AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE	OF	PAGES
	1		3

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
0002	3 AUG 2000		

6. ISSUED BY CODE

US ARMY ENGINEER DISTRICT, FORT WORTH
ATTN: CESWF-CT (RM 2A19)
PO BOX 17300
FORT WORTH, TX 76102-0300

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

CODE FACILITY CODE

(X)

☒ 9A. AMENDMENT OF SOLICIATION NO. DACA63-00-B-0023

9B. DATED *(SEE ITEM 11)* 14 JULY 2000

☐ 10A. MODIFICATION OF CONTRACT/ORDER NO.

10B. DATED *(SEE ITEM 11)*

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☒ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☒ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods:

(a)By completing items 8 and 15, and returning 1 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment your desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (*Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

The Solicitation for AMMO HOT-LOAD AREA, PROJECT NO. 44921, FORT BLISS, TEXAS, is amended as follows:

See Continuation Sheet.

NOTE: The Bid Opening date and time remain "15 August 2000, at 2 p.m., local time," as previously announced.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

Item 14. Continued.

CHANGES TO THE SPECIFICATIONS

1. New Sections - Add the following accompanying new sections, each bearing the notation "ACCOMPANYING AMENDMENT NO. 0002 TO SOLICITATION NO. DACA63-00-B-0023:"

SECTION 05300 STEEL DECKING
SECTION 13202 FUEL STORAGE SYSTEMS
SECTION 13280 ASBESTOS ABATEMENT

2. Replacement Sections - Replace the following sections with the accompanying new sections of the same number and title, bearing the notation "ACCOMPANYING AMENDMENT NO. 0002 TO SOLICITATION NO. DACA63-00-B-0023:"

SECTION 01000 CONSTRUCTION SCHEDULE
SECTION 01420 BASIC STORMWATER POLLUTION PREVENTION PLAN
SECTION 03307 CONCRETE FOR MINOR STRUCTURES
SECTION 11211 PUMPS: WATER, CENTRIFUGAL
SECTION 16264 DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS
SECTION 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
SECTION 16403 MOTOR CONTROL CENTERS, SWITCHBOARDS AND PANELBOARDS
SECTION 16410 AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH
SECTION 16526 AIRFIELD LIGHTING AND VISUAL NAVIGATION AIDS
SECTION 16528 EXTERIOR LIGHTING INCLUDING SECURITY APPLICATIONS

CHANGES TO THE DRAWINGS

3. New Drawings.- The new drawings listed below which accompanies this amendment, bearing the notation "AM #0002" shall be added to and become a part of the contract documents:

C109A_2.CAL Seq 109A C109A EROSION CONTROL PLAN 5
C109B_2.CAL Seq 109B C109B EROSION CONTROL PLAN 6
U003A_2.CAL Seq 115A U3A BOOSTER PUMP DETAILS
E044A_2.CAL Seq 177A E44A APRON LIGHTING REMOTE CONTROL
E046_2.CAL Seq 179 E46 BOOSTER PUMP ELECTRICAL
E047_2.CAL Seq 180 E47 MISC. ELECTRICAL DETAILS

4. Replacement Drawings.- Replace the drawings listed below with the attached new drawings(s) of the same number, bearing the notation "AM #0002":

G002_2.CAL Seq 00 G2 MAIN INDEX OF DRAWINGS
C010_2.CAL Seq 10 C10 LAYOUT, GRADING, JOINTING KEY MAP
C024_2.CAL Seq 24 C24 GRADING PLAN 1
C025_2.CAL Seq 25 C25 GRADING PLAN 2
C026_2.CAL Seq 26 C26 GRADING PLAN 3
C027_2.CAL Seq 27 C27 GRADING PLAN 4
C028_2.CAL Seq 28 C28 GRADING PLAN 5
C029_2.CAL Seq 29 C29 GRADING PLAN 6
C049_2.CAL Seq 49 C49 STAKING PLAN 1

