTM B 32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder. Provide copper tubing for pipe sizes 4 inches or smaller.

2.2.2 Water Valves

Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have threaded end connections with a union on

all but one side of the valve, or solder end connections for connections between bronze valves and copper tubing. Ball valves may be provided in lieu of gate valves.

2.2.2.1 Gate Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-70, Class 125.

2.2.2.2 Angle Valves

MSS SP-80, Class 125, except sizes 2.5 inches and larger shall conform to MSS SP-85, Class 125.

2.2.2.3 Ball Valves

Full port design, copper alloy. Valves shall have two-position lever handles.

2.2.2.4 Hose Bibbs

Provide angle type copper alloy hose bibb with lockshield and removable handwheel. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75 inch external hose threads.

2.2.2.5 Combination Pressure and Temperature Relief Valves

ANSI Z21.22 copper alloy body, automatic reseating, test lever, and discharge capacity based on AGA temperature steam rating.

2.2.2.6 Water Temperature Regulating Valves

MIL-V-18433, provide copper alloy with adjustable range to allow settings between 110 and 160 degrees F.

2.2.2.7 Water Temperature Mixing Valves

Provide copper alloy body valve of the pressure equalizing type. Valve shall be of the adjustable thermostatic type and shall mix the hot water and cold water to deliver hot water at set temperature.

2.2.2.8 Water Pressure Reducing Valves

ASSE 1003.

2.2.3 Water Meters

AWWA C701 turbine type, with register reading in U.S. gallons.

2.2.4 Strainers

Strainers shall have blow off outlet with pipe nipple and gate valve and discharge pipe nipple. Copper alloy or cast-iron body. Provide stainless steel strainer element with perforations of 0.047 inch.

2.2.5 Pressure Gages

Provide single style pressure gage for water with 4.5 inch dial, brass or aluminum case, bronze tube, gage cock, pressure snubber, and syphon. Provide scale range suitable for the intended service.

2.2.6 Thermometers

Provide bi-metal dial type thermometers with stainless steel case, stem, and fixed thread connection; 5 inch diameter dial with glass face gasketed within the case; accuracy within 2 percent of scale range. Provide scale range suitable for the intended service.

2.2.7 Dielectric Connections

Provide at connections between copper and ferrous metal piping materials. ASTM F 441, Schedule 80, CPVC threaded pipe nipples, 4 inch minimum length, may be provided for dielectric connections in pipe sizes 2 inches and smaller.

2.2.8 Water Hammer Arresters

PDI WH201.

2.2.9 Valve Boxes

For each buried valve provide cast-iron, ductile-iron, or plastic box of a suitable size. Provide cast-iron, ductile-iron, or plastic cover for the box with the word "WATER" cast on the cover. Plastic boxes shall be constructed of ABS plastic or inorganic fiber-reinforced black polyolefin plastic. Coat cast-iron and ductile-iron boxes with bituminous paint.

2.2.10 Backflow Preventers

Reduced pressure principle type. Furnish proof that each make, model/design, and size of backflow preventer being furnished for the project is approved by and has a current "Certificate of Approval" from the FCCCHR-USC. Listing of the particular make, model/design, and size in the current FCCCHR-USC will be acceptable as the required proof.

2.3 MISCELLANEOUS PIPING MATERIALS

2.3.1 Flanges

ASME/ANSI B16.1, Class 125, for use in ferrous piping; ASME/ANSI B16.22 or ANSI B16.24 for use in copper tubing; with MIL-R-6855 full face flat type synthetic rubber gaskets.

2.3.2 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated or polished stainless steel finish on copper alloy plates in finished spaces. Provide paint finish on metal in unfinished spaces.

2.3.3 Pipe Sleeves

2.3.3.1 Sleeves in Masonry and Concrete Walls, Floors, Roofs

ASTM A 53, Schedule 40 or Standard Weight, hot-dip galvanized steel, ductile-iron or cast-iron pipe sleeves.

2.3.3.2 Sleeves in Non-Masonry or -Concrete Walls, Floors, and Roofs

Provide 26 gage hot-dip galvanized steel sheet.

2.3.4 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.3.5 Access Doors

Provide 12 by 12 inch factory prefabricated and primed flush face steel access doors including steel door frame with continuous hinges and turn-screw-operated latch. Door frame shall be for installation in plaster and masonry walls. Furnish doors under this section to provide proper access to concealed valves; install doors under the appropriate section of this specification.

2.4 FIXTURES, FITTINGS, ACCESSORIES, AND SUPPLIES

Provide control-stop valves in each supply to each fixture. The finish of fittings, accessories, and supplies exposed to view shall be chromium-plated per ASME A112.18.1M. Centerset faucets shall be top-mounted with inlets on not greater than 4 inch centers. Provide special roughing-in for wheelchair fixtures.

2.4.1 Flush Valve Type Water Closets

ASME A112.19.2M, white vitreous china, floor-mounted, floor or wall outlet as indicated, siphon jet, elongated bowl, white solid plastic elongated open-front seat, and ASME A112.19.5 trim. Provide large diaphragm not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers nonhold-open flush valve of chrome plated cast brass, including vacuum breaker and angle valve with back check, mounted approximately 39 to 44 inches above floor. The water flushing volume of the flush valve and water closet combination shall not exceed 3.5 gallons per flush from 15 to 90 psi. Provide ASME A112.6.1M carrier with feet. Water closet height to top of seat shall be 17 to 19 inches above floor.

2.4.2 Wheelchair Flush Valve Type Urinals

ASME A112.19.2M, white vitreous china, wall-mounted, wall outlet, blowout action, integral trap, elongated projecting bowl, 20 inches long from wall to front of flare, and ASME A112.19.5 trim. Provide large diaphragm not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers, nonhold-open flush valve of chrome plated cast brass conforming to FS QQ-C-390, including vacuum breaker and angle valve with back check. The water flushing volume of the flush valve and urinal combination shall not exceed 1.5 gallons per flush from 15 to 90 psi. Furnish urinal manufacturer's certification of conformance. Provide ASME A112.6.1M concealed chair carriers. Mount urinal with front rim a maximum of 17 inches above floor and flush valve handle a maximum of 44 inches above floor for use by handicapped on wheelchair.

2.4.3 Wheelchair Lavatories

ASME/ANSI A112.19.1M, white vitreous china, contoured front rim, front concealed overflow, ASME A112.6.1M concealed arm carrier support and chair carrier, minimum dimensions of 20 inches wide by 27 inches front to rear, 29 inch minimum clearance from bottom of front rim to floor, 34 inch front rim height above floor. Provide ASEM A112.18.1M copper alloy centerset faucets, gooseneck spout with aerator 5 inches above rim, 4 inch wrist action handles, perforated grid strainers with offset tailpiece, and 1.25 inch adjustable P-trap. Faucets with wrist action handles shall open within one-quarter turn in opposite directions.

2.4.4 Wheelchair Electric Water Cooler

ARI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet.

2.4.5 Shower Supply Fittings

ASME A112.18.1M, ball joint, self-cleaning adjustable spray pattern shower heads with 3 gpm flow control devices, connected to concealed pipe connected to copper alloy pressure balance single control type mixing valves with front access integral screwdriver stops. Anchor the mixing valves and the pipe to each shower head in wall to prevent movement.

2.4.6 Shower Floors and Mop Sink

Precast Terrazzo Shower Floors and Mop Sink: Terrazzo shall be made of marble chips cast in white Portland cement to produce a compressive strength of not less than 3000 psi 7 days after casting. Provide brass body drains with nickel bronze strainers cast integral with terrazzo. Provide stainless steel rim guard for mop sink.

2.5 DOMESTIC WATER HEATERS

2.5.1 Storage Tanks

MIL-T-12295, cement- or glass-lined vertical steel tanks, minimum of 862 kPa (gage) (125 psig) working pressure.

2.5.2 Water Heaters

Provide double wall copper tube domestic water heating elements constructed with air gap to atmosphere between the two walls using steam as the heating medium exterior of the heating elements. Provide posted operating instructions for water heaters.

2.5.3 Water Temperature Regulating Valves

MIL-V-18433, copper alloy or cast-iron with adjustable range thermostat to allow hot water settings between 110 and 160 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of plumbing systems including fixtures, equipment, materials, and workmanship shall be in accordance with the Plumbing Code, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply. Plastic piping shall not penetrate fire walls or fire floors and shall be used on one side of fire walls and fire floors not closer than 6 inches to the penetration.

3.1.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil. Do not thread metal pipe into plastic piping.

3.1.2 Solder End Valves

Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.

3.1.3 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for inline water pumps and flanged valves.

3.1.3.1 Piping to Receive Insulation

Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final

elevations. Temporary wood spacers shall be of the same thickness as the insulation to be provided under Section 15250, "Insulation of Mechanical Systems."

3.1.3.2 Maximum Spacing Between Supports

a. Vertical Piping: Support metal piping at each floor, but at not more than 10 foot intervals, with pipe riser clamps or offset pipe clamps. Support plastic piping at each floor and at midpoint between floors, but at not more than 5 foot intervals.

b. Horizontal Piping: Support cast-iron piping at 5 foot intervals, except for pipe exceeding 5 foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support plastic piping at 4 foot intervals and support plastic piping at each change of direction. Support steel piping and copper tubing as follows:

MAXIMUM SPACING (FEET)

Nominal Pipe Size (inches)	One and under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17
Copper Tube	6	7	8	8	9	10	11	12	13	14

3.1.4 Ductile Iron Pipe Aboveground

Provide flanged joints.

3.1.5 Encased Buried Piping

Completely encase buried copper water piping and cast iron DWV and water piping with polyethylene tube or sheet in accordance with AWWA C105/A21.5.

3.1.6 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs, and partitions. Provide not less than 0.25 inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.

3.2 NAMEPLATES

Provide laminated plastic nameplates for equipment, gages, thermometers, and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125 inch thick melamine plastic, black with white center core. Surface shall be a matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Lettering shall be minimum of 0.25 inch high normal block lettering. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

a. Manufacturer, type, and model number

b. Date installed

c. Capacity or size

d. System in which installed

e. System which it controls

3.3 CONNECTIONS TO EXISTING WATER SUPPLY SYSTEMS

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around mains; bolt valve conforming to AWWA C500 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service. Notify the Contracting Officer in writing at least 15 days prior to the date the connections are required; receive approval before any service is interrupted. Provide materials required to make connections into the existing water supply systems and perform excavating, backfilling, and other incidental labor as required.

3.4 FIELD QUALITY CONTROL

3.4.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.4.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code, except as modified herein. Correct defects in the work provided by the Contractor, and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

3.4.2.1 Domestic Water Piping

Before applying insulation, hydrostatically test each piping system at not less than 100 psig with no leakage or reduction in gage pressure for 2 hours.

3.4.2.2 DWV Piping

Before the installation of fixtures, cap ends of each system, fill piping with water to the roof, and allow to stand until a thorough inspection has been made. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10 foot head or water. After plumbing fixtures have been set and their traps filled with water, subject the entire sanitary system to a final air pressure test of not more than 1.0 inch of water column and a smoke or peppermint test. Perform the air and smoke test with an approved smoke testing machine which shall show a clear passage of smoke and air throughout the entire system. The entire system shall be proven absolutely tight under such test.

3.4.2.3 Backflow Preventers

Backflow preventers shall be tested by a locally approved and certified backflow assembly tester. A copy of the test report shall be provided to the Contracting Officer prior to placing the domestic water system into operation, or no later than 5 days after the test.

3.5 DISINFECTION

Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million (ppm) of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 ppm, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplied by nonportable water is not required.

PART 4 MEASUREMENT AND PAYMENT

Measurement for Payment for plumbing work in this section shall be on a lump sum basis as provided for and indicated in the bid proposal. Payment made at the bid price shall be full compensation for furnishing all labor, materials, equipment in installing all plumbing work in place.

-- End of Section --

SECTION 15483

FUEL OIL HANDLING SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1981; R 1993) Scheme for the *Identification of Piping Systems*

AMERICAN PETROLEUM INSTITUTE (API)

API STD 600	(1991) Steel Gate Valves, Flanged and Buttwelding Ends

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.5	(1988; Errata 1988, Addenda 1992) Pipe Flanges and Flanged Fittings
ASME/ANSI B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME/ANSI B16.39	(1986) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1993; Rev. A) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
ANSI/AWS Z49.1	(1988) Safety in Welding and Cutting

FEDERAL SPECIFICATIONS (FS)

FS WW-V-35	(Rev. C) Valve, Ball

FS WW-S-2739	Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam
FS GG-M-2802	Meters, Fluid Quantity Volumetric

MILITARY SPECIFICATIONS (MIL)

MIL-P-17608	(Rev. D) Pumps, Rotary, Power-Driven, Viscous Liquids
MIL-G-17713	(Rev. D) Gages, Liquid Level Measuring, Tank
MIL-V-18436	(Rev. F) Valves, Check: Bronze, Cast-Iron, and Steel Body
MIL-C-19902	(Rev. C) Caps, Vent, Fuel Storage Tank
MIL-T-22361	(Am. 1) Thread Compound; Antiseize, Zinc Dust-Petrolatum
MIL-P-24441	(Rev. B; Supp. 1) Paint, Epoxy-Polyamide
MIL-T-27730	(Rev. A) Tape, Antiseize, Polytetrafluoroethylene, with Dispenser

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1991) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1993) Flammable and Combustible Liquids Code
NFPA 31	(1992) Installation of Oil Burning Equipment
NFPA 70	(1993) National Electrical Code

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 10	(1991) Near-White Blast Cleaning
SSPC Paint 20	(1991) Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic")

UNDERWRITERS LABORATORIES INC. (UL)

UL 842 (1993) Valves for Flammable Fluids

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements" applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Day tank assembly

b. Strainers

1.3.2 SD-06, Instructions

a. Day tank assembly

1.3.3 SD-08, Statements

a. Welding procedure

b. Qualification of welders

1.3.3.1 Welding Procedure

Before performing welding, submit three copies of welding procedure specification for metals included in the work, together with proof of its qualifications as outlined in ASME B31.1.

1.3.3.2 Qualification of Welders

Before welder or operator performs welding, submit three copies of the Welder's Performance Qualification Record in conformance with ASME B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor.

1.3.4 SD-13, Certificates

a. Day tank assembly

1.3.5 SD-19, Operation and Maintenance Manuals

a. Day tank, Data Package 3

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

1.4.1 Defective Welds

Welders making defective welds after passing a qualification test shall be required to take a re-qualification test. Welders failing the re-qualification tests will not be permitted to work under this contract.

1.4.2 Previous Welder Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without re-qualification, subject to approval by the Officer-in-Charge provided that all the conditions specified in ASME B31.1 are met before a procedure can be used.

1.5 WELDING SAFETY

ANSI/AWS Z49.1.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Steel Pipe and Fittings

2.1.1.1 Pipe

ASTM A 53, Schedule 40, black steel, electric-resistance welded or seamless. Use Schedule 80 where pipe is to be threaded.

2.1.1.2 Threaded and Socket-Welding Fittings

ASME B16.11, forged steel, Class 2000.

2.1.1.3 Threaded Fittings

ANSI/ASME B16.3, black malleable iron, Class 150.

2.1.1.4 Butt-Welding Fittings

ASME/ANSI B16.9, Class 150. Backing rings shall conform to ASME B31.3 and be compatible with materials being welded.

2.1.1.5 Flanges and Flange Fittings

ASME/ANSI B16.5, steel flanges or convoluted steel flanges which meet the criteria of ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross section which afford containment for self-energizing gasket material.

2.1.2 Vent Piping

ASTM A 53 standard weight, zinc-coated steel with zinc-coated malleable iron fittings ANSI/ASME B16.3.

2.1.3 Valves

2.1.3.1 Bronze Gate Valves

MSS SP-80 Class 125, 2 inches and smaller, wedge disk, nonrising stem.

2.1.3.2 Steel Gate Valves

API STD 600, oil service, Class 150.

2.1.3.3 Ball Valves

FS WW-V-35, Type III, Class BZ, CS, PTFE seat, UL listed.

2.1.3.4 Relief Valves

UL 842, steel or bronze bodies, corrosion-resistant valve seats, and positive closing to prevent leakage.

2.1.3.5 Check Valves

MIL-V-18436, Class 150

2.1.4 Piping Accessories

2.1.4.1 Flexible Hose

Flexible metal hose, corrugated type with braided wire sheath covering, close-pitch annular corrugations, rated for a working pressure of at least 125 psig, 8-inch minimum live length, screwed end connections, UL listed for flammable liquid service. Metal for hose and braided wire sheath shall be stainless steel, any type of ASTM 300-series.

2.1.4.2 Strainers

FS WW-S-2739 single basket type, with inlet and outlet on the same center line. Cast steel or fabricated steel body, 40 by 40 mesh ASTM 300-series stainless steel baskets. Open area of one basket shall be 2 1/2-times inlet or outlet piping area. Furnish one spare basket.

2.1.4.3 Bolting

Material for bolts and studs ASTM A 307, Grade-B and for nuts ASTM A 194/A 194M, Grade-2. Dimensions of bolts, studs and nuts ANSI B18.2.1 and ASME/ANSI B18.2.2 with threads conforming to ASME B1.1 coarse type, with Class 2A fit for bolts and studs, and Class 2B for nuts.

2.1.4.4 Sleeves in Masonry and Concrete Walls, Floors, Roofs

Provide ASTM A 53, Schedule 40 or Standard Weight, zinc-coated steel pipe sleeves.

2.1.4.5 Walls, Plates

Plates shall be painted cast-iron, malleable iron, or steel.

2.1.5 Meters

FS GG-M-2802, Style A disk, size as indicated, for 7.5 gpm maximum flow of Grade No. 2 fuel oil at 60 to 80 degrees F and 10 psig maximum pressure. Meter shall be arranged for mounting in pipe line and shall have overrange protection. Casing shall be bronze. Pressure drop through meter shall not exceed 2 psi. Provide combination register-totalizer and water escape hole.

2.1.6 Instruments

2.1.6.1 Tank Gages

MIL-G-17713, buoyant force type with direct reading dial.

2.1.6.2 Pressure Gages

ANSI/ASME B40.1, single style with 4 1/2-inch diameter dial for fuel, brass case, bronze tube; accuracy within 2 percent of scale range. Provide scale range suitable for the intended service.

2.1.7 Design, Construction, and Testing of Day Tank Assembly

2.1.7.1 General

a. Designed to automatically transfer diesel fuel from a remote underground storage tank and supply to engine generator by gravity.

b. Be a product of a manufacturer regularly engaged in manufacturing standard production line of day tanks.

c. Shall comply with NFPA 30, NFPA 30A and NFPA 31 and UL 142.

2.1.7.2 Requirements

a. 275 gallon capacity with a secondary containment dike

b. Duplex gear type fuel supply transfer pumps (one standby) with automatic duplex controllers

c. Tank level controller

(1) Level gauge

(2) High level alarm/lockout

(3) Low level alarm

(4) Tank leak alarm/lockout

(5) Differential fill pump control

(6) Manual and test switches

(7) Remote alarm contacts

d. Fill Control

(1) Solenoid valve, 100 psi

(2) Fuel strainer

(3) Manual shut-off valve, bronze

(4) Fusible link, ductile iron, 165°F

e. Fill Pump

(1) 7 1/2 GPM

(2) Fusible link valve, ductile iron, 165°F on fill line.

f. Supply Line to Engine

(1) Fusible link valve, ductile iron, 165°F.

g. Drain Valve

2.1.8 Protective Coating Materials for Day Tank

Coatings shall be the products of one manufacturer and coating application procedure shall be in accordance with manufacturer's instruction. Tank surface preparation shall be abrasive blast clean steel surfaces in accordance with SSPC SP 10 to a surface profile of 1/2 to 2 mils.

2.1.8.1 External Coatings

Protect day tanks against atmospheric corrosion with a coat of organic, lead and chromate free, zinc-rich primer conforming to SSPC Paint 20, Type II applied to a minimum dry film thickness of 4 mils and finish with two coats of epoxy-polyamide topcoat conforming to MIL-P-24441. Apply a gray first topcoat conforming to MIL-P-2441/2, Formula 151 applied to a minimum dry film thickness of 3 mils and finish with a white second topcoat conforming to MIL-P-24441/3, Formula 152 applied to a minimum dry film thickness of 3 mils resulting in a total system minimum dry film thickness of 11 mils.

PART 3 EXECUTION

3.1 INSTALLATION

Contractor shall provide installation of fuel oil piping system in accordance with applicable Federal, State, regional or local regulations.

3.1.1 Fuel Oil Piping System

Install piping in locations, in a manner that will minimize cutting of beams, girders, columns, or load-bearing members. Installation of oil piping and equipment in buildings shall conform to NFPA 30 and NFPA 31, except as indicated or specified herein.

3.1.2 Pipe Sleeves and Plates

Provide sleeves where piping passes through walls. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls. Provide not less than 1/4-inch space between exterior of piping or pipe insulation and interior of sleeve. Firmly pack space with insulation and calk at both ends of the sleeve with acoustic sealant which will dry to a firm but pliable mass, or provide a segmented elastomeric seal. Secure plates to pipes at sleeves.

3.1.3 Steel Piping

Steel piping 2 inches and smaller shall be threaded or socket-welded. Flanges may be used for valves and equipment installation. Piping joints shall conform to ASME B31.3.

3.1.4 Threaded Joints in Piping

Provide lubricant or polytetrafluoroethylene tape conforming to MIL-T-27730 on male threads of screwed joints. Red or white lead and zinc compound conforming to MIL-T-22361 may be used in accordance with MIL-A-907. Piping shall be free from fins and burrs. Ream or file out pipe ends to size of bore and remove chips. Attach screwed flanges by screwing the pipe through the flange, and reface pipe and flange accurately.

3.1.5 Welding

3.1.5.1 Welding of Piping

Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and cleaning of pipe shall be in accordance with ASME B31.1. Welds shall be visually examined and meet acceptance standards specified in Chapter VI of ASME B31.3.

3.1.5.2 Quality of Welds

Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ASME B31.1.

3.1.5.3 Arc Welding and Gas Welding

In accordance with ASME BPVC SEC IX.

3.1.6 Unions and Flanges

Place unions and flanges where necessary to permit easy disconnection of piping and apparatus. Each connection having a threaded end valve shall have a union.

3.1.7 Valves

Install valves in positions accessible for operation and repair.

3.1.8 Diesel Day Tank

Install storage tanks, vents and other connections in accordance with NFPA 30, NFPA 31, recommendations and published instructions of the manufacturer, and as indicated. Provide grounding of tanks directly through bonding to grounded network in accordance with NFPA 78. Fasten day tank on a firm reinforced concrete foundation.

3.2 FIELD QUALITY CONTROL

Prior to application of test pressure. Maintain test pressure for at least one hour. In the event of leakage, locate and repair leak by rewelding and repeat test. Materials and equipment shall be subject to inspection at the installation site by the Officer-in-Charge.

PART 4 MEASUREMENT AND PAYMENT

Measurement and payment for the diesel fuel handling system shall be paid on a lump sum basis. The total lump sum amount paid for the bid item(s) listed on the bid schedule under which this section is a part shall include full payment for all costs covered by the provisions in this section.

-- End of Section --

SECTION 15601

CENTRAL REFRIGERATION EQUIPMENT FOR AIR CONDITIONING (AIR-COOLED CONDENSING UNIT)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.13	(1971; R 1986) Measurement of Sound Pressure Levels

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 520	(1990) Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 15	(1992) Safety Code for Mechanical Refrigeration

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 117	(1990) Salt Spray (Fog) Testing

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Controllers Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA MG 1	(1993) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 465	(1982; R 1987, Bul. 1994) Central Cooling Air Conditioners

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Air-cooled condensing unit

b. Electric motors and starters

1.3.2 SD-04, Drawings

a. Air-cooled condensers, remote-type

1.3.3 SD-06, Instructions

a. Central refrigeration equipment

b. Chemicals

Submit an Occupational Safety and Health Act (OSHA) Material Safety Data Sheet for chemicals provided.

1.3.3.1 Central Refrigeration Equipment

Include evacuation and charging procedures.

1.3.4 SD-12, Field Test Reports

a. Start-up and initial operational tests

1.3.5 SD-18, Records

a. Posted operating instructions for central refrigeration equipment

Submit text.

1.3.6 SD-19, Operation and Maintenance Manuals

a. Air-cooled condensing unit, Data Package 3

b. Electric motors and starters, Data Package 3

Submit operation and maintenance data in accordance with Section 01781, Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

1.4.1 Personnel Protection

UL 465. Provide personnel protection from moving parts including fans, pulleys, chains, gears, and couplings. High temperature machinery and piping shall be guarded or covered with insulation.

1.4.2 Electrical Systems

Wiring and components shall conform to NFPA 70 and UL 465.

1.5 POSTED OPERATING INSTRUCTIONS FOR CENTRAL REFRIGERATION EQUIPMENT

Provide posted operating instructions for each piece of refrigeration equipment.

1.6 REFRIGERANTS AND OILS

Dehydrate, purge, and charge refrigerant circuit with refrigerant and oil at factory. Factory oil and refrigerant charge shall be full amount required for operation, if within limits permitted by the Department of Transportation; otherwise, a holding charge shall be furnished. Field charging, where only a holding charge is shipped, shall be accomplished without breaking permanent refrigerant connections. Furnish one complete charge of lubricating oil in sealed containers in addition to that placed in system. Equipment using R-11, R-12, R-113, R-114, R-115, or R-500 as a refrigerant will not be permitted. Refrigerants shall have an Ozone Depletion Factor (ODF) of 0.05 or less. The ODF shall be in accordance with the "Montreal Protocol On Substances That Deplete The Ozone Layer," September 1987, sponsored by the United Nations Environment Programme.

PART 2 PRODUCTS

2.1 AIR-COOLED CONDENSING UNIT

2.1.1 System Description

Outdoor-mounted, air-cooled condensing unit suitable for on-the-ground or rooftop installation. Unit shall be factory assembled and consist of a semi-hermetic refrigerant compressor/motor assembly, an air-cooled coil, propeller type condenser fans and a control box. Unit shall discharge supply air upward as shown on contract drawings. Unit hall be used in a refrigeration circuit to match up to a packaged air handling unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, refrigerant charge (R-22), and special features required prior to field start-up.

2.1.2 Unit Cabinet

Unit cabinet shall be constructed of galvanized steel, 18-gage minimum thickness, bonderized and coated with a prepainted baked enamel finish. Unit access panels shall be hinged for compressor and control box service access. Provide lifting holes for rigging. Provide coating an specified under paragraph 2.2.2, "Vinyl Coating."

2.1.3 Fans

Condenser fans shall be direct driven propeller type, discharging air vertically upward. Condenser fan motors shall be totally enclosed 3-phase type with Class B insulation and with permanently lubricated bearings. Shafts shall have inherent corrosion resistance. Fan blades shall be statically and dynamically balanced. Condenser fan openings shall be equipped with PVC coated steel wire safety guards.

2.1.4 Compressor

Compressor shall be serviceable, reciprocating semi-hermetic type. Compressor shall be equipped with an automatically reversible oil pump, operating oil charge, suction and discharge shut-off valves and an insert-type factory sized crankcase hater to control oil dilution. Compressor shall be mounted on spring vibration isolators with an isolation efficiency of no less than 95%. Compressor speed shall not exceed 1750 rpm. Compressor shall unload using suction cutoff unloading. Provide minimum of 2 stages of cylinder unloading in paragraph 2.2.1, "Vinyl Coating."

2.1.5 Condenser Coil

Condenser coil shall be air cooled, circuited for integral subcooler. Coil shall be constructed of aluminum fins mechanically bonded seamless copper tubes. Provide coating as specified.

2.1.6 Refrigeration Components

Refrigeration circuit components shall include hot gas muffler, high side pressure relief device, liquid line shut-off valve, suction and discharge shut-off valves. Anti short-cycling device.