C065_2.CAL	Seq 65	C65	MISCELLANEOUS DETAILS
C092_2.CAL	Seq 92	C92	PAVEMENT MARKING PLAN 4
U003_2.CAL	Seq 115	U3	WATER DETAILS I
S001_2.CAL	Seq 119	S1	GENERAL STRUCTURE NOTES
S002_2.CAL	Seq 120	S2	SENTRY STATION FOUNDATION DETAILS
S005_2.CAL	Seq 123	S5	STORAGE SHELTER FOUNDATION DETAILS
S006_2.CAL	Seq 124	S6	STORAGE SHELTER ELEVATIONS AND ROOF FRAMING DETAILS
S007_2.CAL	Seq 125	S7	STORAGE SHELTER SSSMR ROOF DETAILS
E002_2.CAL	Seq 135	E2	LEGENDS, SYMBOLS AND SIGNS
E003_2.CAL	Seq 136	E3	CONDUIT SCHEDUES
E005_2.CAL	Seq 138	E5	TAXIWAY EDGE LIGHT AREA 2
E006_2.CAL	Seq 139	E6	TAXIWAY EDGE LIGHT AREA 3
E007_2.CAL	Seq 140	E7	TAXIWAY EDGE LIGHT AREA 4
E008_2.CAL	Seq 141	E8	TAXIWAY EDGE LIGHT AREA 5
E009_2.CAL	Seq 142	E9	TAXIWAY EDGE LIGHT AREA 6
E010_2.CAL	Seq 143	E10	TAXIWAY EDGE LIGHT AREA 7
E011_2.CAL	Seq 144	E11	TAXIWAY EDGE LIGHT AREA 8
E012_2.CAL	Seq 145	E12	VAULT EQUIPMENT LOCATIONS
E013_2.CAL	Seq 146	E13	VAULT RISER DIAGRAM
E014_2.CAL	Seq 147	E14	EXTERIOR DETAILS
E015_2.CAL	Seq 148	E15	EDGE LIGHT DETAILS
E016_2.CAL	Seq 149	E16	PALLET STORAGE CCTV AND TELEPHONE
E017_2.CAL	Seq 150	E17	CCTV MOUNTING DETAILS
E019_2.CAL	Seq 152	E19	CCTV AND COMMUNICATIONS ROUTING NO. 1
E020_2.CAL	Seq 153	E20	CCTV AND COMMUNICATIONS ROUTING NO. 2
E021_2.CAL	Seq 154	E21	CCTV AND COMMUNICATIONS ROUTING NO. 3
E022_2.CAL	Seq 155	E22	CCTV AND COMMUNICATIONS ROUTING NO. 4
E023_2.CAL	Seq 156	E23	CCTV AND COMMUNICATIONS ROUTING NO. 5
E024_2.CAL	Seq 157	E24	CCTV AND COMMUNICATIONS ROUTING NO. 6
E025_2.CAL	Seq 158	E25	CCTV AND COMMUNICATIONS ROUTING NO. 7
E026_2.CAL	Seq 159	E26	CCTV AND COMMUNICATIONS ROUTING NO. 8
E027_2.CAL	Seq 160	E27	CCTV AND COMMUNICATIONS ROUTING NO. 9
E028_2.CAL	Seq 161	E28	CCTV AND COMMUNICATIONS ROUTING NO. 10
E029_2.CAL	Seq 162	E29	CCTV AND COMMUNICATIONS ROUTING NO. 11
E030_2.CAL	Seq 163	E30	CCTV AND COMMUNICATIONS ROUTING NO. 12
E031_2.CAL	Seq 164	E31	CCTV AND COMMUNICATIONS ROUTING NO. 13
E032_2.CAL	Seq 165	E32	CCTV AND COMMUNICATIONS ROUTING NO. 14
E033_2.CAL	Seq 166	E33	DEPLOYMENT FACILITY OPERATIONS BUILDING
E034_2.CAL	Seq 167	E34	ELECTRICAL ONE-LINE DIAGRAM
E035_2.CAL	Seq 168	E35	POWER DISTRIBUTION DETAILS
E036_2.CAL	Seq 169	E36	EXISTING UTILITY SERVICE POLE MODIFICATIONS
E037_2.CAL	Seq 170	E37	LIGHTING CONTROL SCHEMATICS
E038_2.CAL	Seq 171	E38	PANEL BOARD SCHEDULES
E039_2.CAL	Seq 172	E39	PALLET STORAGE SHELTER ELECTRICAL DETAILS
E040_2.CAL	Seq 173	E40	SENTRY STATION ELECTRICAL DETAILS
E041_2.CAL	Seq 174	E41	APRON LGIHTING SITE AND CONDUIT ROUTING
E042_2.CAL	Seq 175	E42	APRON LIGHTING
E043_2.CAL	Seq 176	E43	APRON LIGHTING SCHEUDLES AND AIMING PLAN
E045_2.CAL	Seq 178	E45	SENTRY STATION SITE PLAN

END OF AMENDMENT

SECTION 01000

CONSTRUCTION SCHEDULE
01/2000

PART 1 GENERAL

1.1 SCHEDULE

Commence, prosecute, and complete the work under this contract in accordance with the following schedule and Section 00700 CONTRACT CLAUSES COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK and LIQUIDATED DAMAGES:

Item of Work	Commencement of Work (calendar days)	Completion of Work (calendar days)	Liquidated Damages per calendar day
(1) All work except item (2) (See sequence of construction on drawings)	Within 10 days after receipt of Notice to Proceed	360	$ 1630.00
(2) Phase 2 (see drawings)	---	30 days after start of item (2) and no later than the comple-tion of item (1)	$ 1630.00
(3) Establishment of Turf	*	*	---

Liquidated damages are not accummulative.

*Establishment of Turf

Planting and maintenance for turfing shall be in accordance with Section 02933 ESTABLISHMENT OF TURF . No payment will be made for establishment of turf until all requirements of the section are adequately performed and accepted, as determined by the Contracting Officer.

1.1.1 Testing of Heating and Air-Conditioning Systems

The times stated for completion of this project includes all required testing specified in appropriate specification sections of heating, air conditioning and ventilation systems including HVAC Commissioning. Exception: boiler combustion efficiency test, boiler full load tests, cooling tower performance tests, and refrigeration equipment full load tests, when specified in the applicable specifications, shall be preformed in the appropriate heating/cooling season as determined by the Contracting

Officer.

1.2 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (OCT 1989) (ER 415-1-15)(52.0001-4038 1/96)

a. This provision specifies the procedure for determination of time extensions for unusually severe weather in accordance with the contract clause entitled "Default: (Fixed Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

(1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

b. The following schedule of monthly anticipated adverse weather delays due to precipitation and temperature is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities. Wind is not considered in the Monthly Anticipated Adverse Weather Calendar Day Schedule.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1	1	1	2	1	3	3	2	1	1	2

c. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph "b", above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled "Default (Fixed Price Construction)."

1.3 CONSTRUCTION PHASING

1.3.1 Phasing Requirements

The work is to be phased as noted on the Contract Drawings.

1.4 WORK RESTRICTIONS

1.4.1 Joint Occupancy:

Airfield operations will continue during construction unless otherwise indicated on the Contract Drawings.

1.4.2 Working Hours

Working hours are shown on the Contract Drawings. " Any revisions to these normal hours during certain seasons to facilitate concrete paving operations must be requested in writing at least 14 days in advance to the contracting officer's Representative."

1.4.3 Access

Access to the runway area will be restricted. The Contractor shall keep personnel and equipment outside of the limits of the glide path unless prior approval is received from the Contract Officer's Representative.

1.4.4 Other

All equipment shall stay outside of the runway glide path.