2.1.7 Safety Devices

Minimum safety devices shall include:

Automatic reset (after resetting first at thermostat):

a. High discharge pressure cutout.

b. High discharge temperature cutout.

c. Low suction pressure cutout.

d. Condenser fan motors to be protected against overload or single phase condition by internal overloads.

Manual reset at the unit:

a. Low oil pressure cutout.

b. Electrical overload protection through the use of definite-purpose contactors and calibrated, ambient compensated, magnetic trip

circuit breakers. Circuit breakers shall open all three phases in the event of an overload in any one of the phases or a single phase condition.

Unit electrical power shall be single point connection. Unit control circuit shall contain a 24-volt transformer for unit control, with capacity to operate the evaporator fan interlock.

2.1.8 Controls

Provide a control panel fitted with a discharge pressure gage, suction pressure gage, separate high pressure cutout with manual reset, separate low pressure cutout, compressor operating control, and manual off-auto switch. Provide oil pressure gage and low-oil-pressure cutout switch with manual reset for compressors with positive displacement type oil pumps. Provide signal lights or other visual "failed" indications for high pressure, low pressure, and oil pressure protection devices. Multicompressor units shall be provided with a lead/lag selector switch. Provide a timer to prevent compressors from short cycling whenever stopped by safety controls. Time delay shall be not less than 5 minutes. A pumpdown cycle of the nonrecycling start type shall be provided for compressors 20 tons or larger. Provide a minimum 4 inch alarm bell and alarm bell circuit to actuate bell in event of machine cutout on protective devices, except when low-pressure cutout is used as an operating control. Provide system capacity control to adjust output to a minimum of 33 percent of full load capacity without cycling operating compressor and to automatically recycle system on power interruption.

2.1.9 Electric Motors and Starters

Provide polyphase induction motors conforming to NEMA MG 1. Provide reduced voltage motor starters conforming to NEMA ICS 1 and NEMA ICS 2. Provide phase failure, over voltage and under voltage protection.

2.2 COATINGS FOR FINNED TUBE COILS

Where expressly stipulated in equipment specification paragraphs in this section, finned tube coils of the affected equipment items shall be coated as specified below.

2.2.1 Phenolic Coating

Coating shall be applied at the premises of a company specializing in such work. Coils shall be degreased and prepared for coating in accordance with coating applicator's standard procedures for the type metals involved. Coating material shall be a resin base thermosetting type phenolic. Phenolic coating shall be applied by immersion dipping of the entire coil. Minimum of two coats shall be applied by immersion dipping. Coils shall be baked or heat dried following each immersion. After final immersion and prior to final baking, entire coil shall be given a spray coating of phenolic with particular emphasis given to building up coating on sheared edges. Completed coating shall show no evidence of softening, blistering, cracking, crazing, flaking, or loss of adhesion. There shall be no evidence of phenolic "bridging" between the fins. Minimum dry film thickness of coating shall be 1.5 mils.

2.2.2 Vinyl Coating

Equipment shall be disassembled to extend necessary to provide access to spray a special finish on the coil and fins. Exterior bare metal surfaces of equipment shall also be provided with this special finish. Application shall be by experienced applicators, at the premises of a company specializing in such work, using an airless fog nozzle. At least two passes shall be made with the nozzle over the surfaces to be painted for each coat. Materials to be applied are as follows:

2.2.2.1 Mild Steel Surfaces

Self-curing, zinc filled, inorganic coating with 80, plus or minus 2 percent solids content by weight minimum: 1 coat, 3 mils

Lower temperature curing Epoxy-Polyamide, high build coating with 58, plus or minus 2 percent solids content by volume of mixture components: 2 coats, 5 mils per coat

2.2.2.2 Non-Ferrous and Heat Exchanger Finned Surfaces

Total dry film thickness, 6.5 mils maximum

Vinyl primer 24, plus or minus 2 percent solids content by volume: 1 coat, approx. 2 mils

Vinyl copolymer 30, plus or minus 2 percent solids content by volume: 1 coat, approx. 4 mils

2.2.2.3 Galvanized Surfaces

Modified vinyl primer, rush inhibiting with 24, plus or minus 2 percent solids content by volume: 2 coats, 2 mils

Vinyl copolymer 30, plus or minus 2 percent solids content by volume: 2 coats 4 mils

2.3 FINISHES

Steel surfaces of equipment including reciprocating, air-cooled, remote-type condensers, that do not have a zinc coating conforming to ASTM A 123, or a duplex or paint system. Thickness of coating or paint system on the actual equipment shall be identical to that on the salt-spray test specimens with respect to materials, conditions of application, and dry film thickness.

2.4 SOURCE QUALITY CONTROL

2.4.1 Salt-Spray Tests

Factory-applied coating or paint system on equipment located outdoors including air-cooled remote-type condensers, shall be factory salt-spray tested in accordance with ASTM B 117 or Federal Test Method Standard No. 141 (Method 6061). Period of test shall be 500 hours. Test specimens

shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, coating or paint system shall be evaluated and rated in accordance with procedures A and B of ASTM D 1654. Rating of failure at the scribe mark shall be not less than six (average creepage not greater than 3 mm (1/8 inch). Rating of the unscribed area shall not be less than 10 (no failure).

PART 3 EXECUTION

3.1 INSTALLATION

Installation procedures shall conform to ASHRAE 15, and manufacturer's recommendations. Refrigerant safety relief devices shall have discharge piped to building exterior. Condenser water pump starters, so that compressors cannot operate unless the pumps are operating. Make piping connections to equipment after piping systems have been tested and cleaned.

3.2 FOUNDATIONS

Foundations for mounting of equipment, accessories, appurtenances, piping, and controls shall be provided, including supports, vibration isolators, stands, guides, anchors, clamps, and brackets. Anchor bolts and sleeves shall be set using templates. Anchor bolts shall be provided with welded-on plates on the head end embedded in the concrete. Equipment bases shall be leveled, using jacks or steel wedges, and grouted in using a nonshrinking type of grouting mortar. Foundations shall conform to manufacturer's recommendations.

3.3 LOCATIONS AND CLEARANCES

Equipment shall be located so that working space is available for necessary servicing such as shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide manufacturer's recommended clearances for installation, operation, and maintenance, for cooling towers and chillers located within enclosures.

3.4 IDENTIFICATION TAGS AND PLATES

Provide equipment with tags numbered and stamped for their use. Plates and tags shall be brass or nonferrous material. Minimum letter and numeral sizes shall be 3 mm (1/8 inch) high.

3.5 FIELD QUALITY CONTROL

Perform tests and provide labor, materials, and equipment required. Notify the Officer-in-Charge, in writing, 10 days before performing tests. Tests shall be performed in the presence of a manufacturer's representative. Tests shall conform to Section 15950, "HVAC Testing/Adjusting/Balancing."

3.5.1 Start-Up and Initial Operational Tests

Equipment shall be started and operated. Follow manufacturer's procedures and place systems under all modes of operation. Initial charges of refrigerant lubricating oil shall be supplemented to ensure maximum operating capacity. Safety and automatic control instruments shall be adjusted. Record manufacturer's recommended readings hourly. Operational tests shall cover a period of not less than 3 days.

-- End of Section --

SECTION 15850

AIR HANDLING EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

ANSI/AMCA 210	(1990) Testing Fans for Rating
AMCA 500	(1991) Louvers, Dampers and Shutters

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 52	(1976) Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1994) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 117	(1994) Operating Salt Spray (Fog) Testing Apparatus

FEDERAL SPECIFICATIONS (FS)

FS F-F-2790	Filter, Air-Extended Area, Initial Installation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1993) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA DCS	(1985) HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES INC. (UL)

UL 507	(1991; Bul. 1992 and 1994, R 1994) Electric Fans
UL 705	(1994) Power Ventilators
UL 900	(1987; R 1993, Bul. 1994) Air Filter Units

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirement," applies to this section with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, manufacturer's Catalog Data

a. Central station air handlers

b. Supply air fan

c. Wall centrifugal exhaust fan

d. Roof curbs

e. Filter Sections

Include sound rating data and sound power level for all octave-band center frequencies or loudness level.

1.3.2 SD-12, Field Test Reports

a. Air conditioning and air balancing test report

1.3.3 SD-13, Certificates

a. Central station/air handlers

b. Supply air fan

c. Wall centrifugal exhaust fans

d. Gravity ventilators

1.3.4 SD-19, Operation and Maintenance Manuals

a. Central station air handlers, Data Package 3

b. Supply air fan, Data Package 3

c. Wall centrifugal exhaust fans, Data Package 3

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 FANS

Total sound power level of the fan shall not exceed 90 dBA when tested per AMCA 300 and rated per AMCA 301; statically and dynamically balanced, with air capacities, brake horsepowers, and static pressure as indicated. Provide nominal 2 mesh 0.063 inch wire diameter, stainless steel bird screens for outdoor air inlet. Equip with automatic (backdraft) dampers where indicated. Have thermal overload protection with the operating disconnect switches within the building. Construction housings and impellers of aluminum or steel, except as specified otherwise. For wiring terminations, provide terminal lugs to match branch circuit conductor quantities, sizes, and materials. Enclose terminal lugs in terminal box sized to NFPA 70. Modular construction for varying arrangements.

2.1.1 Wall Centrifugal Exhaust Fan

Direct drive, ANSI/AMCA 210 with AMCA seal, heavy-gage corrosion free spun aluminum housing and stainless steel fastenings, permanently lubricated motor mounted outside of exhaust air stream, non-overloading aluminum wheel and hub. Capacity, static pressure and horsepower as indicated on drawing. Housing flanges to connect directly to wall. Gravity back draft damper. Provide motors with resilient mounts and unfused disconnect switch.

2.1.2 Supply Air Fan

Roof-mounted, belt-drive, AMCA 211 with AMCA seal and UL listed, centrifugal blowers with double inlet, forward curve design in strong, die-formed galvanized steel housing with louvered sides and clearable, permanent filters to back-up each louvered side wall, removable roof for easy removal of filters, resilient mounted motor with integral disconnect switch, factory-made roof curbs. Capacity, static pressure and horsepower as indicated on drawing. A motorized multi-blade damper shall be interlocked with the fan motor circuit to open during fan operation and close when fan is not operating. The entire fan assembly shall coated with

a vinyl coating as specified in paragraph 2.5, "Corrosion Protection."

2.2 AIR HANDLERS

ARI 430 with sound rating in accordance with ANSI/ASHRAE 68, single-zone type, sound power level, capacity and static pressure, as indicated. Include damper section, supply blower section, filter section with mixing box section or combination filter-mixing box section, and coil section. Vertical floor-mounted unit with top outlets.

2.2.1 Casings

Construct casings of heavy-gage galvanized steel, on channel base and drain pan and coated externally with manufacturers standard paint finish. Provide removable panels and access doors for inspection and access to internal parts. Insulate casings with manufacturer's standard materials. Finish with seal joints, adjustable galvanized steel louvers with birdscreen, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500.

2.2.2 Dampers

Provide with factory mounted outside and return air dampers in mixing boxes of galvanized steel blades, with vinyl bulb edging in galvanized frame, in opposed blade arrangement with non-slip keyed connecting rods and linkages. Permanently secure damper blades on a single shaft with self-lubricating oil impregnated bronze bearings. Position damper blades across short air opening dimension. Maximum leakage is 2 percent at 4 inches water gage differential pressure when sized for 2000 fpm face velocity.

2.2.3 Supply Blower (Fan) Sections

Centrifugal fan of backward-inclined airfoil blades with V-belt drive motor, adjustable, with belt guards for external mounted motors. Belt guards are not required for internally mounted motors. Provide manual inlet vanes. Bearings shall be grease-lubricated ball-bearing type.

2.2.4 Vibration Isolation

For the entire fan, motor, and drive assembly, provide 2 inch nominal deflection spring vibration isolators, internally mounted at the factory together with fan discharge flexible connection and thrust restraint springs.

2.2.5 Filter Sections

Protect permanent holding frames with rust inhibitor coating. Provide visible identification on media frames showing model number and air-flow direction. Performance shall be determined in accordance with ASHRAE 52.

2.2.5.1 Replaceable Air Filters

UL 900, class 1, those which, when clean, do not contribute fuel when attacked by flame and emit only negligible amount of smoke permanent frames

with replaceable media, one inch nominal thickness, and size as indicated.

2.2.5.2 Filter Housing

Minimum thickness, 14 gage steel with baked finish inside and out. Hardware shall be stainless steel. Joints shall be continuously welded. Interior of cabinet shall have a heavy duty lever action bar or crank-up mechanism to position filter in place against a flange which contains a fixed air sealing gasket. The fixed air sealing gasket shall be hollow cross section, closed cell rubber or resilient neoprene, suitable for repetitive reuse. Cabinets shall have flanged ends for connection to adjacent ducts. Hinged access doors on both cabinet sides. Provide access doors with fixed air sealing gaskets to be airtight at the static pressure expected in service. Provide two 3/8 inch society of Automotive Engineers (SAE) flare connection test ports complete with seal cap, one on each side of the filter. Weld test ports into each filter cabinet or plenum. Test port shall not penetrate to filter frame or media.

2.2.6 Cooling Sections

2.2.6.1 Coils

Provide removable coils per ARI 410 with access to both sides. Enclose cooling coils in a common or individual casing with headers and return bends fully contained within casing. Cooling coils shall have drain pans with piping connections to remove condensate. Seal coils to casing to prevent leakage of air around coils.

2.2.6.2 Eliminators

Equip each cooling coil having an air velocity of over 400 fpm through the net face area with moisture eliminators, unless the coil manufacturer guarantees, that no moisture will be carried beyond the drip pans under actual conditions of operation. Construct of minimum 24 gage copper, removable through the nearest access door in the casing or ductwork. Eliminators shall have not less than two bends at 45 degrees and shall be spaced not more than 2 1/2 inches center-to-center on face. Each bend shall have an integrally formed hook as indicated in the SMACNA DCS.

2.2.6.3 Drip Pans

Provide each cooling coil section with a stainless or steel drip pan not less than 18 gage with drain connections. Drip pans shall collect, confine, and dispose of all condensate from cooling coils and attachments, including headers, return bends, distributors, and uninsulated pipe and fittings. Where individual eliminator blades are in sections (not in one piece from top to bottom of coil bank), provide auxiliary drip troughs at bottom of each section with drains to drip pans. Insulate drip pans with water impervious insulation of sufficient thickness to prevent condensate formation on the exterior at ambient conditions to be encountered.

2.3 MOTORS AND MOTOR STARTERS

Motor kW	Voltage	Type Starter

Up to 1/4	120	Manual
3/8 to 5 1/2	108-230	Across-the-line magnetic
5 1/2 to 11	108-230	Across-the-line magnetic, part winding or wye-delta
11 to 22 1/2	460	Across-the-line magnetic, part winding or wye-delta
Above 11	208-230	Part winding or wye-delta
Above 22 1/2	460	Part winding or wye-delta
Motor hp	Voltage	Type Starter
Up to 1/3	120	Manual
1/2 to 7 1/2	208-230	Across-the-line magnetic
7 1/2 to 15	208-230	Across-the-line magnetic, part winding or wye-delta
15 to 30	460	Across-the-line magnetic, part winding or wye-delta
Above 15	208-230	Part winding or wye-delta
Above 30	460	Part winding or wye-delta

NEMA MG 1, NEMA ICS 2, and NEMA ICS 6, respectively, with electrical characteristics as indicated. Motors shall be dripproof. Motor starters shall be magnetic-across-the-line type with watertight enclosure.

2.4 ROOF CURBS

Factory-fabricated sheet-steel structural members. Provide minimum 4 inch cants for built-up roofing, 2 by 6 inch factory-installed wood nailers, and fully mitered end sections. Provide welded 18 gage galvanized steel shell, base plate, and counterflashing and provide stiffness required to eliminating deflection.

2.5 CORROSION PROTECTION

2.5.1 Corrosion Protection for Supply Air and Wall Centrifugal Fans

Provide a special finish on the interior of the equipment and the exterior, where indicated. Apply coating at the premises of a company specializing in such work.

2.5.1.1 Mild Steel and Factory Primed Surfaces

a. Synthetic Resin Primer: 36 percent, plus or minus 6 percent, solids content by volume; 1 coat, 0.076 mm (3 mils) minimum dry film thickness.

b. Vinyl Copolymer: 23 percent, plus or minus 4 percent, solids content by volume; 2 coats, 0.038 mm (1 1/2 mils) minimum dry film thickness per coat.

2.5.1.2 Nonferrous Heat Exchanger Fin Coil Surfaces

Vinyl copolymer, 4 coats, 0.038 mm (1 1/2 mils) minimum dry film thickness per coat.

2.5.1.3 Galvanized Surfaces

a. Polyamide Epoxy Primer: 48 percent, plus or minus 2 percent, solids content by volume; 1 coat, 0.051 mm (2 mils) minimum dry film thickness.

b. Vinyl Copolymer: 23 percent, plus or minus 4 percent, solids content by volume; 2 coats, 0.038 mm (1 1/2 mils) minimum dry film thickness per coat.

2.5.1.4 Aluminum Surfaces Other than Fin Coil Surfaces

a. Polyamide Epoxy Primer: 48 percent, plus or minus 2 percent, solid contact by volume; 1 coat, 0.051 mm (2 mils) minimum dry film thickness.

b. Vinyl Copolymer: 23 percent, plus or minus 4 percent, solids content by volume; 2 coats, 0.038 mm (1 1/2 mils) minimum dry film thickness per coat.

PART 3 EXECUTION

3.1 PREPARATION

Provide storage for equipment and materials at the project site. Parts shall be readily accessible for inspection, repair, and renewal. Protect materials and equipment from weather.

3.2 INSTALLATION

Install air conditioning equipment as indicated and in accordance with the manufacturer's instructions. Provide clearance for inspection, repair, replacement, and service. Electrical work shall conform with NFPA 70 and Division 16, "Electrical." Provide overload protection in the operating disconnect switches and magnetic starters. Locate air intake of air handling equipment at a minimum of 12 feet from industrial stacks, bathroom vents, and sanitary risers. Prevailing wind direction shall not be used as justification for placing air intake closer than 12 feet of exhaust stacks. Locate annunciator panel in office.

3.2.1 Fans

Install with resilient mountings, flexible electrical leads, and flexible connections between fan inlet and discharge ductwork. Provide adjustable sheaves required for final air balance and safety screen where inlet or

outlet is exposed.

3.2.2 Air Handling Units

Install assembled units on vibration isolators and isolate fan section with flexible duct connections. Pipe condensate drain pan to the nearest floor drain.

3.2.3 Power Ventilators

Secure wall exhausters with stainless steel lag screws to structure. Extend ducts to wall exhausters into structure. Counterflash duct to wall opening.

3.3 FIELD QUALITY CONTROL

Schedule and administer specified tests. Provide personnel, instruments, and equipment for such tests. Correct defects and repeat the respective inspection and tests. Give the Officer-in-Charge ample notice of the dates and times scheduled for tests and trial operations. Conduct inspection and testing in the presence of the Officer-in-Charge.

3.3.1 Inspection

Prior to initial operation, inspect equipment installation for conformance with drawings and specifications.

3.3.2 Preliminary Tests

For each item of air handling and distribution equipment and its components, perform an operational test for a minimum period of 4 hours.

3.3.3 Testing and Balancing

After preliminary tests, perform air handling and distribution equipment tests, adjustment and balancing.

-- End of Section --

SECTION 15895

DUCTWORK AND DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500	(1991) Louvers, Dampers and Shutters
AMCA 501	(1985) Application Manual for Air Louvers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1994) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 527/A 527M	(1990) Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock-forming Quality
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM E 96	(1994) Water Vapor Transmission of Materials
ASTM E 437	(1992) Industrial Wire Cloth and Screens (Square Opening Series)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA DCS	(1985) HVAC Duct Construction Standards - Metal and Flexible
SMACNA SRM	(1991) Seismic Restraint Manual Guidelines for Mechanical Systems

1.2 RELATED REQUIREMENTS

Section 15011, "Mechanical General Requirements," applies to this section with the additions and modifications specified herein.

1.3 PRESSURE CLASSIFICATION

SMACNA DCS, Section 1, 2 inch water gage basis of compliance.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Dampers

b. Insulation and vapor barrier

c. Louvers

d. Diffusers, registers, and grilles

1.4.2 SD-04, Drawings

a. Shop drawings of the air conditioning system

1.4.3 SD-07, Schedules

a. Diffusers, registers, and grilles

Submit a schedule of inlets and outlets indicating location, catalog model number, manufacturer, nominal rated cfm, neck or face velocity at specified cfm, pressure drop at cfm, throw.

1.4.4 SD-12, Field Test Reports

a. Air duct leakage tests

PART 2 PRODUCTS

2.1 METAL DUCTS

2.1.1 Steel Ducts

ASTM A 527/A 527M galvanized steel sheet, lock-forming quality; coating designation G90.

2.2 DUCTS OF PRESSURE CLASSES 3 INCH WATER GAGE OR LESS

Construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA DCS, except that ducts with pressure classifications below 2 inch water gage that are located outside of the conditioned space shall have a seal class C. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork with pressure classifications above one inch water gage. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel.

2.2.1 Curved Elbows

Make a centerline radius not less than 1 1/2 times the width or diameter of the duct.

2.2.2 Laps

Make laps at joints in the direction of air flow. Space button-punch or bolt-connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "button-punch snap-lock," may be used in lieu of Pittsburg Lock.

2.2.3 Fittings

Elbows, vaned elbows, take-offs, branch connections, transitions, splitters, volume dampers, flexible connections, and access doors shall conform with SMACNA DCS, Section 2. Provide factory fabricated airtight, and noncorrosive test holes with screw cap and gasket.

2.3 FLEXIBLE DUCTS AND CONNECTORS

UL 181, Class I, UL listed, SMACNA DCS, and additional requirements herein specified. Provide to connect between rigid ducts and outlets or terminals. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream. At 250 degrees, minimum rating pressures shall be 6 inches water positive and 1/2 inch negative, up to 4,000 fpm and 2 inches water positive and 1/2 inch negative, up to 2500 fpm. Flexible ducts shall be maximum 4 feet in length. Minimum bend radius shall be twice the duct diameter.

2.3.1 Materials

Interlocking spiral or helically corrugated type constructed of zinc-coated steel, corrosion-resistant steel, aluminum, or noncollapsible fire-retardant, chloroprene or chlorosulphonated polyethylene impregnated, minimum 30 ounces per square yard woven mineral fabric.

2.3.2 Insulation and Vapor Barrier

ASTM C 553 Type 1, Class B-2, minimum one inch nominal thickness and three-quarter lb./cu. ft. density. Sheathe insulation with a vapor barrier having a maximum water vapor permeance of 0.20 perm in accordance with ASTM E 96, Procedure A. Coat ends of insulation with cement to prevent erosion and delamination.

2.3.3 Joints

Make airtight slip joints, seal with pressure-sensitive vapor-seal adhesive tape or duct sealer, and secure with sheet metal screws. To prevent insulation compression, place 2 inch wide by one inch thick closed cell foam plastic spacers over joints under vapor barriers. To provide a vaportight joint, provide a corrosion-resistant steel clamp over such spacers.

2.4 DIFFUSERS, REGISTERS, AND GRILLES

2.4.1 Material and Finishes

Provide factory-furnished diffusers, registers, and grilles constructed of steel. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc phosphate treated prior to priming and painting or have a baked-on enamel finish. Colors shall be approved by Officer-in-Charge.

2.4.2 Ceiling Diffusers

Equip with baffles or other devices required to provide proper air distribution pattern. Provide factory-fabricated, single key, volume dampers. Internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.

2.4.2.1 Square and Rectangular Diffusers

Construct each ceiling diffuser of four or more concentric elements designed to deliver air in a generally horizontal direction without excess smudging of the ceiling. Interior elements of square and rectangular ceiling diffusers may be circular, square, or rectangular as manufacturer's standard.

2.4.3 Registers

Double-deflection supply registers. Provide manufacturer-furnished volume dampers. Volume dampers shall be of the group-operated, opposed-blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face. Provide outside air and return registers as specified for supply registers, except that the registers shall have a single set of nondirectional face bars or vanes having the same appearance as the supply registers. Set face bars or vanes at 180 degrees.

2.4.4 Grilles

Construct and finish as specified above for registers, except that volume dampers shall be omitted.

2.5 DUCT SLEEVES, PREPARED OPENINGS, AND CLOSURE COLLARS

2.5.1 Duct Sleeves

Fabricate from minimum 20 gage galvanized steel. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated. Size sleeves to provide one inch clearance between duct and sleeve or between insulation and sleeve for insulated ducts.

2.5.2 Prepared Openings

Provide one inch clearance between the duct and the sleeve, or one inch clearance between insulation and sleeve for insulated ducts except at grilles, registers, and diffusers.

2.5.3 Packing

ASTM C 553, Type 1, Class B-2, mineral fiber.

2.5.4 Closure Collars

Four inches wide minimum, fabricated from minimum 20 gage galvanized steel.

2.6 DEFLECTORS

Factory-fabricated and factory- or field-assembled units consisting of curved turning vanes or scoop type extractors for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved vanes for square elbows. For round ducts taking off from rectangular ducts, provide factory fabricated, galvanized sheet metal, spin-in fittings. These fittings shall have scoop extractors, butterfly dampers, and locking quadrant operators.

2.7 ACCESS DOORS

Door shall be rigid and airtight with neoprene gaskets and two or more galvanized steel hinges and quick fastening locking devices. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed.

2.8 DAMPERS AND LOUVERS

Construct dampers and louvers with galvanized sheet metal two gages heavier than ducts in which installed. Except as modified herein, the construction shall be of galvanized steel with interlocking edges and maximum 10 inch blade width. Conform with SMACNA DCS. Dampers shall be opposed-blade type.

2.8.1 Backdraft Dampers (Gravity Dampers or Shutters)

Factory-fabricated, with statically balanced blades that open automatically when the fan starts and close by gravity when the fan stops. Provide the edges of blades with felt or rubber strips to prevent rattling. Backdraft dampers to be installed to relieve room pressure shall be stainless steel or galvanized steel. If galvanized steel finish with vinyl coating as specified in Section 15601, "Central Refrigeration Equipment for Air Conditioning."

2.8.2 Manual Volume Dampers

Balancing, factory-fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 3/16 inch rods brought through the side of ducts with locking setscrew and bushing. Where quadrant operators are furnished, provide chrome plated or enamel painted type with exposed edges rounded.

2.8.3 Louvers

Manual type. Fold or bead the edges of louver blades to exclude driving rain. Louvers blades shall be oriented to minimize the entrainment of rainwater. Make louver frames of 16 gage galvanized steel. provide stainless steel bird screen.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to NFPA 90A and SMACNA DCS. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Provide electrical isolation between dissimilar metals. electrical isolation may be fluorinated elastomers or sponge-rubber gaskets. Install ductwork accessories as indicated and as recommended by manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service. Louvers in accordance with AMCA 501.

3.1.1 Ductwork

Air distribution systems shall operate with no chatter or vibration.

3.1.1.1 Field Changes to Ductwork

Those required to suit the sizes of factory-fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts.

3.1.1.2 Dampers

When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer.

3.1.1.3 Deflectors

Provide in square elbows, duct-mounted supply outlets, take-off or extension collars to supply outlets, and tap-in branch-off connections. Adjust supply outlets to provide air volume and distribution as indicated or specified.

3.1.1.4 Access Doors

Provide for volume dampers, coils, thermostats, temperature controllers, valves, filters, and other concealed apparatus requiring service and inspection in the duct systems.

3.1.1.5 Duct Sleeves, Prepared Openings, and Closure Collars

Provide for ductwork penetrations in walls, and partitions through which metallic ductwork passes.

a. Duct Sleeves: Fill space between duct and sleeve or between insulation and sleeve for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.

b. Prepared Openings: Fill space between duct and opening or between insulation and opening for insulated ducts with mineral fiber, except at grilles, registers, and diffusers.

c. Closure Collars: Fit collars snugly around ducts or insulation. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier. Provide nails with maximum 6 inch centers on collars.

3.1.1.6 Packing

Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber.

3.1.2 Duct Hangers and Supports

SMACNA DCS, Section 4. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing.

3.1.2.1 Flexible Ducts

Support ducts by hangers every 3 feet, unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations and long radius elbows. Provide minimum length to make connections.

3.1.2.2 Flexible Connectors

Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.

3.1.3 Inspection Plates and Test Holes

Provide, where required, in ductwork or casings for all balance measurements. If possible, test holes should be located at least 7.5 times diameters downstream from a disturbance. Extend cap through insulation.

3.1.4 Flashing

Provide waterproof flashing where ducts pass through exterior walls and roofs.

3.1.5 Cleaning of Ducts

Remove all debris and dirt from ducts and wipe clean. Before installing air outlets, force air through entire system at maximum attainable velocity to remove accumulated dust.

3.2 FIELD QUALITY CONTROL

Administer and direct tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Notify Officer-in-Charge 7 days before inspection or testing is scheduled. Correct defects in work. Repeat tests until work is in compliance.

3.2.1 Air Duct Leakage Tests

Perform duct air leakage test in accordance with Section 15996, "Testing/Adjusting/Balancing: Heating/Ventilating/Cooling Systems."

PART 4 MEASUREMENTS AND PAYMENT

Measurements for payment of ductwork and accessories shall be by pounds or lump sum as provided for and indicated in the bid proposal. Payment made at the bid price shall be full compensation for providing all labor, materials, and equipment and performing all work involved in the fabrication and installation of all ductwork.

-- End of Section --

SECTION 15996

TESTING/ADJUSTING/BALANCING: HEATING/VENTILATING/COOLING SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(1989) Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE HA	(1991) Handbook, HVAC Applications

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB TABES	(1991) Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA HVACADLTM	(1985) HVAC Air Duct Leakage Test Manual
SMACNA HVACTAB	(1993) HVAC Systems - Testing, Adjusting and Balancing

1.2 DESCRIPTION OF WORK

The work includes testing, adjusting, and balancing (TAB) of new ventilating, and cooling (HVAC) air distribution systems.

1.2.1 Air Distribution Systems

Systems shall be tested, adjusted, and balanced (TAB'd) in compliance with this section. Obtain Officer-in-Charge's written approval before applying insulation to exterior of air distribution systems under Section 15250, "Mechanical Insulation."

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-08, Statements

a. Independent TAB Agency Qualifications

1.3.1.1 Independent TAB Agency Qualifications

Submit information certifying that: The TAB agency is a subcontractor who is not affiliated with any other company participating in work on this contract; the work to be perform by the TAB agency shall be limited to testing, adjusting, and balancing of HVAC air to satisfy the requirements of this specification section.

1.3.2 SD-12, Field Test Reports

a. Certified TAB Report

1.3.2.1 Certified TAB Report

a. Report Format

Provide the following TAB data:

(1) Air Handler Supply Air, Return Air and Outside Air (CPM)

(2) Coil Entering and Leaving Air Conditions (temperature of ^{O}F, DB and WB)

(3) Registers and Diffusers (CFM)

(4) Air Handler and Fan Motors (HP, FAA and actual amperage)

(5) Thermostat Settings

(6) Room Conditions (Temperature ^{O}F DB and Relative Humidity)

(7) Outside Conditions (Temperature ^{O}F DB and Relative Humidity)

b. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.4 QUALITY ASSURANCE

1.4.1 Responsibilities

1.4.1.1 Contractor

a. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB Agency:

(1) Contract drawings and specifications

(2) Approved submittal data for equipment

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

b. Certified TAB report: Certify the TAB report. This certification

includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the adherence to the procedures specified in this section.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 TAB PROCEDURES

3.1.1 TAB Field Work

Test, adjust, and balance the HVAC system to the state of operation indicated on and specified in the contract design documents. Air systems shall be proportionately balanced and reported in the certified TAB report. Conduct TAB work on the HVAC system in conformance with the AABC MN-1, or NEBB TABES, except as modified by this section:

a. Maintenance and calibration of instruments.

b. Accuracy of measurements.

c. Preliminary procedures: Test ports required for testing by the TAB engineer shall be located in the field by the TAB engineer during TAB field work. It shall be the responsibility of the sheetmetal contractor to provide and install test ports as required by the TAB engineer.

d. Air Distribution Systems TAB Work:

(1) Air Conditioning System including air handling unit fan, toilet and storage rooms, exhaust fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and makeup air.

(2) Pump Room Ventilation including roof-mounted supply air fans, existing Pump Room exhaust fan and wall gravity clampers. Provide the following data: Outside air condition at Pump Room roof level-temperature of DB and WB. total supply air (5 fans) CFM exhaust air from existing pump room exhaust fan-CFM Pump Motor Room condition at 5 ft. level - temperature ^{O} F DB and WB.

(3) Generator Room Ventilation including remote radiator fan, intake air silencers and discharge air silencers. Provide the following information data with the engine generator operating at full load. Air Entering Room: CFM, temperature ^{P}F DB and WB. Air Entering Radiator: CFM, Temperature ^{O}F DB and WB. Air Leaving Radiator: CFM, Temperature ^{O}F DB and WB.

e. TAB work on performance tests:

(1) Performance tests: In addition to the TAB proportionate balancing work on the air distribution systems accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the cooling systems.

(2) Ambient temperatures: On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.

(3) Refrigeration units: For all refrigeration compressors/condensing units all data as required by NEBB Form TAB 15-83, NEBB TABES shall be reported, including refrigeration operational data.

f. Workmanship: Conduct TAB work on specified HVAC systems until measured parameters are within plus or minus 10 percent of the values specified or indicated on the contract documents.

3.1.2 Completion of TAB Field Work

Except as approved otherwise in writing by the Officer-in-Charge, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled, "Workmanship."

3.1.3 Quality Assurance for TAB Field Work

a. Field check: Test shall be made to demonstrate that capacities and general performance of air systems comply with the contract requirements.

(1) Recheck: During field check, the Contractor shall recheck, in the presence of the Officer-in-Charge, random selections of CFM data recorded in the certified report.

(2) Areas of recheck: Points and areas of recheck shall be selected by the Officer-in-Charge.

(3) Procedures: Measurement and test procedures shall be the same as approved for work for forming basis of the certified report.

(4) Recheck selections: Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the report.

b. Retests: If random tests reveals a measured quantity which is out-of-tolerance, the report is subject to disapproval at the

Officer-in-Charges discretion. In the event the report is disapproved, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and a new field check conducted at no additional cost to the Government.

c. Approval prerequisite: Compliance with the field checking requirements of this section is a prerequisite to the final approval of the certified TAB report submitted.

3.2 MARKING OF SETTINGS

Permanently mark the settings of HVAC adjustment devices including splitters, and dampers so that adjustment can be restored if disturbed at any time. The permanent markings shall indicate the settings on the adjustment devices which result in the data reported on the submitted certified TAB report.

3.3 MARKING OF TEST PORTS

The TAB team shall permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, these markings shall be made on the exterior side of the duct insulation. The location of test ports shall be shown on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

PART 4 MEASUREMENT AND PAYMENT

Testing and Balancing shall not be measured separately for payment but shall be included for various items of related work.

-- End of Section --

SECTION 16011

ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

FEDERAL SPECIFICATIONS (FS)

FS L-P-387	(Rev. A; Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100	(1992) Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Enclosures for Industrial Control and Systems
NEMA MG 1	(1993) Motors and Generators
NEMA MG 10	(1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Work," Division 11, "Equipment," Division 13, "Special Systems," and Division 14, "Conveying Systems" and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 480 volts secondary, three phase.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01300, "Submittals" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured items hall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Drawings

Submit drawings a minimum of 355 by 510 mm (14 inches by 20 inches) in size using a minimum scale of 3 mm per 300 mm (1/8 inch per foot), except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify

circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.3 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.5.4 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.5.4.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.4.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Operation and Maintenance Manuals

Comply with the requirements of Section 01730 and the technical sections.

1.5.5.1 Operating Instructions

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.6 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

FS L-P-387. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm (0.125 inch) thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 25 by 65 mm (one by 2.5 inches). Lettering shall be a minimum of 6.35 mm (0.25 inch) high normal block style.

1.9 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.9.1 Motors and Equipment

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, including control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided

under Division 16.

1.9.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment under Section 16402, "Interior Wiring Systems." Power wiring and conduit shall conform to Section 16402, "Interior Wiring Systems." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.9.3 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters except starters/controllers which are indicated as part of a motor control center, control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits shall be provided under Division 16, except internal wiring for components of packaged equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.9.4 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 16.

1.9.5 High Efficiency Motors

1.9.5.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.9.5.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.10 INSTRUCTION TO MAINTENANCE PERSONNEL AND OPERATIONS

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

1.11 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09900, "Painting."

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 9 meters (30 feet) apart.

PART 4 MEASUREMENT AND PAYMENT

Electrical general requirements has not specific measurement. Measurement and payment is covered in the other specific electrical sections.

-- End of Section --

SECTION 16205

STANDBY DIESEL-ELECTRIC GENERATORS (DESIGN 4) 1,001 KW OR LARGER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws Inch Series
ANSI C12.10	(1987) Electromechanical Watthour Meters
ANSI C37.06	(1987; Supp. 1989) Switchgear - AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
ANSI C39.1	(1981; R 1992) Electrical Analog Indicating Instruments
ANSI C50.13	(1989) Rotating Electrical Machinery - Cylindrical - Rotor Synchronous Generators
ANSI S1.4 (ASA 47)	(1983) Sound Level Meters

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B15.1	(1992) Mechanical Power Transmission Apparatus
ASME/ANSI B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.5	(1988; Errata 1988) Pipe Flanges and Flanged Fittings
ASME/ANSI B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings

ASME B16.11	(1991) Forged Fittings, Socket-Welding and Threaded
ASME/ANSI B16.39	(1986) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME/ANSI B18.2.2	(1987; R 1993) Square and Hex Nuts (Inch Series)
ASME B31.1	(1992) Power Piping
ANSI/ASME B40.1	(1991; Special Notice 1992) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME PTC 26	(1962) Speed-Governing Systems for Internal Combustion Engine-Generator Units
ASME BPVC SEC VIII D1	(1992; Addenda 1992 and 1993) Boiler and Pressure Vessel Code: Section VIII Pressure Vessels, Division 1

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1993; Rev. A) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 126	(1993) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 181/A 181M	(1993; Rev. A) Forgings, Carbon Steel, for General Purpose Piping
ASTM A 193/A 193M	(1993; Rev. A) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1993; Rev. B) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 234/A 234M	(1994) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM B 88M	(1993; Rev. A) Seamless Copper Water Tube (Metric)
ASTM B 88	(1993; Rev. A) Seamless Copper Water Tube
ASTM B 187	(1992) Copper Bus Bar, Rod, and Shapes

ASTM B 317	(1992; Rev. A) Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Standard Structural Shapes for Electrical Purposes (Bus Conductor)
ASTM D 178	(1993) Rubber Insulating Matting
ASTM D 1785	(1993) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2467	(1993) Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(1993) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C651	(1992) Disinfecting Water Mains

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-50498	Valve, Foot, Cast Iron, Bronze and Polyvinyl Chloride (PVC)
CID A-A-50541	Valves, Tank Float, Angle and Globe Pattern

DIESEL ENGINE MANUFACTURERS ASSOCIATION (DEMA)

DMEA SDGE	(1972) Stationary Diesel and Gas Engines

FEDERAL SPECIFICATIONS (FS)

FS WW-T-696	(Rev. E) Traps, Steam and Air
FS VV-F-800	(Rev. D; Am. 2) Fuel Oil, Diesel
FS O-S-801	(Rev. E) Sulfuric Acid, Electrolyte (for Storage Batteries)
FS WW-S-2739	Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC	(1991) Uniform Building Code

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 1	(1986; R 1992) Temperature Limits in the Ratings of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE 115	(1983; R 1991) Synchronous Machines
IEEE 421.1	(1986) Definitions for Excitation Systems for Synchronous Machines
IEEE C37.2	(1991) Electrical Power System Device Function Numbers
ANSI/IEEE C37.04	(1979; R 1989, Supp. 1986, 1990, and 1991) Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C37.09	(1979; R 1989, Supp. 1984, 1985, and 1991) AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
ANSI/IEEE C37.20.2	(1993) Metal-Clad and Station-Type Cubicle Switchgear
ANSI/IEEE C37.21	(1985; R 1992) Control Switchboards
ANSI/IEEE C37.90	(1989) Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C50.10	(1977 Synchronous Machines
ANSI/IEEE C57.13	(1993) Instruments Transformers

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA S18.1	(1979; R 1992) Annunciator Sequences and Specifications

MILITARY SPECIFICATIONS (MIL)

MIL-T-152	(Rev. B) Treatment, Moisture- and Fungus-Resistant, of Communications, Electronic, and Associated Electrical Equipment
MIL-V-173	(Rev. C) Varnish, Moisture and Fungus Resistant (for Treatment of Communications, Electronics, and Associated Equipment)
MIL-T-5544	(Rev. C) Thread Compound, Antiseize, Graphite-Petrolatum

MIL-V-12003	(Rev. F; Am. 1) Valves, Plug: Cast Iron or Steel, Manually Operated
MIL-S-16165	(Rev. E) Shielding Harnesses, Shielding Items and Shielding Enclosures for Use in the Reduction of Interference from Engine Electrical Systems
MIL-P-17552	(Rev. F) Pump Units, Centrifugal, Water, Horizontal; General Service and Boiler-Feed: Electric-Motor- or Steam-Turbine-Driven
MIL-P-17608	(Rev. D) Pumps, Rotary, Power-Driven, Viscous Liquids
MIL-G-17713	(Rev. D) Gages, Liquid Level Measuring, Tank
MIL-F-18113	(Rev. E) Feeders, Boiler Water Treatment, By-Pass and Compound Receiver Types
MIL-V-18436	(Rev. F) Valves, Check: Bronze, Cast-Iron, and Steel Body
MIL-V-18634	(Rev. B) Valves: Safety, Relief, and Safety-Relief
MIL-T-22361	(Am. 1) Thread Compound; Antiseize, Zinc Dust-Petrolatum
MIL-I-24092	(Rev. D; Supp. 1) Insulating Varnishes and Solventless Resins For Applications by the Dip Process
MIL-S-62742	Switch, Pressure (Metric)

MILITARY STANDARDS (MIL-STD)

MIL-STD-461	(Rev. D) Control of Electromagnetic Interference Emissions and Susceptibility

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-80	(1987) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(1987) Steel Pipe Unions Socket-Welding and Threaded
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1993) Motors and Generators
NEMA WC 3	(1992) Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 5	(1992) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	(1993) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1993) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1993) Flammable and Combustible Liquids
NFPA 37	(1994) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1993) National Electrical Code

TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION (TEMA)

TEMA STE	(1988) Standards of Tubular Exchange

UNDERWRITERS LABORATORIES INC. (UL)

UL 429	(1982; R 1994) Electrically Operated Valves

UL 506	(1989; R 1993) Specialty Transformers
UL 1236	(1992; R 1994) Battery Chargers for Charging Engine-Starter Batteries

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements" applies to this section with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Intercooling

Intercooling as used in this specification denotes the cooling of the charged air leaving the turbocharger.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. Engine-generator unit data

b. Engine-generator unit efficiencies

c. Diesel engine data

d. Generator and exciter

1.4.1.1 Engine-Generator Unit Data

Submit the following data pertaining to each engine-generator unit and to the proposed auxiliary equipment.

a. Make of engine.

b. Type or model of engine.

c. Gross bkw (bhp) rating of engine. Gross rating shall be the total rated power output before deducting power requirements of electric motor-driven equipment. Net ratings shall be equal to gross ratings minus the total power requirements of electric motor-driven accessories normally constituting part of "engine assembly" as defined in DEMA SDGE and hereinafter referenced to as DEMA requirements.

d. Net bkw (bhp) rating of engine. Net ratings shall include a deduction in power output for the following parasitic loads.

(1) Lubricating oil pump for lubricating oil circulation and piston cooling service.

(2) Fuel oil booster pump.

(3) Cooling media system power requirements including pumps, radiator fans, and any other power consuming devices required to provide cooling as specified.

e. Strokes per cycle;

f. Number of cylinders.

g. Bore and stroke, inches.

h. Engine speed, rpm.

i. Piston speed, fpm.

j. BMEP at full load.

k. kW rating of generator.

l. kVA rating of generator.

m. Gross kW rating of engine-generator unit.

n. Net kW rating of engine-generator unit.

o. Make of turbochargers.

1.4.1.2 Engine-Generator Unit Efficiencies

Submit for the following. Fractional loads shall be calculated on basis of net ratings unless otherwise called for.

a. Fuel consumption at 0.80 power factor Btu per net kWh.

(1) 1/2 load.

(2) 3/4 load.

(3) Full load.

b. Fuel consumption at 1.00 power factor Btu per net kWh.

(1) 1/2 load.

(2) 3/4 load.

(3) Full load.

c. Fuel consumption Btu per gross kWh.

(1) 1/2 load.

(2) 3/4 load.

(3) Full load.

d. Generator efficiency at 0.80 power factor (percent).

(1) 1/2 of net-rated load.

(2) 3/4 of net-rated load.

(3) Full net-rated load.

f. Remote radiator capacity at design conditions.

(1) Coolant shall be antifreeze mixture as specified under paragraph entitled "Cooling System."

(2) Gpm of coolant.

(3) Kw (Btu/hour) of heat exchanger based on 200 degrees F coolant in, 172 degrees F coolant out.

1.4.1.3 Diesel Engine Data

Submit the following data certified by the engine manufacturer. Provide the following data for all units.

a. Indicated (developed) kw (hp) at specified engine speed.

b. Mechanical efficiency at full load (percent).

c. Maximum cylinder pressure psig.

d. Approximate exhaust temperature degrees F.

(1) 75 percent load.

(2) Full load.

(3) 110 percent load.

f. Weight of exhaust gas at full load lb per hr.

g. Weight of intake air at full load lb per hr.

h. Total heat rejected at full load Btu per hr.

(1) To jacket coolant systems.

(2) To lubricating oil system.

(3) To intercooler system.

(4) Total to cooling system.

i. Optimum jacket coolant temperature to engine degrees F at full load.

j. Optimum jacket coolant temperature from engine degrees F at full load.

k. Maximum safe jacket coolant temperature from engine degrees F.

l. Optimum lubricating oil temperature to engine degrees F at full load.

m. Optimum lubricating oil temperature from engine degrees F at full load.

n. Maximum safe lubricating oil temperature from engine degrees F.

o. Lubricating oil flow through lubricating oil heat exchanger at 110 percent-rated full load.

p. Head loss through lubricating oil heat exchanger at flow listed above psi.

q. Coolant flow through lubricating oil heat exchanger at 110 percent-rated full load.

r. Head loss through lubricating oil heat exchanger at flow listed above psi.

s. Coolant flow through jacket circuit heat exchanger at 110 percent-rated full load.

t. Head loss through jacket circuit heat exchanger at flow listed above psi.

u. Jacket coolant flow through engine at full load.

v. Head loss through engine at flow listed above psi.

w. Coolant flow through intercooler gpm.

x. Lubricating oil consumption in gallons per hour at full load (estimated).

y. Recommended grade and type of lubricating oil.

1.4.1.4 Generator and Exciter Data

a. Make and model number of generator proposed.

b. Generator short circuit ratio.

(1) Synchronous reactance, Xd.

(2) Transient reactance, Xd.

(3) Subtransient reactance, Xd.

c. Generator overspeed limit (percent).

d. Generator flywheel effect (kg-m2) ((lb-ft2)).

e. Test Voltage:

(1) Generator stator.

(2) Generator rotor.

(3) Exciter.

f. Generator 60-Hz saturation curve.

g. Generator and exciter efficiency data.

h. Generator K Valve - machine constant representing maximum permissible rating in generator capability curve.

1.4.2 SD-04, Drawings

a. Engine-generator unit and auxiliary equipment

b. Engine-generator unit electrical drawings

1.4.2.1 Engine-Generator Unit and Auxiliary Equipment

Submit the following.

a. Certified outline, general arrangement (setting plan), and anchor bolt details. Drawing shall show the total weight and center of gravity of the assembled equipment on the structural steel subbase.

b. General arrangement and detail piping of exhaust and air intake piping systems.

c. General arrangement, size, and location of electrical interface points, and detailed elementary, schematic wiring, and interconnecting diagrams of generator, exciter, governor, and other integral devices.

d. Generator guard or guard rail, if applicable.

e. Dimensional drawings of exhaust and intake silencers, intake filters, pumps, tanks, coolers, oil filters, compressors, and other auxiliary equipment.

f. General arrangement drawings showing location of auxiliary equipment in relation to the engine-generator unit.

g. Heat balance diagrams of the coolant system and lubricating oil system showing cooling loads, flow quantities, and operating temperature levels.

h. Piping schematics for fuel oil, lubricating oil, jacket coolant, and cooling water.

i. Detailed piping for piping 2 inches and larger, showing arrangement of piping and pipe sizes, with flows in gpm, cfm, or lbs per hour noted on each line.

1.4.2.2 Engine-Generator Unit Electrical Drawings

Submit electrical drawings including elementary, schematic, wiring, and interconnection diagrams. Utilize IEEE device numbers corresponding to the function names and descriptions of IEEE C37.2 and this specification for the following.

a. Engine and station control panels.

b. Metal-clad switchgear. Submit information and material in accordance with ANSI/IEEE C37.20.2 or ANSI/IEEE C37.20.1.

c. Generator protective devices.

d. Control switchboard.

e. Station battery system.

1.4.3 SD-05, Design Data

a. Design modifications

1.4.3.1 Design Modifications

Submit proposed cooling system design modifications within 10 calendar days after notice to proceed.

1.4.4 SD-08, Statements

a. Diesel engine generator successful operation

b. Field welding procedures

1.4.4.1 Diesel Engine Generator Successful Operation

Submit certificates within 30 calendar days after award certifying that not less than three engines of identical number of cylinders and cylinder size, identical or higher rotative speed, up to a maximum of 1,200 rpm, identical or higher brake mean effective pressure (BMEP), and the same basic configuration (In-line or Vee) as the engine to be provided, shall have driven generators which have produced, in satisfactory operation, not less than 2,000 kWh of electricity for each kW of generator nameplate capability within a 2-year period. Certificates shall include:

a. A list of at least three engine-generator unit installations meeting the experience requirements set forth in paragraph entitled "Experience Requirements."

b. Owner, location and date of initial operation of each such installation.

c. Number of kWh produced per kW of generator net rated capability at each installation.

d. Horsepower rating, kW rating, and rotative speed of each unit.

e. BMEP rating of each engine.

f. Design characteristics of each unit, such as bore and stroke, number of cylinders, and configuration (In-line or Vee).

1.4.4.2 Field Welding Procedures (Piping)

Before performing field welding, submit to the Officer-in-Charge, three copies of field welding procedure specifications for metals included in the work, with proof of qualification as outlined in ASME B31.1.

1.4.5 SD-10, Test Reports

a. Switchgear floor matting

Submit 20-kV ac proof test for switchgear floor matting.

1.4.6 SD-11, Factory Test Reports

a. Engine tests

b. Generator tests

c. Switchgear tests

d. Radio frequency interference (RFI) tests

Submit certified factory test report within 15 calendar days after completion of tests. Provide in accordance with the requirements set forth in paragraph entitled "Source Quality Control."

1.4.7 SD-12, Field Test Reports

a. Piping tests

b. Preliminary operation

c. Phase relationship tests

d. Switchgear field tests

e. Insulation resistance tests

f. Engine-generator unit acceptance tests

g. Auxiliary equipment test

Submit test and inspection reports for work required under the paragraph entitled "Field Quality Control."

1.4.8 SD-18, Records

a. Posted operating instructions for diesel engine-generator

Submit text, for each piece of equipment.

1.4.9 SD-19, Operation and Maintenance Manuals

a. Engine-generator units with accessories, auxiliary equipment, Data Package 4

b. Engine speed governor system, Data Package 3

c. Voltage regulator, Data Package 5

d. Engine control panels, Data Package 5

e. Metal-clad switchgear, Data Package 5

f. Generator protective devices, Data Package 5

g. Control switchboard, Data Package 5

h. Station battery system, Data Package 5

i. Switchgear floor matting, Data Package 1

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data." Manual shall include fuel adjustment procedures and maximum tolerances of wear on bearings and other rubbing surfaces that will require corrective measures.

1.5 QUALITY ASSURANCE

1.5.1 Experience Requirements

Engines installed in the power plant shall meet the following operating experience requirements.

a. Only stationary electric generation service is considered as equivalent experience. Engines driving pumps or compressors or in marine propulsion or railroad service are not acceptable.

b. Only experience on the same engine model is acceptable. Engine model is considered to be given series or class of identical bore and stroke and of the same type of engine, such as In-line or Vee. In-line and Vee engines with identical bore and stroke are considered as two separate models of engines.

c. Only experience at the identical rotative speed as that which is specified is acceptable.

d. Only experience at the identical or higher BMEP as that which is specified is acceptable.

e. Only experience with diesel-fueled engines is acceptable.

1.5.2 Regulatory Requirements

a. Provide devices designed and installed to comply with the following requirements.

(1) Power transmission apparatus: Guard in accordance with ANSI/ASME B15.1.

(2) Electrical installations: Conform to NFPA 70.

(3) Operator protection: Guard in accordance with 29 CFR 1910 as follows:

(a) Fan blades: Part 1910.212(a)(5).

(b) Fixed ladders: Part 1910.27.

(c) Platforms and access openings: Part 1910.23.

(4) Mercury: Use of mercury in instruments, contacts, and manometers is not permitted.

(5) Transformer insulation: Use of askarel or insulating liquids containing polychlorinated byphenyls (PCBs) is not permitted.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver equipment on pallets or blocking and with each entire unit or palletized unit wrapped in heavy-duty plastic wrapping, sealed to protect parts and assemblies from moisture and dirt. Plug and seal shut piping, conduit, exhaust, and air intake openings. Switchgear shall be packed in shipping sections which can be handled and installed at the site. Protect and prepare batteries for shipment as recommended by the battery manufacturer. Store equipment and allied equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water. Properly label each package on the exterior of the wrapping as to the identity of the enclosed equipment, contract number, manufacturer, and purchaser. The manufacturer's standard practice in product protection and identification, meeting the above requirements, will be acceptable.

1.7 SITE CONDITIONS

The components of the engine-generator units, including cooling system components, pumps, fans, and similar auxiliaries, shall be capable of the specified outputs in the following environment.

a. Site Location: Honolulu, Hawaii.

b. Site Elevation: 6 feet above mean sea level.

c. Ambient Temperatures:

(1) Maximum 89 degrees F dry bulb 73 degrees F wet bulb.

(2) Minimum 62 degrees F dry bulb.

d. Seismic Zone: As defined by ICBO UBC.

e. Design Wind Velocity: 10 Km/h (mph).

f. Prevailing Wind Direction: East.

g. Atmospheric Conditions: Moist Corrosive.

1.8 EXTRA MATERIAL

1.8.1 Paint

Furnish one gallon of the identical paint used for the engine generator assembly in the paint manufacturer's sealed containers.

1.8.2 Oil Filters

Furnish two spare replacement elements for each filter with each unit.