1.5 UTILITIES

1.5.1 Payment for Utility Services (FAR 36.303(C)(6))

Water, gas, and electricity are not available from Government-owned and operated systems.

1.5.2 Outages

The Contractor shall coordinate all requests for utility outages with the Contracting Officer in writing 21 days prior to date of requested outage:

a. Water, gas, steam, and sewer outages shall be held to a maximum duration of 4 hours unless otherwise approved in writing.

b. Electrical outages shall have a maximum duration of 4 hours.

1.6 STREET CLOSINGS

The Contractor shall coordinate all requests for street closings with the Contracting Officer in writing 10 days prior to date of requested outage:

a. One lane traffic shall be maintained at all times (except that a total closing may be allowed for specific 8-hour periods).

b. The final street repair shall be completed within 14 days after the start of any street crossing. Any part of the street returned to service prior to final repair shall be maintained smooth with hot-mix cold-lay surface course.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

SECTION 01420

BASIC STORMWATER POLLUTION PREVENTION PLAN
07/1998
AMENDMENT 0002

PART 1 GENERAL

1.1 SUMMARY

This Section provides a basic Stormwater Pollution Prevention Plan (SWPPP) for a National Pollutant Discharge Elimination System (NPDES) General Permit.

1.2 PROJECT IDENTIFICATION AND NOTES

PROJECT TITLE: AMMO HOT LOAD AREA

LOCATION: FORT BLISS MILITARY BASE, EL PASO, TEXAS

NOTE 1: General Permit for Storm Water Discharges from Construction Sites is authorized by the Clean Water Act and is regulated by guidance published in the Federal Register, Volume 63, Number 128, July 6, 1998.

NOTE 2: Under the National Pollutant Discharge Elimination System (NPDES), all construction sites 2.0 hectares (5.0 acres) in size or larger are required to obtain a General Permit for Storm Water Discharges from Construction Sites. Detailed guidance to Storm Water Pollution Prevention Plans (SWPPPs) and Best Management Practices (BMP) is available in the Environmental Protection Agency document EPA-832-R-92-005 titled "Storm Water Management for Construction Activities." NTIS Publication No. Pb9223591 can be purchased through NTIS.

NOTE 3: To fully comply with the regulation, the Fort Worth District (or A/E project designer) and the construction Contractor will each prepare a SWPPP, and file for a separate Notice of Intent (NOI). The construction Contractor shall file the Notice of Termination (NOT) after final site stabilization. The project designer shall use this outline to develop a basic SWPPP. This section is a guidance document for preparing a basic SWPPP. The Contractor shall use the basic SWPPP to prepare the Contractor's detailed SWPPP.

Each project location shall require a separate NPDES General Permit (and separate SWPPP). The basic SWPPP shall not limit the Contractor's ability to determine construction and stabilization methods and their phasing. It shall not include any specific contractual information such as quantities and costs unless it is necessary for Environmental Protection Agency (EPA) to comprehend the pollution prevention measures. The SWPPP shall discuss the pollution control structures, temporary and permanent stabilization methods in the narrative with detailed information provided in the technical specifications, structural control locations, types and typical details on contract drawings. The SWPPP narrative and contract drawings shall be submitted to the Government for review.

1.3 PROJECT DESCRIPTION

This project shall include constructing a new ammo hot load apron and connecting taxiway to the main runway at the Biggs Army Airfield. There shall be concrete and asphalt pavement, tie-downs, lighting, pallet storage area and a new sentry station. Other support facilities include connecting new utilities to existing lines, fire protection, grounding, fencing, and security.

The construction activities shall include establishing storm drainage controls; site demolition; clearing and grubbing; grading; concrete and asphalt pavement; excavation, trenching and backfill for utilities; fencing and landscaping. The project area of the Ammo Hot Load Apron portion of this project occupies approximately 110 hectares (272 acres). The disturbed area of the project is less than 32.3 hectares (79.8 acres).