1.8.3 Power Circuit Breaker

In addition to circuit breaker shown furnish one additional spare circuit breaker.

1.9 POSTED OPERATING INSTRUCTIONS

Furnish operating instructions laminated between matte-surface thermoplastic sheets and suitable for placement adjacent to corresponding equipment. Install operating instructions at the power plant.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials and equipment of manufacturers regularly engaged in production of such materials or equipment and the manufacturer's latest standard design that complies with specification requirements. Provide products of a single manufacturer where two units of the same class of equipment are required; however, component parts of the system need not be products of the same manufacturer. Each major component of equipment shall have the manufacturer's name, address, and model and serial number on a nameplate securely affixed in a conspicuous place; nameplate of the distributing agent will not be acceptable. Nameplates shall not be painted.

2.2 ENGINE-GENERATOR UNITS

Provide an identical engine-generator unit with accessories, auxiliary equipment, and associated work, except as specified otherwise. Each engine-generator unit shall consist of a diesel engine direct-connected to an ac generator provided with brushless excitation system and accessories.

Provide equipment and materials specified under the paragraph entitled "Diesel Engine and Accessories" furnished by the engine manufacturer. Provide equipment and materials specified under paragraph entitled "Generators and Excitation and Voltage Regulation Systems" furnished by the generator manufacturer to the engine manufacturer. Coordinate the engine-generator units to ensure an installed rating in the environment described in paragraph entitled "Site Conditions."

2.2.1 Equipment Rating and Capability

Each engine-generator unit shall have a net continuous rating capacity of not less than 2000 kW at 0.8 power factor and supply 480-volt, three-phase, 60-Hz ac output. Gross kW rating of each engine-generator unit shall be not more than the figure obtained by multiplying the delivered shaft-horsepower rating of the engine by 0.746 and by the overall efficiency of the generator at the corresponding load. The overall efficiency of the generator shall allow for power required to operate the exciter, including power consumed in losses, windage, and friction for the generator and rotating exciter. Furnish auxiliary equipment designed for continuous duty at 110 percent of the rated-net-capacity of the engine-generator unit. Size cooling system auxiliaries relative to the engine coolant specified under cooling system.

2.2.1.1 Fuel Consumption

Fuel consumption at 0.80 power factor shall not exceed the values listed below for various loads. Fuel consumption shall be based upon the use of diesel fuel substantially as specified and having a low heating value of 18,190 BTUs per pound.

BTUs of Fuel/Net kWh

Load	Standby	Emergency
1/2	9750	10200
3/4	9450	9650
Full	9400	9600

2.2.2 Critical Speeds

Each complete engine-generator unit shall be free of critical speeds of either a major or minor order that might endanger satisfactory operation of the unit, or cause undue vibration in any part of plant equipment or structure. Satisfactory operation will be considered endangered, if torsional vibration stresses exceed 5,000 psi within 10 percent above or below rated engine speed.

2.3 DESIGN AND CONSTRUCTION

Rotating or reciprocating parts, or other parts that present a potential hazard to operating personnel, shall be isolated or shielded to minimize danger. Design characteristics shall limit operating temperatures at critical points of maximum wear at full load operating conditions.

2.3.1 Space Heaters

Space heaters shall be thermostatically controlled and provided in the enclosures of generators, and exciters. Heaters shall be 120-volt, 60-Hz, single-phase, of ratings as recommended by the manufacturer for the atmosphere specified under paragraph entitled "Site Conditions."

2.3.2 Diesel Engines

Comply with MIL-S-16165 relative to radiated radio interference. For generators and other devices capable of producing radio interference, comply with MIL-STD-461 relative to radiated and conducted radio interference.

2.3.3 Fungus Control

For electrical components, fungus control is required as follows.

a. Electrical components such as switches, fuses, contacts, heater elements, distributors, spark plugs, and magnetos shall not be treated. Other materials and components which are inherently fungus-resistant or are protected by hermetic sealing need not be treated.

b. Circuit elements, not covered above and which have a temperature rise of not more than 75 degrees F when operating at full load, shall be coated with a fungus-resistant varnish conforming to MIL-V-173. The method of treatment shall be in accordance with MIL-T-152. Circuit elements include, but are not limited to, cable, wire, switchgear, panelboards, terminal and junction blocks, junction boxes, capacitors, and coils.

c. Circuit elements, such as motor coils, generator and transformer windings, and similar electrical components, which have a temperature rise exceeding 75 degrees F when operating at full load, shall not be coated with a fungitoxic compound. Instead, such components shall be given two initial coats and one seal coat of varnish, conforming to MIL-I-24092, Class 220, Type M. Apply the coats by the vacuum-pressure immersion, centrifugal, pulsating pressure, or built-up method so as to fill interstices in the coils and prevent the entrapment of air or moisture. The sealer coat may also be applied by brushing and spraying.

2.4 DIESEL ENGINES AND ACCESSORIES

Diesel engines shall be four-cycle turbocharged and intercooled; vertical Vee type; designed for continuous duty, stationary service. Provide each engine designed and constructed to eliminate undue heating, vibration, and wear. Engines shall be capable of burning diesel fuel oil conforming to FS VV-F-800, Grade DF-2. Provide engines capable of speeds and ratings not higher than those for which they have been designed, which fulfill requirements specified in paragraph entitled "Experience Requirements." Limiting characteristics of the engines shall be as follows.

a. Maximum Engine Speed, rpm:

(1) 2,000 kW 1800

2.4.1 Construction

Provide each engine with a rigid frame. Provide bedplate and frame designed to support main and connecting bearings, which have been constructed to withstand the vibrating stresses which the design imposes. Main bearings and connecting rod bearings shall have removable shells. Enclose parts to prevent throwing or dripping of oil. Cylinder liners shall be replaceable. Where design permits, provide removable oilproof covers to permit access to bearings. Crankshaft shall have a rigid or flexible coupling for connection to the flywheel or the generator. Flywheel shall be solid type arranged to facilitate barring over the engine if not located in the generator. Provide crankcase explosion relief doors sized to prevent engine damage. Provide a rigid outboard bearing support, if required, and arrange for mounting on engine-generator unit subbase.

a. Subbase Mounting: Mount each engine-generator unit on a structural steel subbase sized to support the engine, generator-exciter, lubricating oil filters and the unit's heat exchangers and pumps, fuel oil filters and pumps, jacket coolant heat exchangers, together with the interconnecting piping and wiring for systems, as standard with the manufacturer. The structural subbase shall be designed to properly support the equipment and maintain proper alignment of the engine-generator unit. In addition, provide subbase with lifting rings properly located to facilitate shipping and installation of the unit. The subbase shall be designed to provide the necessary lateral support in the specified seismic zone, and the subbase shall be installed on vibration isolators that are secured to a suitable concrete foundation. Isolators shall be as recommended by the engine-generator unit and isolator manufacturers and integral or external lateral support shall be provided to limit lateral movement and overturning moments in seismic areas. Engine and generator shall be factory-aligned on the subbase and securely bolted into place in accordance with the manufacturer's standard practice.

2.4.2 Assembly

Completely shop assemble each engine-generator unit on its structural steel subbase. Mount turbocharger and integral engine piping on the engine. Paint entire engine with manufacturer's standard paints and colors. After factory tests and before shipping, each unit shall be thoroughly cleaned and painting retouched as necessary to provide complete protection to the unit.

2.4.3 Turbocharger

Provide turbine-type driven by exhaust gas from engine cylinders, and direct-connected to the blower supplying air to the engine intake manifold. Mount turbocharger and piping integral with the engine. Turbocharger may be lubricated from the engine pressure lubricating system or as recommended by the manufacturer. If recommended by the engine manufacturer provide pre-startup and post-shutdown auxiliary lubricating oil pumps. Provide

necessary supports and connections.

2.4.4 Intercooler

Provide tubular heat exchanger type intercooler for cooling intake air for turbocharger, including valves, controls, and integral piping needed for an operable system. Mount intercooler, and piping integral with the engine. Size the capability of the coolant system specified herein to handle the additional heat input from the intercooler. The cooling system shall handle the jacket coolant, lubricating oil coolant, and intercooling air cooling loads.

2.4.5 Engine Lubricating Oil System

Provide each engine with a full pressure lubricating oil system arranged to cool the pistons and to distribute oil to moving parts of the engine. The lubrication oil system integral with the engine shall be complete with necessary oil piping, fittings, and valves for connecting items of equipment which are a part of the system. Oil filters shall be provided as recommended by the engine manufacturer. Lubricating oil piping shall be pickled and entirely free of internal mill scale, rust, or other foreign materials when installed. Include necessary stop, check, pressure relief, and pressure control valves. Blank off connections for external piping with wood blind flanges or plugs prior to shipment. Provide an engine-driven lubricating oil circulating pump for each engine. Pump shall be positive displacement type and driven in a positive manner from the engine crankshaft or camshaft. Pump shall have ample capacity to circulate the amount of lubricating oil and cooling oil required by the engine. Engine may have either a wet or dry crankcase arrangement. Provide engines having dry crankcases with lubricating oil sump tanks of sufficient capacity to suit the engine requirements and arranged to receive necessary piping connections.

2.4.6 Engine Fuel System

Provide each engine with a fuel system integral with the engine, complete with necessary piping, fittings, and valves for connecting items of equipment which are a part of the system, and equipment, except external interconnecting piping, required to provide a complete and workable fuel oil system, with the day tank located as indicated. The overflow level of each day tank shall be below the engine fuel injector level so as to preclude flooding of the engine. Provide a mechanical fuel injection system on each engine. Provide a modified common rail system or an individual pump system. Injection pumps shall be an integral part of the engine and shall be driven in a suitable manner from the camshaft. Provide suitable injection adjustments for timing and for balance of cylinder pressures if standard with the manufacturer.

2.4.7 Engine Speed Governor System, IEEE Device 65

Provide each engine with a speed governing system and an independently driven overspeed limiting engine shutdown device. The speed governing system shall conform to ASME PTC 26, except as modified herein. Provide an adjustable isochronous governor, with suitable speed sensing. The governor shall maintain specified stability without hunting, cycling,

or other irregularities. Governor shall include provisions for adjusting speed droop, load limit, and speed while the unit is in operation. Governor characteristics shall conform to the following:

a. Minus 15 to plus 5 percent minimum range of speed changer expressed as a percent of rated speed.

b. Observed speed band shall not exceed plus or minus 0.25 percent expressed as a percent deviation of rated speed.

c. Transient speed deviation shall not exceed plus or minus 3.0 percent expressed as a percent of rated speed.

d. Time to return to limits of observed speed band shall not exceed 3 seconds after sudden load change of transient speed deviation.

e. 0 percent to 5 percent minimum manual speed regulation range adjustment expressed as a percent of rated speed.

Provide governor with reversible synchronizing, dc motor or speed changer suitable for the station battery voltage. Connect governor to the speed adjusting mechanism by a slip coupling to permit remote manual operation for mechanical governors or equivalent remote operation for electrical governing systems.

2.4.8 Engine Protective Devices

Provide each engine with protective devices as follows.

a. Engine Shutdown: Equip each engine with shutdown devices as listed herein. These devices shall shut down the engine by shutting off the fuel supply to the engine. Shutdown devices shall be positive and direct in action and independent of the governor. Shutdown devices shall have factory-fixed set-points and shall be equipped with either auxiliary electrical contacts and cranking circuitry, relays or equivalent device for shutdown. Auxiliary contacts shall be suitable for the station battery voltage. Shutdown shall open the generator main circuit breaker. Provide the following shutdown devices.

(1) Overspeed device which operates if engine speed exceeds normal synchronous speed by 18 percent or as recommended by manufacturer. Device shall require manual reset.

(2) When turbocharger lubricating oil is separate from engine lubricating oil system, provide pressure switch which operates when lubricating oil pressure to turbocharger drops below a preset value.

(3) Pressure switch which operates when lubricating oil pressure drops below a preset value.

(4) Temperature switch which operates when jacket coolant temperature exceeds a preset value.

(5) Other shutdown devices as recommended by the engine manufacturer.

b. Electrical Interlocks: Equip throttle valve or starting mechanism with two sets of auxiliary contacts for interlocking with the generator main breaker control circuit. With throttle valve open, one set of auxiliary contacts shall be open and one set closed. Auxiliary contacts shall be suitable for the station battery voltage.

2.4.9 Engine Alarm Contact Devices

Equip each engine with alarm devices, relays, and auxiliary contacts, as required, to actuate alarm system on the associated engine control panel. Auxiliary contacts shall be suitable for the station battery voltage. Alarm devices shall have factory-fixed set points. Provide the following alarm contact devices.

a. Throttle valve limit switch contacts or equivalent device operating to energize a portion of alarm system only when the engine is running and not during cranking or shutdown.

b. Pressure switch in jacket coolant manifold piping at the engine to operate if jacket coolant pressure drops below a preset value.

c. Pressure switch in engine lubricating oil system piping from engine to operate when pressure drops below a preset value due to failure of engine-driven lubricating oil pump. In addition to alarm contacts, provide set of contacts to start the auxiliary oil pump.

d. If turbocharger lubricating oil is separate from engine lubricating oil system, provide pressure switch in turbocharger lubricating oil system piping to operate when pressure drops below a preset value.

e. Temperature switch in the jacket coolant discharge piping from the engine to operate when temperature exceeds a preset value. Device shall have an adjustable range between 37 and 100 degrees C (100 and 212 degrees F).

f. Temperature switch in the jacket coolant discharge piping manifold leaving the engine to operate when temperature exceeds a preset value, or as recommended by the manufacturer.

g. Other alarm devices as recommended by the engine manufacturer.

2.4.10 Engine Accessories

Provide the following accessories for each engine where the manufacturer's standard design permits.

a. Piping on engine to inlet and outlet connections, including nonstandard companion flanges.

b. Engine platforms with railings and ladders from operating floor to platforms for normal routine maintenance, as required for engine

furnished.

c. Drilled and tapped holes for installation of pyrometer thermocouples for measuring exhaust gas temperatures.

d. Drilled and tapped holes for attachment of indicator for checking compression and firing pressures, complete with indicator cocks and adapters.

e. Compression relief valve on each cylinder, when applicable.

f. Structural steel subbase and vibration isolators or foundation bolts, nuts, and pipe sleeves for each engine-generator unit.

g. Level jack screws or shims, as may be required.

h. Rails, chocks, and shims for installation of engine and generator on the structural steel subbase or on the concrete foundation, as may be required.

i. Electrically operated, three-phase barring gear suitable for the voltage provided.

j. Indicating thermometers or temperature indicators in accordance with manufacturer's standard on coolant inlet and outlet headers and on turbocharger coolant outlet. Should turbocharger oil system be separate from engine oil system, provide temperature gage on turbocharger lubricating oil outlet.

k. Drilled and tapped holes for attachment of manometer to measure crankcase pressure of vacuum.

l. Removable guard, housing, or rail around flywheel, generator, and exciter. Support guard, housing, or rail entirely on engine subbase, foundation, operating floor, or engine mounted, to suit manufacturer's standard.

2.4.11 Air Intake and Exhaust Systems

Provide air intake and exhaust systems for each engine. Include piping, fittings, and expansion joints necessary to interconnect equipment with engines. Arrangement of air intake and exhaust systems shall be similar to that indicated and modified, as required, to suit the engine furnished, subject to the approval of the Officer-in-Charge. Turbocharger shall not be subjected to piping weight or lateral forces generated in connected piping. Provide flanged connections and motors in accordance with paragraphs entitled "Flange Connections," and "Motors."

a. Air Intake Filters: Provide one intake filter for each engine of the oil bath or dry type, as standard with the manufacturer. Filter shall be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filter to suit engine requirements at 110 percent of rated full load. Unit shall be designed for field access for maintenance purposes.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS BEEN REPHOTOGRAPHED TO ASSURE LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

furnished.

c. Drilled and tapped holes for installation of pyrometer thermocouples for measuring exhaust gas temperatures.

d. Drilled and tapped holes for attachment of indicator for checking compression and firing pressures, complete with indicator cocks and adapters.

e. Compression relief valve on each cylinder, when applicable.

f. Structural steel subbase and vibration isolators or foundation bolts, nuts, and pipe sleeves for each engine-generator unit.

g. Level jack screws or shims, as may be required.

h. Rails, chocks, and shims for installation of engine and generator on the structural steel subbase or on the concrete foundation, as may be required.

i. Electrically operated, three-phase barring gear suitable for the voltage provided.

j. Indicating thermometers or temperature indicators in accordance with manufacturer's standard on coolant inlet and outlet headers and on turbocharger coolant outlet. Should turbocharger oil system be separate from engine oil system, provide temperature gage on turbocharger lubricating oil outlet.

k. Drilled and tapped holes for attachment of manometer to measure crankcase pressure of vacuum.

l. Removable guard, housing, or rail around flywheel, generator, and exciter. Support guard, housing, or rail entirely on engine subbase, foundation, operating floor, or engine mounted, to suit manufacturer's standard.

2.4.11 Air Intake and Exhaust Systems

Provide air intake and exhaust systems for each engine. Include piping, fittings, and expansion joints necessary to interconnect equipment with engines. Arrangement of air intake and exhaust systems shall be similar to that indicated and modified, as required, to suit the engine furnished, subject to the approval of the Officer-in-Charge. Turbocharger shall not be subjected to piping weight or lateral forces generated in connected piping. Provide flanged connections and motors in accordance with paragraphs entitled "Flange Connections," and "Motors."

a. Air Intake Filters: Provide one intake filter for each engine of the oil bath or dry type, as standard with the manufacturer. Filter shall be capable of removing a minimum of 92 percent of dirt and abrasive 3 microns and larger from intake air. Size filter to suit engine requirements at 110 percent of rated full load. Unit shall be designed for field access for maintenance purposes.

b. Air Intake Silencers: Provides for each engine to limit noise of intake air system to a level below the audible mechanical noise level of the engine. Silencers shall be as recommended by the silencer manufacturer for the engine furnished.

c. Exhaust Silencers: Provide Type I and Type II engine exhaust silencers as shown on the plans to reduce the exhaust sound spectrum to or below the levels listed in Section 15200, "Noise, Vibration (and Seismic) Control. Silencer diameter and lengths shall be selected to fit into the space shown on the plan, and in according with the manufacturer's recommendation. Silencer shall be complete with handhole openings and necessary brackets for supporting purposes.

d. Expansion (Flexible) Joints: Provide sections of multiple corrugated stainless steel expansion joints with liner in the engine exhaust piping for each engine to absorb expansion strains and vibration transmitted to the piping. Flexible joints shall be suitable for operation at 200 degrees F above normal exhaust gas temperature at 100 percent load. Air intake expansion joints shall be metal reinforced rubber type suitable for the service. Air intake expansion joints may be for plain end pipe.

e. Exhaust and Air Intake Piping: Provide piping for each engine complete with necessary fittings, flanges, gaskets, bolts, and nuts. Pipe shall be lap-welded, or seamless steel pipe conforming to ASTM A 53. Exhaust piping shall be Schedule 40 pipe for 12-inch and smaller sizes and for larger sizes shall have wall thickness not less than 0.375 inch and shall slope away from engine. Air intake piping shall have wall thickness not less than 0.250 inch. Flanges shall be 150-pound slip-on forged steel welding flanges conforming to ASME /ANSI B16.5, with material in accordance with ASTM A 181/A 181M, Grade I. Fittings shall be buttwelding conforming to ASTM A 234/A 234M, with wall thickness same as adjoining piping. Fittings shall be of same material and wall thickness as pipe. Built-up miter welded fittings may be used. Miter angles of each individual section shall not exceed 22.5 degrees total and not more than 11.25 degrees relative to the axis of the pipe at any one cut. Gaskets for exhaust and air intake piping shall be of high temperature asbestos-free material suitable for the service. Bolting material for air intake flanges shall consist of square-head machine bolts with cold-pressed semifinished hexagon nuts of steel. Bolting material for exhaust flanges shall be alloy-steel bolt-studs conforming to ASTM A 193/A 193M, and alloy-steel nuts conforming to ASTM A 194/A 194M. Bolts shall be of sufficient length to obtain full bearing on the nuts and shall project not more than two full threads beyond the nut.

2.4.12 Crankcase Protection

Provide manufacturer's standard method of preventing crankcase explosions. System shall be complete with motors, pumps, fans, piping, and required appurtenances. System shall provide a positive vacuum or pressure on the crankcase. If air is discharged from crankcase by means of a pressure

blower, provide an oil separator in the system. Vapor discharge shall be carried to outdoors via piping.

2.5 GENERATORS AND EXCITATION AND VOLTAGE REGULATION SYSTEMS

2.5.1 Generator

Provide 0.80 power factor, synchronous, ac, brushless-excited, revolving field, air-cooled, self-ventilated units conforming to IEEE C50.10 and ANSI C50.13 and NEMA MG 1 and rated as specified in paragraph entitled "Equipment Rating and Capability." Match generator speed to that of the engine. Drive generator directly from the engine crankshaft in a manner approved by both the engine and generator manufacturers. Provide continuous 0.80 power-factor capacity equal to the gross kW rating of the engine-generator unit at rated voltage. Do not exceed 85°C NEMA MG 1 armature and field insulation temperature rises. Arrange generator for ventilating air discharge through a screened opening in accordance with the manufacturer's standard location. Locate air discharge apparatus to minimize the recirculation of discharge air into air intake openings. Provide drip-resistant top outlet covers to prevent entrance of water in case of fire.

2.5.1.1 Generator Windings and Leads

Provide insulated copper form-wound coils. Provide a six-lead stator winding with both line and neutral leads of each phase winding brought out from the generator frame to a terminal box. Utilize only Class H insulation in accordance with IEEE 1. Equip armature and ground leads with properly identified crimp-type lugs or connectors for external electrical connections. Terminal markings shall conform to NEMA MG 1.

a. Bracing: Brace windings to withstand stresses of both phase-to-neutral and phase-to-phase faults. Provide continuous or interconnected type amortisseur rotor windings. Size and brace generator leads to withstand mechanical and electrical stresses resulting from an external fault of up to the associated generator circuit breaker's interrupting rating for the period of time required for operation of the generator protective devices including circuit breaker trip time.

b. Detectors: Provide no less than six embedded resistance temperature detectors (rated 10 ohms at 25 degrees C) in the stator coils. Install detectors in accordance with IEEE C50.10. Bring out detector connections to an enclosed accessible terminal block for connection to remote temperature monitoring devices.

2.5.1.2 Grounding

Isolate ac electrical components of the set from ground, except generator neutral which shall be solidly grounded.

2.5.1.3 Generator Construction

Provide a welded steel frame to maintain the alignment of parts that the frame supports. Furnish sufficient flywheel energy storage to meet the

requirements of voltage and frequency regulation and parallel operation as specified. Parallel operation shall be as specified in paragraph entitled "Parallel Operation." Equip the generator with the required foundation bolts and sole plates and mount on the structural steel subbase provided as a part of the engine assembly or arrange for separate mounting on the concrete foundation in accordance with the engine manufacturer's standard practice. Mount the generator rotor on an extended shaft coupled rigidly to the engine crankshaft. Mount impellers on the rotor or flywheel for cooling the generator. Rotor shall be capable of safe operation at a speed 25 percent in excess of its rated synchronous speed. The generator field voltage shall be 125 or 250 volts dc.

2.5.2 Excitation and Voltage Regulation Systems

Comply with IEEE 421.1. Parallel operation with other exciter shall not be utilized. Excitation system shall be designed to provide a continuous current rating of not less than the generator's excitation current required when the generator operates at 105 percent rated voltage under the continuous rating condition requiring maximum field current. Match the voltage rating of the system generator field. Provide an excitation system response ratio of not less than 0.5 and a ceiling voltage of not less than 120 percent of rated voltage.

2.5.2.1 Exciter

Integral with the generator and of the synchronous, rotating armature, rotating rectifier type. Exciter field shall be stationary. Provide a permanent magnet generator (PMG) type pilot exciter with a rotating permanent magnet field on the generator shaft and with a stationary ac winding. Exciter ac output shall be three-phase and shall be rectified by full-wave solid-state rotating rectifier mounted on the generator shaft. Rotating rectifier shall consist of hermetically sealed diodes connected between exciter and generator field without intervening brushes, slip-rings, or commutators. Utilize Class H insulation in accordance with NEMA MG 1. Electrically isolate the exciter field from the rest of the generator. Provide a device or relay to monitor the excitation and de-energize the exciter field, if the field current is maintained at a level which would damage the machine. The acceptable ratio of exciter ceiling voltage to exciter nominal voltage shall be not less than three to two. Exciter shall be equipped with surge protection devices.

2.5.2.2 Semiconductor Devices

Semiconductor device used to supply dc power to the alternator field shall be designed to provide a peak inverse voltage rating of not less than 10 times the rated dc nominal generator field voltage which is the dc field voltage applied at the normal ambient temperature of the generator stabilized at rated output. Utilize 3-phase full-wave solid state rectifier bridge devices and provide surge voltage protection.

2.5.2.3 Voltage Regulator, IEEE Device 90

Provide a completely solid-state microprocessor based digital programmable voltage regulator for control of the generator voltage by control of the exciter field. No vacuum tubes or electromechanical relays shall be used

in the voltage regulator. Regulator shall be designed for three-phase true RMS voltage sensing from two switchgear-mounted dedicated voltage transformers. Provide as an integral part of the regulator, electromagnetic interference (EMI) suppression for conducted and radiation emissions complying with MIL-STD-461, Class C 2. Provide overload protection for power semiconductors in the regulator and for regulator accessories. The regulator will maintain precise control of the generator output with up to 20% harmonic distortion in the generator output voltage.

a. Regulator Control Features: Control generator exciter field as required to maintain a constant and stable generator output voltage within plus or minus 1/2 of one percent of nominal for steady-state loads from no-load to full-load including a 5 percent variation in frequency and the effects of field heating. Regulator response time shall be less than 17 milliseconds. Regulator drift shall be less than plus or minus 1/2 percent for 40 degrees C temperature change including warmup. The PMG pilot exciter in conjunction with the voltage regulator shall provide 300 percent rated generator current for at least 10 seconds to provide short-circuit current adequate to operate circuit protective devices.

b. Regulator Accessories: Provide the following regulator accessories manufactured or approved for associated use by the regulator manufacturer. Accessories may be integral with the regulator or in a separate module as appropriate or as standard with the manufacturer. Mount devices along with the voltage regulator in the generator switchgear, unless noted otherwise.

(1) Provide two dedicated voltage transformers constructed to withstand underfrequency/overvoltage operation encountered in the generator.

(2) Provide equipment to protect against underfrequency/overvoltage conditions by reducing the regulator output during underspeed warmup or prime mover maintenance periods and to automatically remove power input to the voltage regulator, whenever the voltage exceeds 140 percent of nominal voltage.

(3) Provide a manual voltage setting control system with a manual voltage adjusting rheostat or variable autotransformer and a manual-automatic-off switch. Install devices on the control switchboard.

2.6 FUEL OIL SYSTEM

Provide fuel oil system including clay tank as indicated and as specified in Section 15483, "Fuel Oil Handling System.

2.6.1.1 Fuel Oil Drip Tank

Provide tank to receive dirty fuel oil drips from the engine. Working capacity of tank shall be not less than 10 gallons per engine. Include connections for inlet, outlet, overflow, drain, vent, and level gage, and high level alarm switch. Locate high level alarm switch 6 inches below the

top of the tank.

2.6.2 Fuel Oil Meters

Provide positive displacement type. Maximum variation from absolute accuracy measurement over entire range of meter shall be not greater than plus or minus five-tenths of one percent. Provide meters with horizontal setback registers calibrated to read in liters (gallons) and tenths of liters (gallons). Construct meters with cast-iron bodies, with working parts made of material to resist wear, friction, and corrosion and can handle oil containing a small percentage of sulphur. Each meter shall have capacity to measure a maximum of 10 gpm, with pressure drop through meter not exceeding 6 psi.