1.4 STANDARD INDUSTRIAL CLASSIFICATION (SIC)

This project has the following SIC codes in accordance with the Standard Industrial Classification Manual published by the Office of Management and Budget (OBM).

A. 1611 Airport runway construction - general contractors

B. 1542 General Contractors - Non-Residential building, other than industrial buildings and warehouses (i.e. administrative buildings)

C. 4581 Airports, Flying Fields and Airport Terminal Services

D. 9711 National Security (a general category for military facilities).

1.5 LOCATION

The new Ammo Hot Load Area is located at the Biggs Army Airfield. The proposed Ammo Hot Load Area is located to the north of the runway across from Taxiway F. The new apron's latitude and longitude is North 31 degrees 50 minutes 55 seconds and West 106 degrees 22 minutes 49 seconds, respectively.

1.6 RECEIVING WATERS

Surface runoff flows off the pavement and into drainage ditches directing the storm water to the north and west of the aircraft ammo hot load apron. Culverts are constructed at Stations 1+078.550, 1+269.310, 1+354.79 and 1+694.876 to direct water on the east to the west side of the road, taxiway, apron and pallet storage area. The drainage ditch acts as a small detention area and ultimately discharges to the west of the site. In addition, at Station 2+020, a culvert connects the right side detention area with the left side detention area. The watershed flows into the Rio Grande River.

PART 2 SITE DESCRIPTION

2.1 EXISTING CONDITIONS

The existing site of the new apron slopes gently from east to west with coefficient "c" of 0.60. Vegetation amounts to small portions of small to medium size brush. There shall be some demolition of runway pavement and

shoulder at the connection of Taxiway K to the main runway.

There will be demolition of existing power poles and other miscellaneous junk.

2.2 FUTURE CONDITIONS

After construction completion of the Ammo Hot Load area, the site shall slope from east to west and have a coefficient "c" in a range of 0.68 to 0.90. The finished grade of the ammo hot load area is 1.0% from the crown and the flow is directed to drainage ditches on the east and west sides of the ammo hot load area. The taxiway has a 1.5% slope from the center crown and the shoulders have a 2% slope directing storm runoff into the drainage ditches. The drainage ditches direct the storm runoff to a culvert. The storm runoff is then directed to the west of the ammo hot load area and discharged.

A section of hardstand ties the apron to the Pallet Storage Area. The hardstand shall have finished grades ranging from 0.5% to 1.5% and storm runoff shall sheet flow toward the drainage ditch. The access road has a 2% slope with 4% slope on the shoulders.

The detention areas have a combined volume of 33,800 cubic meters and are connected by a 600 mm culvert at Station 2+020.

2.3 CONSTRUCTION PHASING

The project construction is anticipated to begin in November 2000 and complete in December 2001, respectively. The base Bid of this project shall include constructing a new Ammo Hot Load Area. The Contractor shall verify construction phasing requirements and sequence of construction activities.

Major Construction Activities include:

A. Establish erosion and sediment structural controls.

B. Clearing and Demolition - Removing small brush, fencing and wind cone. Some pavement and asphalt shoulder will be demolished for the tie-in to the runway.

C. Grading and Drainage - Grading for positive removal of most storm water from site via drainage ditches which sheet flows to the west.

D. Paving and construction of access road.

E. Paving and construction of Ammo Hot Load area and Taxiway K.

F. Construction of pallet storage area and Sentry Station.

G. Site stabilization per paragraphs TEMPORARY STABILIZATION and PERMANENT STABILIZATION.

2.4 SOILS DATA

The following soils information is from the Soil Survey of El Paso County, Texas,issued November 1971, by the United States Department of Agriculture, Soil Contamination Service.