2.6.3 Fuel Oil Filters

Provide two filters of the throwaway filter element type, consisting of shell, filter elements, drains, and necessary connections and fittings. Equipment and component parts shall be the standard product of the filter manufacturer to ensure prompt and continuing service and delivery of repair or maintenance parts and shall be standard with the engine manufacturer.

2.7 LUBRICATING OIL SYSTEM

Provide tanks, motors, thermostatic control valves, and flange connections in accordance respectively with the paragraphs entitled "Tank Construction," "Motors," "Thermostatic Control Valves," and "Flange Connections."

2.7.1 Auxiliary Lubricating Oil Pumps

Provide one pump for each engine, each for "before-and-after" lubricating and cooling service and capable of circulating not less than 10 percent of the full flow rate of lubricating oil at the pressure required by the engine. Equip pump with a bypass relief valve. Pump unit shall consist of a horizontal, positive-displacement rotary pump driven by a three-phase electric motor either directly or through a gear reduction unit. Pump shall conform to MIL-P-17608, except as modified above.

2.7.2 Lubricating Oil Filtration

Provide each engine with a pressurized lubricating oil filtration system capable of filtering the full rate of oil flow from the oil pumps at the maximum engine speed in accordance with the standard practice of the engine manufacturer. Means shall be provided to ensure delivery of lubricating oil to vital wearing surfaces regardless of the condition of the filters without removing the engine from service. Additionally, the filters shall provide means of automatically bypassing the filter if it should become flow-restricting. When electric heaters are used, provide thermostatically controlled type, suitable for three-phase, supply at the same voltage as three-phase motors. Filter elements shall be of the throwaway type. Where provided, duplex strainers shall be in accordance with the paragraph entitled "Duplex Fuel Oil Strainer." A bypass lubricating system shall be provided for each engine as follows:

a. Provide a bypass filter capable of passing not less than 10 percent of the full flow engine circulating rate and removing not less than 95 percent of the particles 5 microns and larger. Other requirement shall be same as for the full rate of oil flow filters.

b. Provide each bypass filter with a bypass filter pump to circulate the lubricating oil as indicated. Pump capacity shall suit the capacity requirements of the bypass filter, and pump head shall suit the requirements of the system. Pump unit shall consist of a horizontal, positive displacement rotary pump with built-in or external relief valve driven by a three-phase electric motor, either directly or through a gear reduction unit, mounted on a common cast-iron or steel base-plate.

2.7.3 Lubricating Oil Coolers

Provide to maintain the lubricating oil within the engine manufacturer's recommended temperature limits under all operating conditions, for each engine separately. The cooling system and components shall be as specified by the engine manufacturer for use with the class of engine being provided, and the cooling medium to be used, except as otherwise required herein. Engine jacket coolant from the radiator shall be used as the cooling medium. Each thermostate used in the oil cooling system shall be of the nonadjustable type and factory set at the temperature recommended by the engine manufacturer.

2.7.4 Thermostatic Control Valves

Provide one thermostatic control valve, if it is the standard practice of the manufacturer for the engine involved, for each engine, as indicated, to maintain a constant engine input lubricating oil temperature. Valve shall be capable of passing the total lubricating oil flow requirement of the engine as determined by the engine manufacturer with a pressure drop across the valve not to exceed 5 psi.

2.8 COOLING SYSTEM

2.8.1 Jacket Coolant Pumps

Provide a pump driven from the engine crankshaft or camshaft. Pumps shall conform to MIL-P-17552. Each pump shall have ample capacity to circulate the required flow of coolant through the system to remove the total heat rejected from the engine and, where required by the design, from the lubricating oil and aftercoolers. Heat shall be rejected to the jacket coolant to maintain optimum jacket coolant temperature leaving and entering engine as recommended by the engine manufacturer. Pumps shall have characteristics which will permit operation in parallel. Exact head rating based on flow required, as determined by the engine manufacturer, shall be verified by the Contractor after the selection of the engine-generator units.

2.8.2 Radiators

Provide remote radiators of the forced draft type with horizontal air discharge.

a. Design conditions: Each radiator unit shall have ample capacity to remove not less than the total kW (Btu per hour) of heat rejected by its respective engine at 110 percent full-rated load to the jacket water and lubricating oil system and that necessary for intercooler charge air cooling. Radiator capacity shall be rated at optimum temperature of coolant leaving the engine and intercooler as recommended by the engine manufacturer with a dry bulb air temperature of 100 degrees F. Pressure drop through the radiator shall not exceed 6 psi when circulating the maximum required coolant flow.

b. Remote-type radiator construction: Construct each radiator unit as an integral unit, complete with plenum chamber, supporting structure, fans, and fan drive. Coil section shall consist one-inch outside diameter, admiralty brass tubes having 18 BWG minimum wall thickness with continuous helical fins 12.7 or 1/2 or 5/8 inch high. Fins shall be formed footed type uniformly wrapped under tension or mechanically bonded to tubes. Roll tubes into fabricated steel tank headers at each end. Header construction shall permit access to tubes at each end and have removable bolted-on cover plates for access to tube openings. Flange connections to radiator. Design supporting steel structure in accordance with AISC S335. Distribution of air across cooling coils shall be uniform.

c. Remote-type radiator fan and drive: Capacity of the fan shall be sufficient to supply the quantity of air necessary to obtain the cooling effect required. Fan shall be propeller-type with multiblade construction, four blades or more, and operated at a tip speed not to exceed 11,000 at 520 RPM feet per minute. Individually fasten blades to a common hub in such a manner that blade pitch may be adjusted. Each fan shall be driven by an electric motor through a multiple V-belt drive. Provide guards for each fan and drive. Total fan motor hp required for each radiator unit shall be not more than 1.25 percent of the full load gross hp rating of the engine. Motors shall be two-speed, single-winding, totally enclosed, fan-cooled, three-phase type.

d. Coolant solution shall be a mixture of clean water and a commercial standard methoxy propanol type coolant. Mixture shall be of proportions recommended by the engine manufacturer to meet site conditions. Provide an anti-freeze solution tester suitable for the solution used.

2.8.3 Thermostatic Control Valves

If recommended and standard practice of the engine manufacturer, provide a thermostatic control valve in the jacket coolant system for each engine-generator unit, as indicated, to maintain a constant jacket coolant temperature to the engine. Valves shall be capable of passing coolant flow, as determined by the engine manufacturer.

2.9 ENGINE CONTROL PANELS

Provide one free-standing engine control panel, 6 feet 8 inches high by 18 inches deep by width as required, complete with cabinet and accessories for each engine. Fabricate front, sides, back, and top of each cabinet of 14-gage sheet steel in compliance with NEMA 250, Type 12 enclosures. Provide back of cabinet with hinged doors arranged to close tightly, and provide with locks and keys. Cabinet shall be of sufficient size to accommodate instruments. Provide angle iron framework within the cabinet, as required, to make panel free standing and to obtain proper stiffness and support. Provide panel with canopy with diffused incandescent lighting and flush snap switch. Mount instruments, pushbutton stations, indicating lights, and other devices specified herein on each panel in an orderly and approved manner. Completely wire each engine control panel for apparatus. Mount fuses and fuse blocks within the cabinet and connect outgoing leads, except those for the pyrometer, to terminal blocks near the bottom of the cabinet. Provide complete internal factory piping and tubing for each panel and for equipment mounted thereon. Terminate outgoing piping at bulkhead unions near bottom of panel and affix identifying nameplates. Provide instruments, controls, and indicating lights mounted on the control panel with suitable nameplates of laminated black gloss-finished plastic with white engraved lettering. Provide the following items on each control panel.

2.9.1 Pressure Gages

Conform to paragraph entitled "Piping Specialties."

a. Fuel oil pressure to engine, duplex gage across the duplex filter.

b. Jacket coolant pressure to engine.

c. Lubricating oil pressure to engine, duplex gage across the strainer.

d. Lubricating oil pressure to turbocharger.

e. Coolant pump discharge pressure.

2.9.2 Manometer

Provide a manometer to indicate vacuum in the air intake piping after the air filter. Manometer shall be flush mounted type, calibrated to the inch and tenth of an inch of water using "Red Oil," specific gravity of 0.827.

2.9.3 Manometer or Pressure Gage

Provide in accordance with engine manufacturer's recommendations, either a monometer or a pressure gage to indicate air pressure from turbocharger and to indicate crankcase vacuum or pressure.

2.9.4 Level Gage

Provide a level gage to indicate level in the lubricating oil sump tank, if a separate sump tank is required by the engine. Gage shall be the buoyant force type conforming to MIL-G-17713. Dial shall show contents of tank from minimum pump suction level to overflow level, with graduation markings from empty to full with intermediate points of 1/4, 1/2, and 3/4. Dial shall be of a type approved by the Officer-in-Charge and arranged for flush mounting. Operate gage by mechanical linkage utilizing the positive action of a leverage float and arm arrangement transmitted through metal bellows and tubing of a balanced hydraulic transmission system to the dial. Provide tubing to extend from control panel to sump tank. Verify exact required length prior to shipment.

2.9.5 Alarm System

Provide an alarm system on each engine panel to provide visual and audible signals for various abnormal operating conditions. Alarm system shall be complete, with components and accessories mounted and wired. Entire alarm system shall be suitable for operation at battery voltage.

2.9.5.1 Annunciator

Provide a factory-assembled annunciator, back-lighted nameplate window type. Annunciator shall be microprocessor based type or utilize a solid-state relay type of modular construction. Relays shall be hermetically-sealed of plug-in construction. Nameplate windows shall be nominally 2 inches high by 3 inches wide and equipped with two long-life lamps per window. Annunciator shall comply with ISA S18.1. Annunciators provided with engine panels and the control switchboard shall utilize interchangeable components.

2.9.5.2 Accessories

a. Mount a main alarm circuit switch on panel and connect to permit de-energizing the alarm system. Switch shall be toggle type, one-hole mounting, two-pole.

b. Mount an alarm howler on top of panel. Howler shall be single-bell projector type having a noise level of not less than 95 decibels at 10 feet.

c. Mount a master alarm light on top of panel and connect to indicate operation of alarm point in the associated system. Light shall be 25-watt incandescent with guard and red globe.

d. Mount two pushbuttons on panel to perform "Silence" and "Test" functions for the alarm system. Connect the "Silence" pushbutton to silence the alarm howler. Connect the "Test" pushbutton to similate an alarm condition on all points. pushbuttons shall be semiflush, one-hole mounting type, oil-tight construction, with momentary contact operation. Contacts shall be rated N150 in accordance with NEMA ICS 2.

e. Mount an alarm system pilot light on panel to indicate when alarm

system is energized. Provide light with red color cap.

f. Provide auxiliary relays, as required, for operation of howler and master light to protect annunciator relays from overloads. Provide an auxiliary relay to actuate the control switchboard alarm lights upon operation of any alarm point in the associated engine panel system. Mount relays within panel. Relays shall be industrial-type with general purpose enclosures and with Form A, B, or C contacts in accordance with NEMA ICS 2.

2.9.5.3 Alarm System Operation

Operate alarms for each condition as follows.

a. Normal: Nameplate windows and master light are not lit and howler is silent.

b. Alarm:

(1) Nameplate windows flash, howler sounds, and master light burns steadily.

(2) Howler is silenced, master light goes out, and nameplate windows burn steadily when alarms are acknowledged, silenced.

(3) If more than one alarm occurs before acknowledgment, the nameplate window for the alarm which occurs first hall exhibit an intermittent fast flash. Windows for subsequent alarms shall exhibit a slower steady flash.

c. Return to Normal: Nameplate windows go out.

d. Depressing the "Silence" Pushbutton: For a specific alarm occurrence, functioning is as described above, but depressing the silence pushbutton shall not affect the functioning of the remainder of the alarm system.

2.9.5.4 Alarm Points

Alarm system shall operate in the event one or a combination of the following conditions occur.

a. Engine Throttle Actuated Alarms: Disable these alarms by utilizing the contacts on the engine throttle switch specified in paragraph entitled "Engine Alarm Contact Devices" and provide as follows:

(1) Low lubricating oil pressure to engine.

(2) Low lubricating oil pressure to turbocharger.

(3) High jacket coolant temperature from engine.

(4) Low jacket coolant pressure to engine.

(5) High lubricating oil temperature from engine.

(6) Low fuel oil pressure to engine.

(7) Low coolant pump discharge pressure.

b. Other Alarms: Provide additional alarms as follows:

(1) High fuel oil day tank level.

(2) Low fuel oil day tank level.

(3) High-differential fuel oil filter pressure.

c. Spare Alarms: Alarm system shall include not less than two spare alarm points per engine panel, complete with nameplate window, plug-in relays, required accessories for complete operation, and wiring to terminal blocks.

2.10.6 Motor Control Stations

Provide motor control stations consisting of selector switches. Selector switches shall be semiflush, one-hole mounting type, oil-tight construction and having integral contact blocks. Contacts shall be rated A150 in accordance with NEMA ICS 2.

a. Selector Switches: Utilize maintained contact type, provided with red, green, and amber indicating lights. Equip selector switches with "Hand-Off-Automatic," or "Fast-Off-Slow" escutcheon plates for each of the following motors:

(1) Auxiliary lubricating oil pump.

(2) Radiator fan.

2.9.7 Pyrometer

Provide complete with multipoint selector switch and thermocouples and arranged for connection of individual thermocouples to show exhaust temperature leaving each cylinder of the engine and combined exhaust temperature from the engine. Provide additional thermocouples to show temperatures in the turbocharger exhaust gas inlet and discharge passes. Pyrometer shall be milli-voltmeter-type equipped with an internal automatic cold end compensator and calibrated for use with the mean length of lead wire actually used. The instrument shall have an internal resistance of not less than 100 ohms a scale not less than 4.25 inches in length. Selector switch shall be double-pole type having an "off" position and one set or point for each thermocouple. Provide an indicating dial on the switch. Pyrometer and selector switch shall be constructed and furnished with a flush-mounting, dust and moisture-tight case. Thermocouples shall be iron-constantan wire encased in a seamless steel tube provided with a busing threaded for 1/2 inch standard pipe and a junction box with threaded openings for conduit connections. Thermocouple extension shall be iron-contantan, No 16 AWG as specified in the paragraph entitled 'Wire and Cable." Pyrometer, thermocouples, leads, and compensating device shall be calibrated to show true exhaust temperature for the unit.

2.9.8 Temperature Indicator

Provide multipoint resistance temperature detectors of platinum encased in a seamless steel tube equipped with a separable socket well and with a semiflush mounted indicator having dial graduations of minus 20 to 120 multiposition selector switch and connect to indicate the following temperature.

a. Jacket coolant to engine.

b. Jacket coolant from engine.

c. Lubricating oil to engine.

d. Lubricating oil from engine.

e. Coolant to lubricating oil cooler.

f. Coolant to intercooler.

g. Coolant from intercooler.

h. Jacket coolant to radiator.

2.10 STATION CONTROL PANEL

Provide one free-standing panel complete with cabinet and accessories of the required height. Construct and utilize devices as specified in paragraph entitled "Engine Control Panels." Furnish and install the following items on the panel.

a. Fuel oil filter discharge header pressure gage.

b. Cooling water return header pressure gage.

c. Fuel oil strainer pressure gap.

d. Each fuel oil transfer pump pushbutton.

e. Heating system circulating pump pushbutton.

2.11 PIPING SPECIALTIES

2.11.1 Pressure Gages

Conform to ANSI/ASME B40.1, pressure detecting class, of 4.25-inch nominal diameter, with silver or white dials and black markings. Provide each gage with a properly rated shutoff valve of the needle type and suitable pressure snubber. Provide duplex gages of the two Bourdon tube style and simplex gages of the single Bourdon tube style. Gages specified herein are in addition to those specified with the specific items of equipment. Provide one pressure gage with ranges indicated for each independent service, that is, one per engine, pump, cooler, header, compressor, strainer, filter, or tank.

a. Duplex Gages: Provide for the following services.

(1) Before-and-after fuel oil duplex strainer psi.

(2) Before-and-after lubricating oil filter, psi.

(3) Heating system circulating pump suction and discharge psi.

(4) Coolant to and from jacket coolant pumps, psi.

(5) Coolant pump suction and discharge, each psi.

b. Simplex Gages: Provide for the following services.

(1) Jacket coolant pump discharge, each psi.

(2) Jacket coolant to engine, each psi.

(3) Fuel oil transfer pump discharge header psi.

(4) Compressed air supply to pneumatic barring device, psi.

2.11.2 Thermometers

Provide liquid-filled or bimetallic type. Thermometers shall be angle or straight type, as required, for easy readability. Provide the following thermometers with range of scale as indicated for each independent service, that is, one per engine, cooler or heater.

a. Jacket coolant to engine, degrees F.

b. Jacket coolant from engine, degrees F.

c. Coolant to lubricating oil cooler, degrees F.

d. Coolant from lubricating oil cooler, degrees F.

e. Coolant from jacket coolant cooler, degrees F.

f. Lubricating oil to engine from cooler, degrees F.

g. Lubricating oil from engine to cooler, degrees F.

h. Fuel oil to heater degrees F.

i. Fuel oil from heater degrees F.

j. Coolant to fuel oil heater degrees F.

2.11.3 Alarm Contact Devices

Provide the following alarm contact devices to operate on the station to alarm for pressure drops below a predetermined point.

a. Low fuel oil filter pressure switch: Install as indicated, in the fuel oil piping from the fuel oil system with an adjustable range.

2.11.3.1 Level Alarm

Utilize the high level alarm switch provided in the fuel oil drip tank and provide for each auxiliary relay necessary to energize the control alarm system, if fuel oil level in the drip tank drops below a predetermined level.

2.11.4 Overflow Sight

Provide an overflow sight in the lubricating oil piping at each sump tank as indicated and position relative to the indicated sump tank oil level. Utilize an atmospheric vent type equipped with a pyrex glass top for observation of liquid flow and designed to eliminate syphoning. Construct body of cast iron or bronze with a removable top with 2-inch flanged inlet and outlet connections.

2.11.5 Pipeline Strainers

Install pipeline strainers conforming to FS WW-S-2739, with screwed connections for sizes up to 1 1/2 inches and flanged connections for 2-inch and larger sizes. Utilize Y pattern style rated not less than 125 psig. Provide one strainer as specified below and elsewhere as follows.

a. Coolant return header.

b. Coolant suction header.

c. Jacket coolant to fuel oil heater.

d. Coolant from jacket cooler, each cooler.

2.11.6 Special Valves

a. Relief valves: Install, valves for protection of equipment against excessive water, fuel oil, or lubricating oil pressure of the specified SAE oil type; suitable for liquid service and conforming to MIL-V-18634. Valves shall be spring-loaded, adjustable, brass or bronze hydraulic, for pressures up to 150 psig. Valves shall have seal caps with provisions for wire seal.

b. Safety valves: Provide valves for protection of equipment and piping against excessive air pressure on the delivery pipe on the low pressure side of each pressure reducing valve. Valves shall conform to MIL-V-18634 and meet applicable requirements of ASME BPVC SEC VIII D1.

c. Automatic air vent valves: Valves for automatically venting air from liquid pipe lines shall be float-controlled type arranged to close promptly when water enters trap. Valves shall conform to the requirements for nonthermostatic float-operated steam traps set forth in FS WW-T-696, except that the valve mechanism shall be

inverted so as to be closed, not opened, by rising water. Capacity of each valve shall be not less than 10 cfm at a pressure of 10 psig.

d. Solenoid valves: Provide in fuel oil system piping as indicated. Valves shall conform to UL 429 for fuel oil service. Valves shall be two-way, direct acting, normally closed (open when energized, closed when de-energized), with brass body and resilient seat material. Solenoid enclosures shall be NEMA ICS 6, Type 1. Electrical rating shall be single-phase suitable for the voltage provided. Body connections shall be same size as connecting piping.

2.12 PIPING SYSTEMS

2.12.1 Engine Jacket Coolant and Fresh Water Piping Systems

Piping systems shall conform to the following.

a. Piping: Provide seamless steel pipe, Schedule 40, conforming to ASTM A 53, Grade A.

b. Fittings and Flanges: Fittings, 1 1/2 inches or smaller, shall be malleable iron conforming to ANSI/ASME B16.3 for 300-pound threaded type. Fittings, 2 inches and larger, shall be steel buttwelding conforming to ASME/ANSI B16.9. Utilize either ASME/ANSI B16.1 or Class A of ASTM A 126 for 125-pound cast-iron flanged fittings. Flanges shall be in accordance with ASME/ANSI B16.5 for 9150-pound slip-on or welding neck forged steel welding flanges, material conforming to ASTM A 181/A 181M. Provide flat face flanges for connecting to 125-pound standard cast-iron valves, fittings, and equipment connections.

c. Valves:

(1) Gate Valves: For valves, 1 1/2 inches and smaller, provide double disk, rising stem, inside screw, union bonnet type, 150-pound class bronze gate conforming to MSS SP-80. For valves, 2 inches and larger, provide double-disk, parallel seat type, hydraulic-rated, 125-psi class, outside screw and yoke type with flanged ends and bronze trim conforming to MSS SP-70. Provide stem packing of material compatible with the system coolant.

(2) Globe Valves: For valves, 1 1/2 inches and smaller, provide rising stem, inside screw, union bonnet type, 125-pound class bronze valves conforming to MSS SP-80. For valves, 2 inches and larger, provide 125-pound class cast iron, flanged ends, bronze trim globe valves conforming to MSS SP-85. Valves shall have renewable composition or cast iron discs compatible with the system coolant.

(3) Check Valves: Provide MIL-V-18436, swing check type.

2.12.2 Fuel Oil Piping System

Piping systems shall conform to the following, except that factory-installed piping may conform to the engine-generator unit manufacturer's standards.

a. Piping: Provide seamless steel, conforming to ASTM A 53, Grade A/ Screwed piping, 1 1/2 inches and smaller, shall be Schedule 80; remaining piping shall be Schedule 40.

b. Fittings and Flanges: Fittings for steel piping, 1 1/2 inches and smaller, shall be 3,000-pound forged steel socket welding, conforming to ASTM B16.11. Fittings, 2 inches and larger, shall be steel buttwelding, conforming to ASME/ANSI B16.9. Flanges shall be per ASME/ANSI B16.5 for 150-pound slip-on or welding neck forged steel welding flanges, material conforming to ASTM A 181/A 181M. Provide flat face flanges for connecting to 125-pound standard cast-iron valves, fittings, and equipment connections.

c. Unions: For steel piping, 1 1/2 inches and smaller, unions shall conform to MSS SP-83 with socket welding ends. For piping, 2 inches and larger, a pair of flanges may be used in lieu of a union.

d. Plug Valves: Utilize lubricated tapered plug type in conformance with MIL-V-12003, 125-pound class. Valves, 4 inches and smaller, shall be wrench-operated. Provide valves, 6 inches and larger, with worm gear hand wheel operator. Valves, 1 1/2 inches and smaller, shall have screwed ends. Valves 2 inches and larger shall have flanged ends.

e. Gaskets: Provide woven nonasbestos fibers with fluorocarbon plastic binder or compressed with nitrile or neoprene binder compatible with either diesel fuel oil or lubricating oil.

2.13 GENERATOR CONTROL

Provide semi-automatic control for the engine-generator unit. Provide transfer circuitry as a part of the manual control switchboard and metal-clad switchgear.

2.13.1 Semi-Automatic Control

Provide automatic starting, and manual stopping at the metal-clad switchgear.

2.15.2 Automatic Circuitry

Provide relays, switching, and other devices and wiring necessary for automatic operation.

2.15.2.1 Automatic Starting

Provide undervoltage relays, IEEE Device 27, and auxiliary time-delay relaying so that when the normal supply voltage in a phase drops below a predetermined value, adjustable from 65 to 90 percent normal, for a predetermined interval, adjustable 0 to one minute, an automatic operation shall begin. The engine-generator unit shall automatically start, accelerate to the governed speed, and build up to the regulated voltage.

2.15.2.2 Engine Starting Switch

The switch shall be a four-position rotary, enclosed rear mounting type of the maintained-position type. The switch positions shall be "Semi-Automatic," "Off," "Test," and "manual" and shall be connected to provide the following operation.

a. In the "Semi-Automatic" position, the engine-generator unit shall start automatically in response to loss of voltage, as described in the paragraph entitled "Automatic Starting."

b. In the "Off" position, the engine-generator unit starting circuits shall not function.

c. In the "Test" position, the engine may be started and brought up to speed, but the engine-generator unit cannot be put on line.

d. In the "Manual" position, the switch shall simulate a loss of voltage condition, whereupon the engine-generator unit shall start and be connected to the line, but only after the incoming line circuit breaker has been opened.

2.15.2.3 Engine Cranking Relay

Provide to operate as follows.

a. When actuated, device shall close contacts to actuate the engine starting system.

b. Should the engine fail to start at once, cranking shall continue for 25 seconds (adjustable) after which a 10-second "off" period (adjustable) shall occur, followed by a 7-second starting period (adjustable) and another 7-second "off" period, adjustable. Durations of cranking and specified "off" periods may be modified in accordance with the engine manufacturer's recommendations.

c. Repeat the specified cranking cycle for three starting attempts.

d. If the engine still fails to start, the cranking device shall lock out further starting attempts until it is manually reset. When the cranking relay locks out, an alarm light shall be energized at the indicated location and remain lighted until it is manually reset.

2.16 GENERATOR PROTECTION AND SUPPORT

Provide the specified switchgear, associated generator protective devices, control switchboard, and station battery system to support the operation of the engine-generator units.

2.16.1 Metal-Clad Switchgear

Provide indoor, single-bus type suitable for a nominal 480-volt, three-phase four-wire, 60-Hz electrical power distribution system. Switchgear main bus shall have the indicated continuous current rating. Conform with the requirements of ANSI/IEEE C37.202 and, except where indicated otherwise. The switchgear shall have the same short-circuit rating as the power circuit breakers.

2.16.1.1 Manufacture and Assembly

Assemble each equipment group at the factory and check alignment, fit, and operation. Design shall be such that the only necessary installation labor will be required to secure the various pieces of equipment in place and to make necessary mechanical and electrical connections. Provide interconnecting wiring required between switchgear sections.

2.16.1.2 Finish

Provide manufacture's standard gray enamel. After installation, apply an approved spot paint to surfaces chipped or damaged during transportation, handling, storage, and installation.

2.16.1.3 Switchgear Control

Control as indicated. Provide switchgear wiring required for remote monitoring of the switchgear. Terminal blocks for current transformer circuits shall be shorting type. Remote alarm, and monitoring equipment and devices shall be as shown and specified herein. Control circuits shall comply with ANSI/IEEE C37.21.

a. Wiring: Provide only stranded copper wiring. Provide wiring to separate terminal boards for interswitchgear wiring and for interface wiring to other items of equipment. Splices shall not be made in control wiring except for connections made a terminal blocks. Not more than two wires shall be terminated at any one connection point. Unused relay contacts and auxiliary switch or other control and indicating component contacts shall be wired to terminal blocks. Wiring requirements include control and secondary circuits.

b. Terminal and Wiring Identification: Mark terminals and wiring with a code identification. Such identification shall be marked on shop drawings, as well as on terminals and wiring. Utilize yellow plastic slip-on jackets for wiring and permanently stenciled identification on terminals or approved equal labeling.

c. Control Functions: Utilize, to the maximum extent possible, IEEE device numbers corresponding to the function names and descriptions

of IEEE C37.2 and this specification for identification data.

2.16.1.4 Circuit Terminations

Arrange cable compartments in the switchgear for top entrance of primary cables and top entrance of control and secondary cables.