This site contains one soil classification, the Hueco-Wink association. This Hueco soil type generally has 4-inch thicksurface layer of noncalcareous, alkaline soil consisting of brown, loose, heavy, loamy, fine sand. The subsoil tends to be a yellow-brown fine, sandy, loam that is approximately 600 mm deep and is comprised of a yellow-brown, friabl, calcareous alkaline fine sandy loam. A 1270 mm layer of extremely hard caliche follows.

These soils are highly susceptible to wind erosion. They do not have much organic material and are low in fertility and available moisutre capacity. Permeability occurs at a rate of 51 mm to 160 mm per hour. The shrink and swell potential is low.

2.5 DRAWINGS

Two separate sets of drawings are prepared for the Ammo Hot Load Area. The storm water pollution prevention requirements for each portion are shown as Sheet Nos. C27, C28, C106, C107, C108, C109, C110, C111 and C65. The project Location Map is civil drawing Sheet No. C1.

PART 3 EROSION AND SEDIMENT CONTROLS

3.1 TEMPORARY STABILIZATION

Temporary stabilization shall be required when construction activities cease for periods greater than 21 days; or when there are contract delays in the turfing operaton, a quick cover shall be required to prevent erosion; or when seasonal conditions preclude immediate permanent stabilization measures, the Contractor shall provide temporary soil stabilization, as soon as practicable, for all unpaved, graded, and disturbed portions of the site. Section 02940 MULCHING FOR EROSION CONTROL provides a recommnded method that consists of the following: till soil to a depth of 102 mm, spread straw or haymulch at a rate of 4.54 metric tons per hectare, and anchor the mulch into place using a mulch anchoring machine equivalent to a disk harrow with cupped disks removed and replaced with straight rolling coulters spaced not more than 203 mm apart.

3.2 PERMANENT STABILIZATION

Permanent soil stabilization shall be initiated 14 days after construction activities have ceased. All unpaved, graded, and disturbed areas within the limit of erosion and sediment control resulting from the Contractor's construction activities shall receive turfing treatment in accordance with Section 02933 ESTABLISHMENT OF TURF.

In arid areas (areas with annual rainfall of 0-254 mm or 0-10 inches) and semi-arid areas (areas with an average annual rainfall of 254-508 mm or 10-20 inches), where stabilization is precluded by seasonal arid conditions, stabilization measures shall be initiated as soon as practicable.

3.3 TEMPORARY SEDIMENT BASINS

A temporary sediment basin is not attainable since runoff from the site does not drain to a common collection point.

3.4 STRUCTURAL CONTROLS

The Contractor shall use silt fence and staked hay bales to prevent soil erosion at the construction site. Structural controls shall be established along the limit of erosion and sediment control.

PART 4 STORM WATER MANAGEMENT CONTROLS

4.1 RUNOFF COMPUTATIONS

The project site is undeveloped. The 10-year frequency storm event at the existing site conditions has intensity of 33 millimeters per hour (or 1.3 inches per hour) and runoff coefficient of 0.62. After construction, runoff coefficient at the site is estimated to range from 0.68 to 0.90.

4.2 OUTFALL VELOCITY DISSIPATION DEVICES

The outfalls from the drainage ditch at the Hot Ammo Load Pad will have rip-rap to dissipate the velocity of the storm water. Rip-rap will also be installed along the access road from Station 1+992 to 2+052 to help prevent pavement washout. There is no outfall at the new fire training facility.

PART 5 BEST MANAGEMENT PRACTICES (BMP)DURING CONSTRUCTION

The Contractor, or its subcontractors, shall be responsible to minimize pollution of storm water runoff. The Contractor shall discuss BMP in detailed SWPPP. They shall comply with the BMP to minimize stormwater pollution.

5.1 WASTE MATERIALS

Solid waste materials (trash and construction debris) shall be placed in covered and appropriate waste containers . Waste containers shall be emptied regularly; they shall not be allowed to overflow. The disposal area of excavated material from project construction shall not be utilized for waste disposal. Routine janitorial service shall be provided for all construction buildings and surrounding grounds. No construction waste materials, including concrete, shall be buried or otherwise disposed of on-site. All site personnel shall be briefed on the correct procedures for solid waste disposal. Asbestos-containing materials shall be handled and disposed of per specification section ASBESTOS ABATEMENT prior to building demolition.