2.16.1.5 Buses

Utilize tin-plated bolted pressure joints for internal connections. Provide at least two bolts at each joint, and secure nuts to bolts with a lockwasher or other suitable locking means. Support bus on track-resistant, molded polyester glass or wet porcelain electric grade insulator and internal supporting barriers. Brace buses and connections to withstand forces developed by currents equal to the circuit breaker close, carry, and interrupting rating requirements.

a. Primary Buses: Provide primary buses of ASTM B 187, copper. Insulate buses with preformed covering or sleeves or with a fluidized-bed uniform coating and provide removable insulating boots for bus joints. Use of tape-wrapped insulation is not permitted.

b. Ground Bus: Provide insulated copper ground bus, not less than 2 inches by 1/4 inch in cross-sectional area for the full length of the switchgear. Aluminum ground bus is not acceptable. Utilize properly-sized compression indent type cable lugs at each end of a ground bus for connection to the switchgear ground cables.

2.16.1.6 Power Circuit Breakers

Three-pole, single-throw, oilless type, electrically operated, electrically and mechanically trip free, and complete with stored-energy operating mechanism and auxiliary switches, as required, for control and interlocking as specified or as shown, and mounted on a mobile drawout frame. Design circuit breakers and furnish equipment to permit complete disconnection of the circuit breaker from the line and bus for testing of the circuit breaker within the switchgear compartment. Mechanically interlock circuit breakers to ensure that circuit breaker is tripped before being withdrawn from or inserted into the connected position. Circuit breakers shall be completely interchangeable, mechanically and electrically. Circuit breakers shall have the following characteristics and associated related capabilities in conformance with ANSI/IEEE C37.04 and ANSI C37.06 standard duty cycles, when tested in accordance with ANSI/IEEE C37.09.

a. Nominal voltage class: 0.6 kV.

b. Rated continuous current: 4000 A rms.

c. Rated short circuit current: 65 kA.

d. Rated interrupting time: 5 cycles.

2.16.1.7 Alarms

Provide switchgear with connections for indicating the automatic operation of any circuit breaker. Connect alarm system to contacts in each circuit breaker control switch to prevent an alarm upon manual circuit breaker operation.

2.16.1.8 Relays

Provide semiflush drawout, back-connected, switchboard type, which conform to ANSI/IEEE C37.90. Relays shall have rectangular cases finished in dull black; metal cases shall be rustproof or finished to resist rust or corrosion. Relays shall have built-in test facilities. Relay contacts shall be visible to permit ready inspection, and self-aligning. Covers shall be easily removable for adjustment of settings. Provide auxiliary relays, as required, for proper operation of the switchgear. Solid-state relays shall have equivalent trip characteristics as electromechanical units. Solid-state relays shall comply with the surge withstand test requirements of ANSI/IEEE C37.90. Substitution of three single-phase relays for a three-phase relay is acceptable, if such relays are specifically designed for the specified function.

a. Undervoltage relays, IEEE Device 27: Provide a single-phase, time-delay undervoltage relay with a 3-to-30-second adjustable time delay to decreasing voltage.

b. Loss of excitation relays, IEEE Device 40: Provide three-phase relays specifically designed for high-speed detection of damaging low generator excitation. Provide relays having a separate phase voltage to each element.

c. Negative sequence relay, IEEE Device 46: Provide three-phase relays designed to protect against a continuous load unbalance in excess of the rated capability of the associated generator.

d. Overcurrent Relays: Provide single-phase, nondirectional, relays with adjustable current ranges as indicated.

   (1) Feeder protection, IEEE Devices 50/51 and 50N/51N: Provide indicated time characteristics for the overcurrent relay, and provide relays with integral instantaneous units.

   (2) Generator protection, IEEE Devices 51G and 51V: provide indicated time characteristics. Provide with voltage restraint to prevent operation of the overcurrent device, unless the voltage drops below a predetermined level for IEEE Device 51V.

e. Differential relays, IEEE Device 87: Provide single-phase, high-speed percentage differential, relays specifically designed for generator protection.

f. Lockout relay, IEEE Device 86: Provide multicontact auxiliary relays to trip and lock out associate circuit breaker when so directed by the associated differential relays.

2.16.1.9 Instrument Transformers

Provide indoor dry type conforming to ANSI/IEEE C57.13. Coordinate mechanical and thermal ratings with circuit breakers and other apparatus in the switchgear in accordance with ANSI/IEEE C37.20.1. Mount voltage (potential) transformers on drawout carriages with primary and secondary disconnecting devices and provide with primary circuit current-limiting fuses. Provide fuses for secondary leads of all voltage transformers.

2.16.1.10 Instrument and Control Switches and Indicating Lights

Conform to paragraph entitled "Control Switchboard." Elapsed time meters shall be of the same type and shall totalize engine running time to 9999.9 hours total.

2.16.1.11 Watthour Meters

Provide flush or semiflush drawout, back-connected integrating switchboard type conforming to ANSI C12.10. Provide with primary reading, pointer type, daily-reading type registers with multiplier to be a power of 10. Meters shall have built-in test facilities and indicators to show energized potential coils and shall conform to ANSI C12.10. Meters for feeder and station service circuits shall have indicating demand registers with 15-minute intervals.

2.16.1.12 Transducers

Provide separate transducers of the unidirectional constant-current type providing an analog signal directly proportional to the instantaneous quantity measured. Rate at 60 Hz for a 120-volt nominal input voltage, a 150-volt overload voltage, a 5-ampere nominal input current, a 10-ampere continuous overload current, a 250-ampere one second instantaneous overload current, to provide an accuracy of plus or minus 0.5 percent. Provide instrument transformer designed so that the maximum individual burden does not exceed 4 voltamperes, and output at full scale does not exceed one milliampere.

2.16.1.13 Test Switches, Blocks, and Connections

Provide test blocks and connections for convenient testing of meters. Provide test switches and connections for testing relays, and where three-phase relays are amployed, for testing one phase at a time without losing the protection of the other two phases.

2.16.1.14 Control Power

Switchgear shall be suitable for operation of the station battery voltage specified herein. Provide control circuit cutout devices with separate fuses for closing and tripping circuits for each switchgear unit and for coordination in a sectionalized dc distribution system.

2.16.1.15 Nameplates

Provide for identification of switchgear units, primary circuits, control switch functions, meters and instruments where required, and voltage transformer compartments. Nameplates shall be laminated plastic with engraved white letters on a black background.

2.16.1.16 Excitation and Voltage Regulation System Equipment

Provide as specified in paragraph entitled "Generators and Excitation and Voltage Regulation Systems." Install equipment in switchgear as specified in paragraph entitled "Equipment Details."

2.16.1.17 Accessories

Provide tools for testing and routine maintenance. Include portable lifting devices, manual positioning devices, maintenance closing level, test plugs for relays and watthour meters, and test cabinet. provide test cabinet suitable for wall mounting, complete with control switch, indicating lights, and 6-foot long control jumper.

2.16.1.18 Semi-Automatic Equipment Details

a. Generator and Exciter Unit: Equip unit with a main and auxiliary compartment compartment to provide complete control, switching, and relaying for one generator and its associated exciter and to include the following.

(1) 1 set insulated primary bus, splices, and connections.

(2) 1 ground bus, splices, and connections.

(3) 1 power circuit breaker unit, IEEE Device 52.

(4) 1 circuit breaker position control switch with two indicating lights, red and green.

(5) 1 engine starting switch.

(6) 1 true RMS ammeter and ammeter switch.

(7) 1 elapsed time meter.

(8) 1 temperature meter.

(9) 1 varmeter, three-phase, three-wire.

(10) 1 wattmeter, three-phase, three-wire.

(11) 1 watthour meter, three-phase, three-wire, three-element type.

(12) 1 generator voltage regulator and accessories in accordance with paragraph entitled "Voltage Regulator, IEEE Device 90," including two dedicated voltage transformers and three dedicated current transformers.

(13) 1 engine cranking relay.

(14) 1 relay, three-phase, loss of excitation, IEEE Device 40.

(15) 1 relay, three-phase, negative sequence, IEEE Device 46.

(16) 1 relay, single-phase, time overcurrent, ground, IEEE Device 50G.

(17) 3 relays, single-phase, voltage-restrained, time overcurrent, IEEE Device 51V.

(18) 3 relays, single-phase, generator differential, phase, IEEE Device 87.

(19) 1 relay, auxiliary tripping, lockout, hand reset, IEEE Device 86.

(20) 6 current transformers, single secondary.

(21) 3 voltage transformers, fused, drawout.

(22) 2 nameplates for circuit identification, one front and one rear.

NLMANS

(23) Necessary auxiliary relays, small wiring, nameplates, control and instrument buses, fuses, terminal blocks, wire terminals, and accessories.

2.16.2 Associated Generator Protective Devices

Provide generator surge protection and neutral grounding equipment each mounted in separate enclosures.

2.16.2.1 Equipment Enclosure

Fabricate enclosures of sheet steel supported by a suitable framework. Utilize not lighter than 11-gage panels with structural members electrically welded. Provide removable bolted covers to permit installation and maintenance of equipment. Size and ventilate to maintain manufacturer's recommended clearances, from the equipment enclosed and operating temperature limitations.

2.16.3 Control Switchboard

Provide control switchboard conforming to ANSI/IEEE C37.20.1 completely assembled, wired, and tested with instruments, controls, relays, and miscellaneous equipment. Mount apparatus substantially as shown. Provide minor modifications only to suit the equipment furnished.

2.16.3.1 Vertical Switchboard Construction

Construct switchboard as a rigid, free-standing, general purpose structure of the vertical enclosed switchboard type as defined by ANSI/IEEE

C37.20.1. Completely enclose switchboard with a sheet metal covering on the back, front, ends, and top. Hinge and arrange front panels for mounting instruments and control devices. Provide switchboard with a continuous cable raceway located at the bottom and extending the full length of the switchboard. Provide raceway with removable top covers and removable bottom plates to allow access to the cable raceway from the bottom of the control switchboard at any point selected. Provide each unit with a vertical perforated metal wiring trough extending from the horizontal cable raceway to the top of the control switchboard enclosure. Mount terminal blocks on the perforated vertical raceway, from which hinge-type wiring shall be taken, to instruments and control devices mounted on front hinged panel. Brace all portions of the control switchboard and add stiffening members where required to provide a rigid structure.

2.16.3.2 Instruments

Provide semiflush-mounted, rectangular, switchboard instruments with rear connecting terminals and conforming to ANSI C39.1. Construct with taut-band suspension movement and 250-degree scales in a nominal 4.5-inch square case. Design and calibrate for vertical or horizontal mounting, as required.

2.16.3.3 Instrument and Control Switches

Utilize rotary-enclosed, rear-mounted switches having positive means of maintaining contacts, which shall be silver-to-silver type, identifying escutcheon plates, and handle targets to indicate switch position. Utilize knurled handles for instrument switches, standard pistol grip handles for circuit breaker and governor control switches, and provide only two removable oval handles for the synchronizing switches. Provide red and green indicating lights for circuit breaker control switches.

2.16.3.4 Indicating Lights

Provide front removable, low drain, push-to-test, indicating lights equipped with dropping resistors suitable for the station battery voltage or 120-volt ac service, as required and color caps as specified.

2.16.3.5 Generator Voltage Adjustment

Install manual voltage setting control systems as specified under paragraph entitled "Voltage Regulator, IEEE Device 90."

2.16.3.6 Control Alarm System

Provide an alarm system conforming to paragraph entitled "Engine Control Panel." Furnish spare alarm points complete with nameplate windows, plug-in relays, accessories required for operation, and panel wiring to terminal blocks. Provide the following alarm points as a minimum.

a. Each metal-clad switchgear circuit breaker unit.

b. Each engine control panel.

c. Low fuel oil pressure from filters.

d. High fuel oil level in drip tank.

e. Direct-current system abnormal.

f. Station service transformer on high temperature.

g. High coolant temperature alarm.

h. Eight spare alarm points.

2.16.3.7 Nameplaces, Wiring, and Accessories

Conform to the requirements of paragraph entitled "Metal-Clad Switchgear."

2.16.4 Station Battery System

2.16.4.1 Station Battery

Battery shall be lead-acid type, with standard operating voltage of 125 volts and a minimum rating of 120 ampere-hours at the 8-hour rate. Battery shall be made up of either the lead-antimony or the lead-calcium type contained in individual jars of shock-and heat-resistant clear acrylic or polystyrene plastic. Covers shall form an air-tight, acid-tight seal with the jars, and each shall be provided with a suitable vent with removable plug designed to allow free venting of gases from the cell and to prevent the escape of electrolyte. Electrolyte shall be sulphuric acid conforming to FS O-S-801 and shall have a specific gravity not exceeding 1.220 at 25 degrees C (77 degrees F) at full charge. Cells shall have adequate space below the plates for accumulation of sediment under normal operation and maintenance. Provide special tools, cell-lifters, trays, racks, and maintenance equipment. Include portable hydrometer-syringe and thermometer, vent-mounted hydrometer-syringe and thermometer, one cell container and cover, and six intercell connectors.

2.16.4.2 Battery Racks

Provide battery racks constructed for the type of battery provided. Racks shall be of substantial construction and arranged as indicated, or in an approved convenient and accessible manner. Construct racks of securely braced welded steel frames. Racks shall have steel rails with a top covering of acid- or alkali-resistant rubber or plastic, as suitable. Permanently attach acid- or alkali-resistant rubber or plastic numerals not less than one inch high to the rack in a position to readily indicate the associated cell. Structural parts of the racks shall have not less than two coats of an approved acid- or alkali-resistant paint or varnish. Racks shall be designed to resist the lateral forces for the seismic zone involved.

2.16.4.3 Battery Charger

Provide silicon diode type, adjustable, self-regulating, current limiting, and either floor or wall mounting, as appropriate to the size. Charger shall comply with UL 1236. Charger shall have an input rating of 120 volt, single-phase 60-hertz. Output voltage shall be suitable for

battery tank, dc; output current rating shall be not less than 10 amperes dc. Voltage regulation of the charger shall be 0.5 percent maximum from 0 to 100 percent load. Charger shall be a dual-rate type complete with output voltage potentiometer, line switch, equalizing charge switch and timer, reverse power protection, dc ammeter, dc voltmeter, grounding terminal, and enclosing steel cabinet treated to resist corrosion. Provide white indicating lights and red alarm lights. Equip charger with the following alarm and display devices and provide a summary alarm relay for connection to the control alarm system.

a. "ON" indicating light for ac power input.

b. Failure of ac power input relay and alarm light.

c. "No charge" relay to close contacts upon charger failure and alarm light.

d. Ground detector relay to close contacts upon occurrence of a dc system ground and alarm light.

e. Low dc voltage relay and indicating light.

f. High dc voltage relay and indicating light.

2.17 WIRE AND CABLE

Provide wire and cable required for a complete electrical system as shown. Low-voltage power cables shall conform to the applicable portions of Section 16402, "Interior Wiring Systems."

2.17.1 Multiple-Conductor Control Cables

Insulate for 600-volt service. Provide cables with necessary fillers and binder tape. Color-code individual conductors in accordance with NEMA WC 8, Method 1. Multiple-conductor control cables shall be one of the following constructions.

a. Each conductor shall have 47 mils of Type RHW synthetic rubber insulation plus 15 mils of neoprene followed by an overall neoprene jacket. Insulation shall conform to NEMA WC 3.

b. Each conductor shall have 20 mils of polyethylene plus 10 mils of polyvinylchloride insulation followed by overall polyvinylchloride jacket. Insulation and jacket materials shall conform to ICEA NEMA WC 5.

c. Each conductor shall have 30 mils of cross-linked polyethylene insulation followed by an overall neoprene or polyvinylchloride jacket. Insulation and jacket materials shall conform to NEMA WC 5 and NEMA WC 7.

2.17.2 Thermocouple Extension Wires

Provide duplex, twisted, No. 16, solid iron-constantan with polyvinylchloride insulation, Mylar tape separator, and polyvinylchloride

jacket. Insulation and jacketing shall conform to NEMA WC 5. No splices are permitted in thermocouple wiring.

2.18 SOURCE QUALITY CONTROL

Perform and report on factory tests and inspections prior to shipment. Provide certified copies of manufacturer's test data and results. Notify Officer-in-Charge before performing tests. Officer-in-Charge or Officer-in-Charge's representative reserves the right to witness tests. Test procedures shall conform to ASME, IEEE, and ANSI Standards, and to DEMA requirements on testing, as appropriate and applicable. Ensure that manufacturer performing the tests provides equipment necessary for tests and certifies measuring and indicating devices correct or correction data furnished for the device. Tests shall indicate satisfactory operation and attainment of guarantees and specified performance. If satisfactory, equipment tested will be given a tentative approval. Equipment shall not be shipped before approval of the factory test reports for the following tests.

2.18.1 Engine Tests

Perform customary commercial factory tests on each engine, including, but not necessarily limited to, the following.

a. Perform hydrostatic test on water jackets to ensure that water seals and water jackets are water tight. Test report shall indicate pressure at which test was made and the results.

b. Place engine-generator unit in continuous operation without stoppage for a period of not less than 8 hours. Operate not less than one hour at each load point, 1/2, 3/4, and full load, at either 0.80 or 1.0 power factor. If stoppage becomes necessary during this period, repeat the 8-hour run. During each load run, record compression and firing pressures if this is a manufacturer's standard test. Record the following data at the start, at 15-minute intervals, and at the end of each load run: fuel consumption; exhaust, jacket coolant, and lube oil temperatures, lube oil and crankcase pressures or crankcase vacuum; and any other data of importance.

2.18.2 Generator Tests

Ensure that temperature tests on each generator's windings are performed by the manufacturer of the generator in the manufacturer's own plant. Temperature tests shall be in accordance with IEEE 115. Generator tests shall include insulation resistance and dielectric resistance. Provide IEEE 115 design tests. Provide prototype design test values for open circuit saturation, short circuit saturation, zero power factor, 60-hz saturation curve, direct-axis transient reactance, and negative sequence reactance tests. Calculations of the subtransient reactance using test values shall be included in the test report.

2.18.3 Switchgear Tests

Perform standard production tests listed in ANSI/IEEE C37.09 and ANSI/IEEE C37.20.2. Certify that switchgear bus meets the ANSI/IEEE C37.20.2 rated continuous current design test by listing bus size, bus quantity, bus material, rated amperes used, plus the measured temperature rise and the ambient temperature used during the test.

2.18.4 Radio Frequency Interference (RFI) Tests

Conduct test in accordance with MIL-S-16165 and MIL-STD-461. Furnish testing equipment, instruments, personnel for conducting the tests, a test location reasonably free from radiated and conducted interference, and other necessary facilities. Tests for RFI will not be required for items that are physically and electrically identical to those that have previously met the requirements of the specifications.

PART 3 EXECUTION

3.1 INSTALLATION

Use cribbing and shoring as required to protect construction from moving-in damage. Protect flooring and finished surfaces by heavy planking. Obtain approval of methods and materials used from the Officer-in-Charge before moving equipment across shored floors. After equipment has been moved in, remove shoring and repair damage to floors and other parts of the building. Furnish the services of one more diesel-generator representative or technicians, experienced in the installation and operation of the type of systems being provided to supervise the installation.

3.1.1 Mechanical Equipment

Installation shall be in accordance with manufacturer's instructions. furnish a competent and experienced erecting engineer to directly supervise unloading, moving, and erection of equipment. Provide labor, tools, and equipment, for erection and installation of the equipment.

3.1.1.1 Erection of Engine-Generator Units

a. Subbase Mounting: Erect subbase-mounted engine-generator units on concrete foundation, utilizing isolators specified. Carefully level structural subbase isolators prior to grouting in accordance with both the engine manufacturer's and the vibration isolator manufacturer's recommendations.

3.1.1.2 Equipment Supports

Provide devices to support equipment, not supported on concrete foundations, in the indicated position. Fabricate the required supports of structural steel sections, plates, or rods; and arrange to provide rigid and sturdy support. Provide connections and fasteners required between equipment supports and building structures.

3.1.1.3 Anchor Bolts and Sleeves

Provide anchor bolts and sleeves for equipment installed on concrete foundations or concrete bases. Anchor bolts and sleeves shall be type, size, and metallurgy recommended by the manufacturer of equipment. Placement of anchor bolts and sleeves for the engine-generator unit shall be in strict accordance with details provided by the manufacturer of the engine.

3.1.1.4 Equipment Cleaning

Before assembly or erection, thoroughly clean equipment. Remove temporary protective coatings and foreign materials. After erection of equipment, clean external surfaces. Remove oil, grease, dirt, and foreign material. Touch up shop paint as necessary.

3.1.1.5 Equipment Aligning

Align rotating equipment in accordance with manufacturer's recommendations. Align equipment, except the engine-generator unit. After alignment, drill, ream, and fasten items of equipment in place on baseplates using tapered dowel pins so that permanent alignment will be maintained. Accomplish finite leveling of the engine-generator unit with shims. Make external connections and install piping, before equipment is placed in operation.

3.1.1.6 Grouting

a. Engine-Generator Unit: Provide epoxy resin compound mixture of the type recommended by the engine manufacturer for grouting the engine rails, generator sole plate, and outboard bearing support. Mix and apply grout in accordance with instructions provided by the grout manufacturer.

b. Other Equipment: Grout equipment bedplates or bases on the foundations with a nonshrink Portland cement grout. Grout shall have a minimum thickness of one inch. Mix grout in accordance with the manufacturer's instructions and apply in a manner to ensure complete filling of spaces between the foundation and equipment baseplates.

3.1.1.7 Instruction of Operators

During the period of erection, inform plant superintendent and operators as to placement and assembly of equipment. After equipment is ready to be placed in service, fully instruct plant operators in operation and maintenance of the equipment.

3.1.2 Piping

Fabricate, assemble, weld, solder, braze and visually examine piping to ensure that piping work conforms to ASME B31.1. Shop fabrication of piping 4 inches and larger is permitted. If shop fabrication is chosen, provide detailed fabrication drawings or isometrics and submit for approval before work is started. Field erect fabricated piping to provide a workable arrangement, with convenient access to valves and specialty items.

Maintain adequate clearance between runs of piping to permit access around adjacent pipe for dismantling, repair, and maintenance of valves. Piping shall be straight, plumb, and run direct as possible. Locate groups of pipes parallel to each other, with adequate spacing. Do not install piping over electrical equipment. Piping shall be installed by competent and skilled workmen.

3.1.2.1 Identification of Materials

Paint identifying numbers on sections of prefabricated piping corresponding to identifying numbers shown on shop fabrication detail drawings.

3.1.2.2 Shop Fabrication

Shop fabricate pipe in the largest sections practical for shipping and field assembly. After fabrication, remove loose scale, sand, weld spatter, cutting chips, and other foreign materials by mechanically driven cleaning tools or wire brush. Before shipment, apply one coat of paint to shop fabrications, valves, fittings, and flanges using painting materials of metallic pigment type free of asphalt or asphaltum base. Plug ends of piping and openings prior to shipment to plant site.

3.1.2.3 Welding

Preparing, bending and cleaning and welding of joints in piping shall conform to ASME B31.1. Welds shall be visually examined and meet acceptance standards of ASME B31.1.

3.1.2.4 Taps

Taps for thermometer separable sockets shall be in locations which permit installation of thermometers for convenient observation from the floor or platform elevations and which minimize obstruction of the flow in the pipe. Make taps before fitting main piping in place. Burning of holes after piping is fitted is prohibited.

3.1.2.5 Field Cleaning

Before placing in position, clean the inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter. Pipe, 2 inches and larger, shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to apparatus, wash out interior of piping with water, except air, fuel, and lubricating oil lines. Blow out air, fuel, and lubricating oil lines with 80 to 100 psi dry air or nitrogen. Sterilize potable-water piping by means of liquid chlorine or lime in accordance with AWWA C651 before being placed in service.

3.1.2.6 Pickled Piping

Clean steel fuel oil piping and pickle internally by chemical cleaning. Cleaning process shall remove grease, oil, dirt, mill scale, lacquer, and corrosion products. Clean piping either by circulating the cleaning solution through the completed piping systems or by soaking prefabricated piping sections in a tank of the solution. Provide and remove after use,

pumps, temporary piping connections, tanks, heaters, and other equipment required to accomplish cleaning of piping. After completing cleaning, thoroughly flush, drain, and dry piping and take precautions to prevent rerusting before pipe is used. While cleaning, remove or isolate instrumentation, valves, and equipment installed in the piping, which contain bronze or brass. Cleaning solution shall not come in contact with bronze or brass. Cleaning solution shall not be circulated through the engine, engine lubricating-oil sump, lubricating oil cooler, or pumps in the oil piping systems. Provide cleaning solution of the type recommended by a reputable chemical manufacturer for the specific purpose.

3.1.2.7 Provisions for Expansion

Provide for expansion of piping subject to temperature change by using compatible expansion joints, bends, ball joints, offsets, and loops in a manner that shall prohibit development of excessive stresses between anchor points or at equipment connections. Use bends, loops, and offsets wherever practical to prevent overstressing of piping systems due to thermal expansion and to provide adequate flexibility. A piping system may be cold sprung by an amount no greater than 50 percent of the total linear expansion to alleviate end thrusts and moments. Method of cold springing shall be as approved.

3.1.2.8 Reducing Fittings

Use for changes in pipe size, except where taps are permitted. Use of bushings are prohibited. In horizontal mains containing liquids, use eccentric reducers.

3.1.2.9 Unions or Flanges

Place where necessary to permit easy disconnection of piping and appraratus. Provide each connection having valves with screwed ends with a union. In long lines inside buildings, place unions or flanges not farther apart than 100 feet except in pipe lines of welded construction where unions or flanges shall be placed as indicated.

3.1.2.10 Valves

Install in positions accessible for operation and repair. Install stems preferably in a vertical position with handwheels or operators on top, or install in a horizontal position. Do not install handwheels on stop valves below the valve. Install globe valves with flow direction from below the disk.

3.1.2.11 Connections to Equipment

Make piping connections to equipment shown and provide reducers, increasers, unions, valves, and strainers required to make a complete installation. Make connections to equipment with unions or flanged joints. Valves shall be the same size as the piping in which installed.

3.1.2.12 Joints

a. Flanged Joints: Face pipe flanges true to line and clean before assembly. Gasket faces shall be free of burrs or bruises. Make up flanged joints prior to completing the last weld in connecting piping. Coat bolt threads with a mixture of equal parts of graphite and boiled linseed oil or with an approved commercial coating.

b. Screwed Joints: Use graphite pipe-joint compound conforming to MIL-T-5544; apply to male threads only. Red or white lead and zinc compound conforming to MIL-T-22361 may be used, except lead compounds are prohibited in potable water lines. Piping shall be free of fins and burrs. Ream pipe ends or file out to size of bore; remove chips.

3.1.2.13 Instrument and Control Tubing

Stretch and straighten rolled copper tubing prior to installation to remove kinks and unnecessary bends. Do not use tubing which has been kinked, twisted, flattened, sharply bent, or otherwise deformed. Make joints in copper tubing in locations that permit inspection and convenient maintenance. Where possible, run copper tubing flat against building structural members and secure with copper straps at intervals not exceeding 6 feet. Where tubing cannot be placed flat against building structure, provide and install in channel sections or expanded metal troughs. Install capillary tubing to prevent kinking, flattening, or breaking. Roll excess tubing length in a neat roll and securely support in a location affording maximum protection with least possible danger of damage. Support pressure gages and other accessories connected by copper tubing, independently of tubing. Provide ample expansion loops in tubing connections to equipment subject to vibration to prevent failure due to metal fatigue.

3.1.2.14 Pipe Sleeves

Provide where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Provide galvanized steel pipe sleeves in outside walls above grade, in floor, or in roof slabs. Sleeves in partitions shall be zinc-coated sheet steel having a nominal weight of not less than 0.906-pound per square foot. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/4 inch, except sleeves in the plant operating floor shall be 2 inches larger in diameter than the pipe. Hold sleeve securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 3 inches above the finished floor. Firmly pack space between the pipe or tubing and the sleeve with oakum and calk on both ends of the sleeve with non-hardening acoustic sealer, except for sleeves in the plant operating floor which shall be free of packing and elastic cement. Where piping passes through steel grating, band the opening with one-by 1/8-inch thick steel edge bands welded to the grating bars.

3.1.2.15 Capped or Plugged Outlets

For connections to future equipment, if not located exactly by the drawings, locate outlets as directed.

3.1.2.16 Anchors, Guides, and Supports

Anchor and support piping in a manner such that expansion and contraction shall take place in the desired direction. Prevent vibration by use of vibration dampers and prevent undue strains on equipment served. Hangers used for support of piping of 2-inch nominal pipe size and larger shall be the type permitting adequate adjustment after erection while still supporting the load. Use wall brackets where pipes are adjacent to walls or to other vertical surfaces which may be used for supports. Provide supports to adequately carry weight of lines and to maintain proper alignment. Provide inserts and sleeves for supports in concrete where necessary, and in new construction place before concrete is poured. Provide insulated piping with a pipe-covering protection saddle at each support. Provide auxiliary structural steel members, other than building structural steel, required for supporting or anchoring piping and accessories. Provide longitudinal and lateral seismic sway bracing to restrain piping when subjected to the lateral forces generated by the seismic zone involved. In accordance with procedures approved by the Officer-in-Charge, drill holes, provide bolting materials, and perform welding to fasten auxiliary structural steel to building steel. Provide pipe guides and anchors of approved type at points where necessary to keep pipes in accurate alignment, to direct expansion movement, and to prevent buckling and swaying and undue strain. Provide pipe guides for alignment of pipe connected to free, unanchored end of each expansion joint. Support pipe rollers in concrete trenches by manufactured preformed steel hanger units. Hanger units, supports, hangers, inserts, rollers, and similar items shall be hot-dipped galvanized after fabrication. Space pipe supports to provide adequate support.

3.1.3 Electrical Equipment

Install equipment in accordance with the standards, and codes, and in conformance with manufacturer's instructions and recommendations.

3.1.3.1 Metal-Clad Switchgear

Provide floor mounting channels and install in concrete floor slab in accordance with switchgear manufacturer's drawings and instructions. Install floor channels flat rather than on edge. Align, level, and bolt or weld switchgear units to floor channels to allow easy withdrawal or insertion of removable elements and to permit proper operations of component devices. Splice the main bus and insulate bus joints in accordance with switchgear manufacturer's recommendations. Connect control wiring as required at shipping splits.

3.1.3.2 Protective Devices, Switchboard, and Control Center

Install generator protective devices, control switchboard, and motor control centers at the indicated locations, and align, level, and bolt equipment to the floor.

3.1.3.3 Batteries and Chargers

If batteries are to be stored during the construction period, follow manufacturer's instructions as to charging and protection from environmental damage.

3.1.3.4 Miscellaneous Devices

Install motor starters, pushbuttons, selector switches, safety switches, and other miscellaneous devices in the approximate locations shown. Choose precise locations in the field to provide ample space for operation and maintenance of the equipment. Attach equipment to structural steel or permanent walls when such support is available. Provide a suitable steel framework if other acceptable support is not available. Attach equipment to permanent walls with expansion anchors and bolts, and to structural steel or steel framework by bolting to the steel or to brackets welded to the steel. Provide an air space between the equipment enclosure and the supporting wall or steel by means of metal shims or washers.

3.1.4 Raceway Systems

Install building raceway systems in accordance with the applicable portions of Section 16402, "Interior Wiring Systems." Install underground raceway systems in accordance with the applicable portions of Section 16375, "Underground Electrical Work."

3.2 PAINTING

Ensure that manufacturer paints equipment and equipment assemblies specified under this section before factory testing. Ensure that the manufacturer cleans and retouches as required after factory testing and before shipment. The Contractor shall retouch damaged painted surfaces after field installation and testing. Retouching shall be done with the exact color and type of paint used by the manufacturer. Other field painting is specified under Section 09900, "Painting."

3.3 FIELD QUALITY CONTROL

Perform and report on field tests and trial operations, and conduct field inspections. Provide labor, calibration and approved test equipment, and incidentals required for the tests. The Officer-in-Charge will witness field tests and trial operations and will conduct final field inspections. Give the Officer-in-Charge 10 days notice of the dates and times scheduled for tests, trial operations, and inspections which require the presence of the Officer-in-Charge. Deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested.

3.3.1 Piping Tests

Test piping systems after lines have been cleaned and before applying insulation covering. Test piping systems at a pressure of 1.5 times the design working pressure, and in no case less than 100 psig. Hydrostatically test piping, except for air, oil, and gas, using water not exceeding 100 degrees F). Test air, oil, and gas lines with clean, dry

air. For air lines operating at pressure greater than 100 psig, test at the design working pressure. In all tests, remove gages, traps, and other apparatus which may be damaged by the test pressure or valve off before the tests are made. Install a calibrated test pressure gage in the system to observe loss in pressure. Brush joints in piping systems tested with air with a soapy water solution to check for leaks. Maintain the required test pressure for a sufficient length of time to enable inspection of joints and connections. Rectify defects which develop during testing, and retest piping systems until they show no defect or weakness and are tight.

3.3.2 Preliminary Operation

Place into operation equipment provided and installed. Make necessary adjustments to equipment to ensure proper operation as instructed by the manufacturers of the equipment. Lubricate equipment prior to operation in accordance with the manufacturer's instructions. Dry out motors before operation as required to develop and maintain proper and constant insulation resistance. *Upon approval by the Officer-in-Charge or the* Officer-in-Charge's authorized representative, operate engine-generator units under the supervision of the supervising erector at varying loads throughout the load range for a sufficient time to demonstrate that operation is proper and that pressures and temperatures are normal and within the specified limits. Operate engines as specified in paragraph entitled "Engine-Generator Units Acceptance Tests" for a period of time sufficient to ensure that the units are ready to carry the test loads without damage to engine parts. During this preliminary operation, check the operation and ensure the proper functioning of auxiliary equipment furnished under this contract. Make necessary adjustments to place auxiliary equipment in operating condition.

3.3.3 Electrical Equipment and Material Tests

Test procedures, inspections, and sampling shall be as specified and noted below.

a. Phase Relationship Tests: Check connections to equipment for proper phase relationship. During such check, disconnect all devices which could be damaged by the application of voltage or reversed phase sequence.

b. Switchgear Field Tests: Following installation and immediately prior to energization, perform switchgear field dielectric tests in accordance with ANSI/IEEE C37.20.2. Test and adjust meters and relays in accordance with the applicable referenced specifications. Test completed switchgear by operation under simulated service conditions to ensure accuracy of wiring and proper functioning of equipment.

c. Insulation Resistance Tests: Perform on cables and equipment as listed herein. Make tests with motor-driven or rectified type insulation resistance testers having ranges of 500 and 2,500 volts dc. Disconnect solid-state and other equipment which may be damaged by such tests before tests are made. Tests shall measure insulation resistance from line to ground. Test medium-voltage circuits and equipment for one-minute duration using the 2,500-volt

tester range. Test cables after placement of cables and completion of terminations, but before connection to equipment. Test low-voltage circuits and equipment, including current transformer and voltage transformer secondary circuits and equipment, with the 500-volt tester range. Minimum acceptable values of insulation resistance of circuits and equipment shall be as recommended by the manufacturer.

3.3.4 Engine-Generator Unit Acceptance Tests

When installation is complete and in operating condition, notify the Officer-in-Charge in writing that the engine-generator units and auxiliary equipment are ready for final field tests. The Officer-in-Charge or the Officer-in-Charge's authorized representative will witness final acceptance tests. Conduct fuel consumption tests on the engine-generator units to determine compliance with the specification requirements. Perform such other tests as necessary to ensure that equipment is functioning properly. Tests shall include the following.

a. A test to determine engine-generator unit speed regulation under a gradual change from zero to full load.

b. A test to determine engine-generator unit instantaneous speed change with 25 percent load on or off.

c. A test to ensure proper functioning of the overspeed trip.

d. An individual test of each pressure and temperature alarm switch.

Inspect auxiliary equipment including, but not limited to, pumps, fans, radiators, instruments, centrifuges, and special valves to ensure proper operation. Officer-in-Charge may require to field test the auxiliary equipment. Auxiliary equipment test shall be in accordance with the latest ASME and IEEE performance test codes, if applicable. If no code exists for the equipment to be tested, perform tests as prescribed by the Officer-in-Charge. Perform generating unit tests in accordance with the provisions of the "Field Test Code," as set forth in DEMA SDGE, except as modified herein. Use plant electrical system load for loading the generating unit under test. Furnish and connect a suitable water rheostat for loading the engine-generator unit under test. Perform operational tests of a minimum duration of 14 hours at varying loads to demonstrate satisfactory performance of automatic and parallel operations. Fuel consumption tests undertaken during this period shall be of not less than 4 hours at each load, that is 1/2, 3/4, and full, with an interval of at least 30 minutes between tests, after operation is stabilized at a given load. Provide and install necessary scales and tanks for measuring fuel oil. Check oil after tests for presence of metal filings and water. Provide and install temporary instrumentation, piping, and electrical wiring and make electrical connections required for the engine-generator unit tests.

3.3.4.1 Test Reruns

If the specified performance is not met by these tests, make such adjustments and changes, as necessary, and conduct additional tests, as

necessary to further check the performance of the equipment.

3.3.4.2 Failure to Meet Requirements

In the event equipment fails to meet specified performance or fails to operate satisfactorily, the Government shall have the right to operate the equipment until the defects have been corrected. Equipment proved to be faulty or inadequate for the service specified will be rejected, but the Government shall have the right to operate the rejected equipment until such time as new equipment is provided by the Contractor to replace the equipment rejected.

3.4 MANUFACTURER'S REPRESENTATIVE

Furnish the services of one or more diesel-generator representative or technician, experienced in the installation and operation of the type of systems being provided, to supervise the testing, and adjustment of the system, and to instruct Government personnel.

-- End of Section --

SECTION 16262

AUTOMATIC TRANSFER AND BYPASS/ISOLATION SWITCHES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL STANDARDS (FED-STD)

FED-STD-595	(Rev. B) Colors Used in Government Procurement

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Controllers, Contactors and Overload Relays, Related Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 4	(1993) Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1008	(1989; Bul. 1990, 1993, and 1994, R 1993) Automatic Transfer Switches

1.2 SUBMITTALS FOR GENERAL USE AUTOMATIC TRANSFER SWITCHES (ATS)

Submit the following in accordance with Section 01300, "Submittals."

1.2.1 SD-04, Drawings

a. General use automatic transfer switch

b. Bypass/isolation switch

Include certified outline, electrical ratings, general arrangement, and detail drawings.

1.2.2 SD-10, Test Reports

a. Withstand and closing tests

b. Dielectric withstand test

c. Test for non-welding of contacts

Submit for each rating of ATS and BP/IS, the reports of tests required by UL 1008 and by the additional requirements listed below. The proof of listing by UL shall be submitted and will be acceptable evidence that the ATS conforms to UL requirements.

1.2.2.1 Withstand and Closing Tests

The ATS and BP/IS shall be rated for use on a circuit having an available short circuit current of amperes RMS symmetrical at 20 percent power factor for a duration of 3 cycles when coordinated with molded case circuit breakers, 10 cycles when coordinated with power circuit breakers, and 0.5 cycle when coordinated with current limiting fuses. The withstand and closing tests shall be conducted at full rated system voltage in accordance with UL 1008. The 3- and 10-cycle tests shall be conducted without contact damage.

1.2.2.2 Dielectric Withstand Test

The dielectric withstand test shall be repeated in accordance with UL 1008, after the withstand test specified in paragraph titled "Withstand and Closing Tests Above UL 1008."

1.2.2.3 Non-Welding of Contacts

Automatic transfer switches shall be rated for non-welding of contacts when used with the feeder overcurrent devices indicated on the drawings and with the available fault current specified herein.

1.2.3 SD-19, Operation and Maintenance Manuals

a. General use automatic transfer switch, Data Package 5

b. Bypass/isolation switch, Data Package 5

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Automatic transfer switch

b. Bypass/isolation switch (BP/IS)

c. Accessories

Submit a description of each separate item of equipment or materials recommended for approval.

1.3.2 SD-04, Drawings

a. Automatic transfer switch

b. Bypass/isolation switch (BP/IS)

Include a one-line diagram of each ATS and BP/IS assembly, an elementary or schematic diagram, a wiring diagram of the unit, and an interface equipment connection diagram that shall show all conduit and wiring between ATS and BP/IS and other related equipment. Device and nameplate numbers and item numbers shown on the list of equipment and materials shall appear on drawings wherever the item of equipment or material appears. One-line diagram shall show interlocking provisions and cautionary notes, and elementary or schematic diagram shall appear on the same drawing.

1.3.3 SD-07, Schedules

a. ATS and associated equipment

1.3.3.1 ATS and Associated Equipment

Submit a list of equipment and materials proposed. Indicate the quantity of each item.

1.3.4 SD-10, Test Reports

a. UL 1008, ATS test

b. UL 1008, BP/IS test

c. Temperature rise test

d. Withstand and closing rating test

1.3.4.1 Equipment Test

Submit, for each rating of ATS and BP/IS, the reports of ATS test and BP/IS test required by UL 1008. Proof of listing by UL shall be submitted and will be acceptable evidence that the ATS conforms to UL requirements.

1.3.4.2 Underwriters Laboratory Testing

Test reports shall verify that the tested unit passed all tests without modification, or repair during a test period of not more than 90 days. The 90-day period does not include the time required to perform additional testing necessary to demonstrate compliance with the withstand and closing rating provisions of these specifications, when the withstand and closing rating exceeds the requirements of UL 1008.

1.3.4.3 Temperature Rise Test Reports

Submit UL or other certified test reports to demonstrate that the temperature rise test was conducted, following the conclusion of the endurance and overload tests.

1.3.4.4 Withstand and Closing Rating Test Reports

Test reports to demonstrate compliance with the withstand and closing rating provisions of these specifications, if those provisions exceed withstand and closing rating requirements in UL 1008. Submit oscillographic traces of each phase of voltage and current, with withstand and closing rating test reports to demonstrate that the main switch contacts did not separate and were not damaged during the performance of the withstand and closing rating tests.

1.3.5 SD-11, Factory Test Reports

a. ATS and BP/IS withstand and closing tests

b. Dielectric tests

c. Operational tests

Preform tests on each assembled switch unit. Test reports shall be certified and dated, shall demonstrate that the tests were conducted as specified, and that tests were successfully completed prior to the shipment of the equipment. Submit reports within 14 days following completion of the tests.

1.3.5.1 ATS and BP/IS Withstand and Closing Tests

ATS and BP/IS shall be tested and rated to withstand and close in on an available fault or short-circuit current of 60,000 amperes, RMS symmetrical, at a power factor between 0.0 and approximately 0.20 for a duration of 3 cycles at a maximum voltage of 480 volts ac.

1.3.5.2 Dielectric Tests

Perform tests in accordance with NEMA ICS 1. Wiring of each control panel shall be subjected to voltage surge tests as stipulated in NEMA ICS 1. Perform impulse withstand rating tests in accordance with the requirements of NEMA ICS 1.

1.3.5.3 Operational Tests

Perform test to demonstrate that the operational sequence of the ATS and BP/IS unit conforms to the requirements of the specifications with regard to operating transfer time, voltage, frequency, and timing intervals.

1.3.6 SD-19, Operation and Maintenance Manuals

a. Automatic transfer switch, Data Package 5

b. Bypass/isolation switch (BP/IS), Data Package 5

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.4 SERVICE CONDITIONS

ATS and BP/IS shall be suitable for performance under the following service conditions:

a. Altitude: 20 feet above mean sea level.

b. Relative humidity: 100 percent maximum, continuous.

c. Temperature: Minus 0 degrees C to 80 degrees C.

d. Seismic Zone: 4

PART 2 PRODUCTS

2.1 GENERAL USE AUTOMATIC TRANSFER SWITCH (ATS)

Provide automatic transfer switch and associated bypass/isolation switch with the number of poles, amperage, voltage, and withstand ratings as indicated. Transfer switch shall conform to UL 1008 as a recognized component for emergency systems, rated for all classes of loads when installed in an unventilated enclosure. Electrical operation shall be accomplished by a nonfused momentarily energized solenoid direct operating or electric motor operated mechanism or stored energy operator. Provide mechanical locking in each direction. Operation shall be double throw switching where normal and alternative contact operate with no intentional delay in mid position.

2.1.1 Accessories

A separately mounted control unit shall include:

a. Nonadjustable, one-second time delay to override momentary dips in normal power source.

b. Phase voltage relay supervision of three phases of the normal source. Relay shall dropout at 65 to 70 percent and pickup at 92 to 95 percent of nominal voltage to detect "brown-out" conditions.

c. Voltage/frequency lockout relay with 90 percent pick-up nominal, to prevent premature transfer.

d. System test switch, momentary type.

e. Auxiliary pilot contacts rated 10 amperes at 480 volts a.c., one closed on normal and one closed on alternative.

f. Retransfer time delay to normal power source: adjustable from 2 to 25 minutes.

g. Pilot lights to indicate source to which the load is connected.

2.1.2 Bypass/Isolation Switch (BP/IS)

Provide a manual bypass/isolation switch for the automatic transfer switch, arranged to bypass the alternative or the normal source of power directly to the load in one operation. Switch shall isolate the automatic transfer switch from the load and both normal preferred and alternative power sources. Bypass/isolation switch shall be lockable in the "isolated" position. Arrangement shall permit electrical testing of the transfer switch before the load is reconnected. Interlocks shall prevent operation of the transfer switch, except for testing purposes, when the switch is in the "isolated" position. Enclosure shall be designed so that the automatic transfer switch and the bypass isolation switch shall be accessible through individual door openings and installed in separate compartments to eliminate any exposure to the operator when servicing the automatic transfer switch while the bypass/isolation switch is in the "isolation" position. Bypassing the automatic transfer switch shall not cause any interruption of power to the load. The current, voltage, phase, and short circuit ratings shall be at least equal to the transfer switch ratings. Bypass/isolation switch shall also have the same number of switched poles as the transfer switch. Bypass/isolation switch may be a nonloadbreak device, but the short circuit withstand and closing rating of the bypass/isolation switch shall be equal or greater than that of the transfer switch. When the switch is installed in an unventilated enclosure and is carrying rated current, its contact temperature shall not exceed the limitations designed for the transfer switch.

2.3 ENCLOSURE

Switch and accessories shall be in a wallmounted, and ventilated NEMA ICS 6, Type 1, smooth sheet metal enclosure constructed in accordance with UL 1008. Metal shall be not less than US Standard Gauge No. 14. The enclosure shall be equipped with one grounding lugs grounding the enclosure using No. 4 AWG copper conductors. Contractor's field wiring terminating within the enclosure shall comply with NFPA 70. If wiring is not color coded, wires shall be permanently tagged near the terminal at each end with the wire number shown on approved shop drawings. Terminal blocks shall conform to NEMA ICS 4. Terminal facilities shall be arranged for entrance of external conductors from the top of the enclosure. Main switch terminals, shall be of the pressure type and suitable for the termination of copper conductors shown.

2.3.1 Construction

Enclosure shall be constructed for convenient removal and replacement of contacts, coils, springs and control devices from the front without the removal of main power conductors or removal of major components.

2.3.2 Cleaning and Painting

Ferrous surfaces shall be cleaned and painted. Surfaces to be painted shall be free of all oil, grease, welding slag and spatter, mill scale, deleterious corrosion, dirt, and other foreign substances. Painting shall include at least one coat of rust-inhibiting primer and one coat of finish enamel. Rust-inhibiting primer shall be applied to a clean, dry surface as

soon as practicable after cleaning. Painting shall be manufacturer's standard material and process, except the total dry film thickness shall be not less than 0.0635 mm (2.5 mils). Color of the finish coat may be the manufacturer's standard color, if approved, or No. 26314 Gray as specified in FED-STD-595. Finish shall be free from runs, sags, peeling or other defects.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements of NFPA 70 and manufacturer's recommendations.

3.2 FIELD TESTS AND INSPECTIONS

The Contractor shall furnish labor, equipment, and incidentals for, and shall perform all field tests. The Contractor shall give the Officer-in-Charge 7 calendar days notice of the times scheduled for tests so that the Officer-in-Charge may be present. Work affected by deficiencies shall be completely retested at the Contractor's expense.

a. Simulate power failure and demonstrate complete ATS and BP/IS operation. Contractor shall show by demonstration in service that the ATS and BP/IS are in good operating condition, and function not less than five times.

b. Conduct 3-hour load run utilizing Contractor-furnished portable load banks with each power source as follows:

(1) One-half load: One hour

(2) Full load: Two hours

PART 4 MEASUREMENT AND PAYMENT

The various components of the electrical work shall be measured and paid for on a lump sum basis. The unit prices paid shall be full compensation for all plant, labor, tools, equipment and materials required to provide switches and wiring complete, including testing.

Full compensation for all additional materials and labor not specifically shown or called for which are necessary to complete the electrical system described shall be considered incidental to the various contract items in the proposal.

-- End of Section --

SECTION 16312

LOW-VOLTAGE SWITCHGEAR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1993) National Electrical Safety Code
ANSI C12.1	(1988) Code for Electricity Metering
ANSI C12.4	(1984; R 1990) Mechanical Demand Registers
ANSI C37.06	(1987; Supp. 1989) Switchgear - AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
ANSI C37.121	(1989) Switchgear - Unit Substations - Requirements

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989; Rev. A) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	(1982; R 1987) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1994) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 525M	(1991; Rev. A) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525	(1993) Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 780	(1993; Rev. A) Repair of Damaged and Undercoated Areas of Hot-Dip Galvanized Coatings
ASTM D 92	(1990) Flash and Fire Points by Cleveland Open Cup
ASTM D 117	(1989) Electrical Insulating Oils of Petroleum Origin

ASTM D 877	(1987) Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes
ASTM D 1535	(1989) Specifying Color by the Munsell System
ASTM D 3487	(1988; R 1993) Mineral Insulating Oil Used in Electrical Apparatus

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203	(1991) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM P7825	(1994) Approval Guide

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

ANSI/IEEE C37.04	(1979; R 1989, Supp. 1986, 1990, and 1991) Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C37.13	(1990) Low-Voltage AC Power Circuit Breakers Used in Enclosures
ANSI/IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.90	(1993) Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers
IEEE C57.12.91	(1979) Dry-Type Distribution and Power Transformers
ANSI/IEEE C57.13	(1993) Instrument Transformers
IEEE C62.1	(1989) Gapped Silicon-Carbide Surge Arresters for AC Power Circuits
ANSI/IEEE C62.11	(1987) Metal-Oxide Surge Arresters for Alternating Current Power Circuits

MILITARY SPECIFICATIONS (MIL)

MIL-P-21035	(Rev. B) Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LI 1	(1989) Industrial Laminated Thermosetting Products
NEMA PB 2	(1992) Deadfront Distribution Switchboards
NEMA PB 2.1	(1991) Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less
NEMA ST 20	(1992) Dry-Type Transformers for General Applications

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(1991) Electrical Power Distribution Equipment and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 70B	(1990) Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES INC. (UL)

UL 198C	(1986; Bul. 1991, 1992, and 1993, R 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	(1988; R 1988, Bul. 1991, 1992, and 1993) Class R Fuses
UL 467	(1993; Bul. 1994) Grounding and Bonding Equipment
UL 489	(1991; Bul. 1992, 1993, and 1994, R 1994) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 977	(1984; Bul. 1991, 1992, 1993, and 1994, R 1993) Fused Power-Circuit Devices
UL 1053	(1988; R 1993) Ground-Fault Sensing and Relaying Equipment
UL 1437	(1993) Electrical Analog Instruments - Panel Board Types

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Switchboard

Each submittal shall include data on fuses, circuit breakers, switches, meters, instrument transformers, surge arresters, and associated accessories.

1.3.2 SD-04, Drawings

a. Switchboards

1.3.2.1 Switchboards

Furnish drawings that include, but are not limited to, the following:

a. Overall dimensions, front view, and sectional views.

b. Ampere ratings of bus bars.

c. Maximum short-circuit bracing.

d. Circuit breaker type, interrupting rating, trip setting.

e. Ratings and sizes of lugs, impedance, and taps.

f. Provision for future extension.

g. Elementary diagrams and wiring diagrams with terminals identified, and indicating prewired interconnections between items of equipment and the interconnection between the items.

h. One-line diagram.

i. Manufacturer's published time-current curves on full size logarithmic paper, main secondary breaker, secondary circuit breaker and current-limiting fuses to ensure that protection and coordination are achieved.

1.3.3 SD-10, Test Reports

a. Switchboard production and design tests

Submit certified copies of laboratory test reports by serial number required as indicated below for the following tests.

1.3.3.1 Switchboard Production and Design Tests

Furnish reports which include results of production tests performed in accordance with NEMA PB 2.

1.3.4 SD-12, Field Test Reports

a. Certified copies of dielectric tests reports

b. Report of check of time-current characteristics on low-voltage circuit breakers

c. Ground resistance test reports

1.3.4.1 Ground Resistance Test Reports

Upon completion and before final acceptance of work, submit the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system and soil condition at the time the measurements were taken.

1.3.4.2 Circuit Breaker Test Reports

Submit test result on the time-current characteristics on low-voltage circuit breakers performed in accordance with NETA ATS.

1.3.5 SD-19, Operation and Maintenance Manuals

a. Switchboard, Data Package 5

Submit Operation and Maintenance Manuals in accordance with Section 01730, "Operation and Maintenance Data."

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be transformers, substations, switchgear, switchboards, and related accessories are specified in Section 16402, "Interior Wiring Systems."

2.2 SWITCHBOARDS

NEMA PB 2, deadfront, metal-enclosed, self-supported type. Main bus shall be rated 4000 amperes at 480 volts and shall have a short-circuit-current rating of 65 rms symmetrical amperes. Switchboard shall be UL listed as service entrance equipment. Devices shall be front and rear accessible and shall be completely isolated between sections by vertical steel barriers. Provide switchboard in NEMA ICS 6 Type 1 enclosure. Switchboard shall be completely factory engineered and assembled, including protective devices and equipment indicated with necessary interconnections, instrumentation, and control wiring. Switchboard shall consist of main, auxiliary, and distribution sections. Switchboard shall have provisions for future extension.

a. Bus bars: Copper with tin-plated contact surfaces. Make bus connections and joints with hardened steel bolts. A full-capacity bus shall connect sections together, with provisions for future expansion. Buses shall be completely insulated from the devices so that the only exposed energized parts will be at the point of connection to devices. Locate each bus horizontally in the rear of each section behind the components and vertically centered. Support and brace the buses for the short-circuit current specified. Provide and secure ground bus to each vertical switchboard section and extend ground bus to the entire length of the structure.

b. Main protective device: Individually mounted drawout removable from the front of the switchboard.

(1) Main circuit breaker

(a) Power circuit breaker: ANSI/IEEE C37.13. Electrically operated stored energy drawout low-voltage power circuit breaker with an interrupting rating as indicated at 480 volts. Breaker frame size shall be 4000 amperes. Sensor rating shall be 4000 amperes. Equip breaker with solid-state trip device with long time, ground fault, and adjustable short time tripping characteristics so that branch breakers will normally trip first on overload and at lower fault current levels. Equip electrically operated breakers with motor-charged, stored-energy closing mechanism to permit rapid and safe closing of the breaker against fault currents within the short time rating of the breaker, independent of the operator's strength or effort in closing the handle. Circuit breaker shall meet the specified interrupting rating without the use of fuses.

1 Contacts: Silver-plated, multifinger, positive pressure, self-aligning type for auxiliary, control, and main drawout contacts.

2 Each drawout breaker shall be provided with four-position operation. Each position shall be clearly identified by an indicator on the circuit breaker front panel.

a Connected position: Primary and secondary contacts are fully engaged. Breaker must be tripped before racking into or out of position.

b Test position: Primary contacts are disconnected but secondary contacts remain fully engaged. Position shall allow complete test and operation of the breaker without energizing the primary circuit.

c Disconnected position: Primary and secondary contacts are disconnected.

d Withdrawn position: Places breaker completely out of compartment, ready for removal.

c. Meter and Monitor: Microprocessor-based device providing complete metering, system voltage protection, plus waveform and harmonics data, and events logs. Ammeter readings will be true RMS.

d. Instrument transformers: ANSI/IEEE C57.13, as applicable.

(1) Current transformers: Transformers shall be single ratio, 60 hertz, 4000- to 5-ampere ratio.

(2) Potential transformers: Transformers shall be 60 hertz with voltage rating and ratio coordinated to the rating of the associated switchboard meters and instruments. Potential transformers shall be with two fuses in the primary. Fuses shall be sized as recommended by the potential transformer manufacturer.

e. Distribution section: Provide individually mounted devices arranged to allow removal and interchanging from the front of the switchboard without disturbing adjacent devices. Where indicated, "space for future" or "space" shall mean to include bus, device supports, and connections. Each individually mounted device shall be isolated in its own compartment, and shall be positioned vertically with operating handles extending through hinged front cover. Each device shall be individually fed by connectors from the main bus of the switchboard. The load side of each device shall be bused to cable lugs located at the rear of the switchboard.

(1) Feeder breakers: Molded-case type of sizes and capacity indicated. Breakers shall have a minimum short-circuit-current rating equal to the short-circuit-current rating of the switchboard in which the breaker will be mounted. Series rated breakers are unacceptable. Provide ground fault protection of the zero sequence for the feeder breakers indicated. Coordinate feeder breakers' ground fault protection with main breaker ground fault sensor for selective operation. Provide monitoring panels for testing of ground fault protection system.

(2) Handles for individually mounted devices shall be of the same design and method of external operation. Label handles prominently to indicate device ampere rating, color coded for device type. Identify ON-OFF indication by handle position and by prominent marking.

f. Finish: Light gray No. 61 or No. 49 in accordance with ASTM D 1535 for exterior surfaces of switchboard assembly.

g. Ground fault protection of equipment for switchboards.

Provide ground fault protection in accordance with UL 1053 consisting

of current transformers, fault protection relays with time delay suitable for protecting circuit components against phase to ground faults, and a system monitor panel. The relay shall be time delay type and have continuously adjustable current pickup settings of 100 to 1200 to amperes and continuously adjustable time delay setting from 0.1 to one second. It shall provide two independent output contacts each rated 5 amperes continuous and 30 amperes inrush at 120/208 volts ac. The relay shall include a memory function to recognize and initiate tripping on intermittent ground faults. The monitor panel shall indicate relay operation and provide means for testing the system with or without interruption of service and shall not permit the ground fault system to be inadvertently left in an inactive or OFF state. Provide 120 volts ac power to monitor panel.

2.2.1 Insulated Barriers

Where insulated barriers are required by reference standards, provide barriers in accordance with NEMA LI 1, Type GPO-3, 6.35-mm (0.25-inch) minimum thickness.

2.2.2 Corrosion Protection

Bases, frames, and channels of substations, switchgear, and switchboards which come in contact with concrete shall be corrosion resistant and shall be fabricated of hot-dip galvanized steel or stainless steel.

2.2.2.1 Galvanized Steel

ASTM A 123, ASTM A 525M, (ASTM A 525) G90 coating, and ASTM A 153, as applicable. Galvanize after fabrication where practicable. Galvanizing repair paint shall conform to MIL-P-21035.

2.2.2.2 Stainless Steel

ASTM A 167, Type 302 or 304.

2.2.3 Terminal Boards

Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal boards associated with current transformers shall be short-circuiting type. Terminate conductors for current transformers with ring-tongue lugs. Terminal board identification shall be identical in similar units. External wiring shall be color coded consistently for similar terminal boards.

2.2.4 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white, plastic tubing, heat stamped with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number, shall be elliptically shaped to securely grip the wire, and shall be keyed in such a manner to ensure alignment with adjacent sleeves.

Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.3 NAMEPLATES

Provide as specified in Section 16011, "Electrical General Requirements."

2.4 WARNING SIGNS

Provide as specified in Section 16011, "Electrical General Requirements."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to ANSI C2, NFPA 70, and to the requirements specified herein.

3.2 GROUNDING

NFPA 70 and ANSI C2, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding 5 ohms.

3.2.1 Switchboard Grounding

Provide bare copper cable not smaller than 750 mm to the existing ground rods.

3.2.2 Grounding and Bonding Equipment

UL 467, except as indicated or specified otherwise.

3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

Install and connect switchboards furnished under this section as indicated on project drawings, the approved shop drawings, and as specified herein.

3.3.1 Switchboard

NEMA PB 2.1.

3.3.2 Meters and Instrument Transformers

ANSI C12.1.

3.3.3 Galvanizing Repair

ASTM A 780, using galvanizing repair paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces that repair paint has been applied to.

3.4 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.4.1 Interior Location

Mount switchboard on concrete slab. Unless otherwise indicated, the slab shall be at least 100 mm (4 inches) thick. The top of the concrete slab shall be approximately 100 mm (4 inches) above finished floor. Edges above floor shall have 15-mm (1/2-inch) chamfer. The slab shall be of adequate size to project at least 200 mm (8 inches) beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant calking or sealant. Cut off and bush conduits 75 mm (3 inches) above slab surface.

3.5 FIELD QUALITY CONTROL

3.5.1 Performance of Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Perform visual and mechanical inspections and electrical tests specific to switchboards, low-voltage power circuit breakers, ground fault systems, instrument transformers, and grounding system in accordance with NETA ATS. Perform tests to obtain information about the performance of the breakers, meters, wiring, and instrument together as a unit, as well as separately. Remove wedges, ties, and blocks installed by the manufacturer to prevent damage during shipment. Perform changes of connection, insertion, and removal of instruments and meters so that the secondary circuits of energized current transformers are not opened momentarily.

3.5.2 Field Dielectric Tests

Perform test on low-voltage switchgear in accordance with ANSI/IEEE C37.20.1.

3.5.3 Follow-Up Verification

Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. Circuit breakers shall be tripped by operation of each protective device. Test shall require each item to perform its function not less than three times. As an exception to requirements stated elsewhere in the contract, the Officer-in-Charge shall be given 5 working days' advance notice of the dates and times for checks, settings, and tests.

PART 4 MEASUREMENT AND PAYMENT

Low voltage switchboard work shall be measured for payment on a lump sum basis. Payment shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals for providing a low voltage switchboard in full working condition, complete in placed and tested, as specified herein.

-- End of Section --

SECTION 16402

INTERIOR WIRING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1991) Electrical Metallic Tubing - Zinc Coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1990) Hard-Drawing Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM E 814	(1994) Fire Tests of Through-Penetration Fire Stops

FEDERAL SPECIFICATIONS (FS)

FS W-P-115	(Rev. C) Panel, Power Distribution
FS W-C-375	(Rev. B) Circuit Breakers, Molded Case, Branch Circuit and Service
FS L-P-387	(Rev. A; Int Am. 2) Plastic Sheet, Laminated, Thermosetting (for Design Plates)
FS W-S-896	(Rev. E) Switches, Toggle (Toggle and Lock), Flush Mounted

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NEMA ICS 4	(1993) Terminal Blocks for Industrial Use
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA KS 1	(1990) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(1993) Motors and Generators
NEMA MG 10	(1983; R 1988) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA MG 11	(1977; R 1992) Energy Management Guide of Selection and Use of Single-Phase Motors
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA TC 3	(1990) PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 13	(1993) Electrical Nonmetallic Tubing
NEMA TC 14	(1984; R 1986) Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
NEMA VE 1	(1991) Metallic Cable Tray Systems
NEMA WD 1	(1983; R 1989) Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1	(1993; R 1993) Flexible Metal Conduit
UL 4	(1986; R 1990, Bul. 1992 and 1993) Armored Cable
UL 5	(1985; R 1990, Bul. 1990) Surface Metal Raceways and Fittings
UL 5A	(1994) Nonmetallic Surface Raceways and Fittings

UL 6	(1993; Bul. 1993) Rigid Metal Conduit
UL 44	(1991; Bul. 1992, 1993, and 1994, R 1994) Rubber-Insulated Wires and Cables
UL 50	(1992; R 1994) Safety Enclosures for Electrical Equipment
UL 67	(1988; R 1993, Bul. 1993) Panelboards
UL 83	(1991; Bul. 1991, 1992, and 1993, R 1993) Thermoplastic-Insulated Wires and Cables
UL 198C	(1986; Bul. 1991, 1992, and 1993, R 1993) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	(1988; R 1988, Bul. 1991, 1992, and 1993) Class R Fuses
UL 198H	(1988; Bul. 1992, 1993, and 1994, R 1993) Class T Fuses
UL 360	(1986; Bul. 1991, R 1993) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Bul. 1994) Grounding and Bonding Equipment
UL 486A	(1991; Errata 1991 and 1992, R 1992, Bul. 1993 and 1994) Wire Connectors and Soldering Lugs for Use With Copper Conductors
UL 486B	(1991; Errata 1992, R 1992, Bul. 1994) Wire Connectors for Use with Aluminum Conductors
UL 486C	(1991; R 1992, Bul. 1994) Splicing Wire Connectors
UL 489	(1991; Bul. 1992, 1993, and 1994, R 1994) Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
UL 498	(1991; R 1993, Bul. 1993 and 1994) Attachment Plugs and Receptacles
UL 506	(1989; R 1993) Specialty Transformers
UL 508	(1993; Bul. 1993 and 1994) Industrial Control Equipment
UL 510	(1986; R 1994) Chloride, Polyethylene, and Rubber Insulating Tape

UL 514A	(1991; R 1993, Bul. 1993 and 1994) Metallic Outlet Boxes
UL 514B	(1989; Errata 1991, R 1993, Bul. 1993 and 1994) Fittings for Conduit and Outlet Boxes
UL 651	(1989; R 1989, Bul. 1993) Schedule 40 and 80 Rigid PVC Conduit
UL 719	(1985; Bul. 1992, 1993, and 1994, R 1993) Nonmetallic-Sheathed Cable
UL 797	(1993; R 1993) Electrical Metallic Tubing
UL 845	(1988; R 1993, Bul. 1994) Motor Control Centers
UL 854	(1991; Bul. 1992, 1993, and 1994, R 1993) Service-Entrance Cables
UL 869	(1989; R 1991, Bul. 1992 and 1993) Service Equipment
UL 870	(1991) Wireways, Auxiliary Gutters, and Associated Fittings
UL 886	(1994; R 1994, Bul. 1994) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	(1993; R 1993, Bul. 1994) Ground-Fault Circuit Interrupters
UL 984	(1991; Bul. 1993) Hermetic Refrigerant Motor-Compressors
UL 1010	(1991; R 1991, Bul. 1993 and 1994) Receptacle-Plug Combination for Use in Hazardous (Classified) Locations
UL 1242	(1983; R 1993, Bul. 1993) Intermediate Metal Conduit
UL 1569	(1983; Bul. 1991, 1992, 1993, and 1994, R 1993) Metal-Clad Cables
UL 1660	(1987; Bul. 1991) Liquidtight Flexible Nonmetallic Conduit

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.3.1 SD-02, Manufacturer's Catalog Data

a. Receptacles; G

b. Circuit breakers; G

c. Switches; G

d. Conduit and fittings (each type)

e. Surface raceway

f. Ground rods

g. Device plates

h. Wires and cables

i. Outlet boxes and covers

j. Junction boxes

k. Splices and termination components

l. Enclosed circuit breakers; G

m. Motor controllers; G

1.3.2 SD-04, Drawings

a. Cable trays; G

b. Motor control centers; G

c. Wireways; G

1.3.3 SD-08, Statements

a. Fuses; G

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.3.4 SD-12, Field Test Reports

a. 600-volt wiring test; G

b. Grounding system test; G

c. GFCI receptacle test; G

1.3.5 SD-19, Operation and Maintenance Manuals

a. Electrical Systems, Data Package 5

1.3.5.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Officer-in-Charge.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall be rigid steel zinc-coated conduit, rigid nonmetallic conduit, intermediate metal conduit (IMC), electrical metallic tubing (EMT), and flexible metal conduit:

2.2.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, in accordance with NEMA TC 2, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.5 Flexible Metal Conduit

UL 1.

2.2.6 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.6.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.6.2 Fittings for EMT

Steel compression type.

2.2.7 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3.

2.3 CABLE TRAYS

NEMA VE 1. Cable trays shall form a wireway system, and shall be of nominal 4-inch depth. Cable trays shall be constructed of steel that has been zinc-coated after fabrication. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius.

2.3.1 Ladder-Type Cable Trays

Sized as indicated with maximum rung spacing of 12 inches.

2.4 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 1640 mL (100 cubic inches), UL 50, hot-dip, zinc-coated, if sheet steel.

2.6 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.6.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.6.1.1 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.6.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, 3-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, 3-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

2.6.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN conforming to UL 83 or Type XHHW conforming to UL 44, except that grounding wire may be Type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where indicated or for lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.6.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6.5 Cable Tray Cable

UL listed, type TC.

2.7 *SPLICES AND TERMINATION COMPONENTS*

UL 486A and UL 486B, as applicable, for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C twist-on splicing connector. Provide solderless terminal lugs on stranded conductors.

2.8 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be phenolic, minimum 0.792-mm (0.03-inch) wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Plates on finished walls shall be satin finish stainless steel or brushed-finish aluminum, minimum 0.792-mm (0.03-inch) thick. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations." Test device plates for compliance with UL 514A and UL 514C for physical strength. Attach device plates with spanner head bolts.

2.9 SWITCHES

2.9.1 Toggle Switches

FS W-S-896, totally enclosed with bodies of thermosetting plastic and mounting strap. Handles shall be brown. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.9.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. se. Switches serving as motor-disconnect means shall be horsepower rated. Enclosure shall be per NEMA ICS 6.

2.10 RECEPTACLES

UL 498 and NEMA WD 1, heavy-duty, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of brown thermosetting plastic supported on a metal mounting strap. Wiring

terminals shall be screw-type, side-wired. Connect grounding pole to mounting strap.

2.10.1 Duplex Receptacles

Duplex receptacles shall be 15 amperes, 125 volts, No. 5242.

2.10.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations."

2.10.3 Ground-Fault Circuit Interrupter (GFCI) Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and

2.11 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated. Provide solid neutral.

2.12 FUSES

2.12.1 Cartridge Fuses, Current Limiting Type (Classes J, L, and CC)

UL 198C, Class J for zero to 600 amps, Class L for 601 to 6,000 amps, and Class CC for zero to 30 amps.

2.12.2 Cartridge Fuses, Current Limiting Type (Class T)

UL 198H, Class T for zero to 1,200 amps, 300 volts; and zero to 800 amps, 600 volts.

2.13 MOTORS

NEMA MG 1. Hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of kW (HP), or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Provide motors in hazardous locations with classifications as indicated.

2.13.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

2.13.2 High Efficiency Polyphase Motors

Polyphase motors shall be selected based o high efficiency characteristics relative to the application as listed in NEMA MG 10. Additionally polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

2.13.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.14 MOTOR CONTROLLERS

UL 508, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. Selector switch shall have means for locking in any position. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor widenings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.14.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers shall conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits, shall have primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side. Provide fuses in each ungrounded primary feeder. One secondary lead shall be fused; other shall be grounded.

Control circuits shall have maximum voltage of 120 volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. One secondary lead shall be fused; other shall be grounded. For designated systems, as indicated, provide backup power supply, including connection to emergency power source. Provide for automatic switchover and alarm upon failure of primary control circuit.

2.14.2 Enclosures for Starters and Controllers

NEMA ICS 6.

2.14.3 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and none normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.14.4 Pilot and Indicating Lights

Provide transformer, resistor, or diode type.

2.14.5 Terminal Blocks

NEMA ICS 4.

2.15 MOTOR CONTROL CENTERS

UL 845, NEMA ICS 2. Wiring shall be Class I, Type B, in NEMA Type 1 enclosure. Provide control centers suitable for operation on 480-volt, 3-phase, 3-wire, 60 Hz system and shall have minimum short-circuit withstand and interrupting rating of 42,000 amperes rms symmetrical. Incoming power feeder shall be cable entering at the top of enclosure and terminating on main protective device. Main protective device shall be molded case circuit breaker rated at 65,000 amperes rms symmetrical interrupting capacity. Arrange busing so that control center can be expanded from both ends. Interconnecting wires shall be copper. Terminal blocks shall be plug-in-type so that controllers may be removed without disconnecting individual control wiring.

2.15.1 Bus Systems

Provide the following bus systems. Power bus shall be braced to withstand fault current of 42,000 amperes rms symmetrical. Wiring troughs shall be

isolated from horizontal and vertical bus bars.

2.15.1.1 Horizontal and Main Buses

Horizontal bus shall have continuous current rating of minimum 400 amperes. Main bus shall be copper, tin-plated enclosed in isolated compartment at top of each vertical section. Main bus shall be isolated from wire troughs, starters, and other areas.

2.15.1.2 Vertical Bus

Vertical bus shall have continuous current rating of 300 amperes, and shall be copper, tin-plated. Vertical bus shall be enclosed in flame-retardant, polyester glass "sandwich."

2.15.1.3 Ground Bus

Copper ground bus shall be provided full width of motor control center and shall be equipped with necessary lugs.

2.15.2 Motor Disconnecting Devices and Controllers

Shall comply with paragraph entitled "Combination Motor Controllers."

2.15.3 Combination Motor Controllers

UL 508 and other requirements in paragraph entitled, "Motor Controllers." Controller shall employ molded case circuit breaker for branch circuit protection. Minimum short circuit withstand rating of combination motor controller shall be 42,000 rms symmetrical amperes. Circuit breakers for combination controllers shall be thermal magnetic.

2.16 NAMEPLATES

FS L-P-387. Provide as specified in Section 16011, "Electrical General Requirements."

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in feeder and branch

circuits, including lighting circuits. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green equipment grounding conductor for circuit installed in conduit or raceways. Minimum conduit size shall be 16 mm (1/2 inch) in diameter for low voltage lighting and power circuits.

3.1.2.1 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 75 mm (3 inches) of concrete and shall be installed minimum 24 inches below slab or grade.

3.1.2.2 Conduit in Floor Slabs

Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40.

3.1.3 Conduit Installation

Conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 150 mm (6 inches) away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.3.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.3.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.

3.1.3.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 40 mm (1 1/2 inches) in reinforced concrete beams or to depth of more than 20 mm (3/4 inch) in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems must be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation

shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 3050-mm (10-foot) maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.3.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. *Do not* install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.3.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 890-N (200-pound) tensil strength. Leave minimum 915 mm (36 inches) of slack at each end of pull wire.

3.1.3.6 Conduit Installed in Concrete Floor Slabs

Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, exept at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum 25-mm (one-inch) cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than 27-mm (one-inch) trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway must be converted to rigid steel or steel IMC before rising above floor, unless specifically indicated.

3.1.3.7 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.3.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in

rigid steel conduit, except that flexible metal conduit may be used 150 mm (6 inches) above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.3.9 Flexible Connections

Provide flexible steel conduit between 915 and 1830 mm (3 and 6 feet) in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 16 mm (1/2 inch) diameter.

3.1.4 Cable Tray Installation

Install and ground per NFPA 70, Article 318. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support in accordance with manufacturer recommendations. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. For grounding of cable tray system provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations. Boxes in other locations shall be sheet steel, nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 100 mm (4 inches) square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separated boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 610 mm (24 inches) from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 40 mm (1 1/2 inches) deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 100 mm (4 inches) square, except that 100- by 50-mm (4- by 2-inch) boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 100 mm (4 inches) square by 40 mm (1 1/2 inches) deep.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, circuit breakers, and disconnecting switches so height of operating handle at its highest position is maximum 1980 mm (78 inches) above floor. Mount lighting switches 1220 mm (48 inches) above finished floor, receptacles 460 mm (18 inches) above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1.58 mm (1/16 inch). Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, and ceilings utilizing proper firestopping

materials to maintain fire resistive integrity.

3.1.11 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. [Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make ground connection to existing driven ground rods on exterior of building. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.11.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 25 ohms under dry conditions.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.13 Repair of Existing Work

Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

3.1.13.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.13.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.13.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, fittings, etc., back to equipment's power source.

3.1.13.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Officer-in-Charge 5 working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test 600-volt wiring and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 GFCI Receptacle Test

Test GFCI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground does not exceed 25 ohms. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Officer-in-Charge, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

PART 4 MEASUREMENT AND PAYMENT

Interior wiring work shall be measured for payment on a lump sum basis. Payment shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals for providing a interior wiring in full working condition, complete in placed and tested, as specified herein.

-- End of Section --

SECTION 16431

SHORT CIRCUIT AND COORDINATION REPORT, AND RELAY SETTINGS

PART 1 GENERAL

1.1 DESCRIPTION

This section specifies that the Contractor prepare a short circuit and coordination study for the electrical power system. The short circuit and coordination study report will provide an evaluation of the electrical power system and the model numbers and settings of the protective devices. Additionally, the Contractor shall provide relay settings for the 2000 KW generator protective relays.

1.2 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 141	(1993) Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242	(1986) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

1.3 SCHEDULE

The report shall be completed before the low voltage switchboard is shipped to the jobsite, so adjustments or changes to the switchboard can be made at the factory.

1.4 SUBMITTALS

The report shall be provided to the Engineer in accordance with Section 01300, "Submittals."

PART 2 PRODUCTS

2.1 REPORT

The product shall be a certified report summarizing the short circuit and coordination study and conclusions or recommendations which may affect the integrity of the electric power distribution system. As a minimum, the report shall include the following:

a. The equipment manufacturer's information used to prepare the study.

b. Assumptions made during the study.

c. Short circuit calculations listing short circuit levels at each bus.

d. Coordination study time-current curves and settings for each new protective device, including ground fault settings for both utility and 2000 KW as the source.

e. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment protecting that bus.

f. Recommendations for resetting existing circuit protective devices to property coordinate with new.

g. Recommended new setting for protective devices with HECO upgrades primary service to 25 KV.

PART 3 EXECUTION

3.1 GENERAL

Provide a short circuit and coordination study on the electrical power distribution system as specified. The studies shall be performed in accordance with IEEE 141 and IEEE 242. The studies shall be performed using actual equipment data for both existing and new equipment. The Contractor shall be responsible to obtain requisite data from Hawaiian Electric Company, 2000 KW generator manufacturer, and existing VFD supplier.

3.2 QUALIFICATIONS

The short circuit and coordination report shall be performed by the manufacturer of the switchboard or their designated technical representatives. The studies shall be signed by the professional electrical engineer responsible for the studies.

3.3 SHORT CIRCUIT STUDY

As a minimum, the short circuit study shall include the following:

a. One-Line Diagram:

1. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.

2. Type designation, current rating, range or adjustment manufacturer's style and catalog number for all protective devices.

3. Power, voltage ratings, impedance, primary and secondary connections of all transformers.

4. Nameplate ratings of all motors and generators with their subtransient reactances. Transient reactances of synchronous generators and synchronous reactances of all generators.

5. Sources of short circuit currents such as utility ties, generators, and induction motors.

6. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.

7. Emergency as well as normal switching conditions.

8. The time-current setting of existing adjustable relays and direct-acting trips, if applicable.

b. Impedance Diagram:

1. Available MVA or impedance from the utility company, existing and future primary service change to 24 KV.

2. Local generated capacity impedance.

3. Bus impedance.

4. Transformer impedances.

5. Cable impedances.

6. Equipment impedances.

7. System voltages.

8. Grounding scheme (resistance grounding, solid grounding or no grounding).

c. Calculations:

1. Determine the paths and situations where short circuit currents are the greatest. Assume bolted faults and calculate the 3 phase and line-to-ground short circuits of each case.

2. Calculate the maximum and minimum ground-fault currents.

3. Calculate settings for all 2000 KW generator protective relays, loss of excitation, etc.

3.4 COORDINATION STUDY

As a minimum, the Coordination study for the power distribution system shall include the following on 5 cycle log-log graph paper:

a. Time-current curve for each protective device showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified, and the settings shall be specified.

b. Time-current curves for each device shall be positioned to provide for maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the Engineer

shall be notified as to the cause.

c. Time-current curves and points for cable and equipment damage.

d. Circuit interrupting device operating and interrupting times.

e. Indicate maximum fault values on the graph.

f. Sketch of bus and breaker arrangement.

g. Transformer curves showing mechanical and electrical damage limits.

PART 4 MEASUREMENT AND PAYMENT

Short circuit and coordination report, and relay settings shall be measured and paid for on a lump sum basis. Payment shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals for completing the report, setting relays, and testing.

-- End of Section --

SECTION 16510

INTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C82.1	(1985; Supp. 1990 and 1991) Ballasts for Fluorescent Lamps
ANSI C82.2	(1984; R 1989) Fluorescent Lamp Ballasts - Methods of Measurements
ANSI C82.11	(1993) High-Frequency Fluorescent Lamp Ballasts

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	(1993) Lighting Handbook, Reference and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1993) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES INC. (UL)

UL 20	(1986; Errata 1988, R 1993, Bul. 1993) General-Use Snap Switches
UL 935	(1993; Bul. 1993, R 1994) Fluorescent-Lamp Ballasts
UL 1570	(188; Bul. 1991, 1993, and 1994, R 1994) Fluorescent Lighting Fixtures

1.2 RELATED REQUIREMENTS

Section 16011, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Wiring Systems." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Total harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals." Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

1.4.1 SD-02, Manufacturer's Catalog Data

a. Fluorescent lighting fixtures; G

b. Fluorescent electronic ballasts; G

c. Fluorescent lamps; G

1.4.2 SD-08, Statements

a. Qualification of manufacturer; G

Certify that the manufacturer of fluorescent electronic ballasts meets requirements specified under paragraph entitled "Qualification of Manufacturer."

1.4.3 SD-12, Field Test Reports

a. Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, ANSI C82.11, and NFPA

70 unless specified otherwise. Ballast shall be designed for operation of the lamps in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum). Lamp current crest factor shall be 1.7 (maximum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast shall operate in an instant start mode.

f. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.1.1.1 T-8 Lamp Ballast

a. Ballast shall be capable of starting and maintaining operation at a minimum of 10 degrees C (50 degrees F) for F32T8 lamps, unless otherwise indicated.

b. Total harmonic distortion (THD): Shall be less than 10 percent.

c. Input wattage:

(1) 62 watts (maximum) when operating two F32T8 lamps

2.1.2 Fluorescent Lamps

a. T-8 rapid start lamps shall be rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

PART 3 EXECUTION

3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures may be supported from suspended ceiling support system ceiling tees when the ceiling system support wires are provided at a minimum of four wires per fixture and located not more than 150 mm (6 inches) from each corner of

each fixture. For recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture. For round fixtures or fixtures smaller in size than the ceiling grid, provide a minimum of four wires per fixture and locate at each corner of the ceiling grid in which the fixture is located. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently or with at least two 19-mm (3/4-inch) metal channels spanning, and secured to, the ceiling tees. Provide wires for lighting fixture support in this section.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

PART 4 MEASUREMENT AND PAYMENT

Interior lighting work shall be measured for payment on a lump sum basis. Payment shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals for providing a interior lighting in full working condition, complete in placed and tested, as specified herein.

-- End of Section --