5.2 HAZARDOUS WASTE

All hazardous waste shall be handled, stored, and disposed in accordance with all Federal, State, and local regulations and prior to all other construction activities. Chemical waste shall be stored in clearly labeled, corrosion-resistant containers, and stored in designated areas before removal from the site. Materials in excess of job requirements shall not be stored on-site. All site personnel shall be briefed on the correct procedures for hazardous waste disposal. All buildings to be demolished under this contract shall require removal of items containing regulated materials. These items include lead-based paint containing wood components, abated LBP debris, fluorescent light tubes, light ballasts, fire extinguishers, thermostats, transformers, utility poles, smoke detectors, lighted exit signs and emergency light batteries.

5.3 SANITARY WASTE

On-site sanitary facilities shall be established. Facility location, design, maintenance, and waste collection practices shall be in accordance with local regulations. Temporary parking area(s) to be used 30 calendar days or more for the Contractor's equipment or personal vehicles shall be paved with temporary asphalt per specification and it shall be removed by the Contractor upon project completion. The Contractor shall be required to stabilize the disturbed area in accordance with paragraph PERMANENT STABILIZATION.

5.4 OFF-SITE VEHICLE TRACKING AND DUST

The Contractor shall describe practices to keep vehicles from tracking soils from the project sonstruction, material borrow and disposal sites. The Contractor shall describe practices for dust control (i.e. sprinkling, chemical treatment, light bituminous treatment, or similar methods). The Contractor shall describe practice in hauling construction material or debris to avoid their loss during transport (i.e. open-bed vehicles shall be covered or otherwise stabilized.

5.5 FERTILIZERS

If fertilizers are required by this project, it shall be applied in the stated amounts as as specified in Section 02933 ESTABLISHMENT OF TURF, and only when weather conditions are appropriate.

5.6 CONSTRUCTION VEHICLE MAINTENANCE AND REPAIR

Specific areas shall be designated for equipment maintenance and repair to minimize potential impact on storm runoff. Locations shall be chosen to minimize potential impacts on receiving streams and waterways. These locations shall be approved by the Contracting Officer, and structural controls shall be provided. All construction vehicles shall be regularly inspected for leaks and receive regularly scheduled maintenance to reduce the potential for leaks.

5.7 VEHICLE FUELING

Vehicle fueling at project site shall be conducted in accordance with good safety practices to reduce the potential for leaks and spills. Only properly constructed fuel containers shall be used on-site and shall be labeled and stored in accordance with applicable Federal, State, and Local codes. Washing and curing waters shall be drained into a retention basin constructed by the Contractor. It shall be cleaned up by the Contractor, to the satisfaction of the Contracting Officer, after project completion.

5.8 WATER SOURCE

Water used at site to establish and maintain grass, to control dust, and for other construction purposes shall be from a public water supply or private well approved by the Contracting Officer, state or local health department.

PART 6 TIMING OF CONTROLS AND ACTIVITIES.

The Contractor shall perform the following control activities:

(1) Stabilize construction entrance at the new facility.
(2) Install silt fence at the limit of erosion and sediment control.
(3) Install hay bale dikes in the new drainage ditches.
(4) Establish temporary and permanent stabilization.
(5) Backfill utility and all other open trenches in a timely manner to minimize erosion.
(6) Place natural or synthetic fiber met on excavated and stockpiled material.
(7) Inspect and maintain erosion and sediment structural control structures (reference GENERAL NOTES on Erosion and SEDIMENT CONTROL PLAN 1)
(8) Remove all structural controls after approvalfrom Contracting Officer.

PART 7 COMPLIANCE WITH FEDERAL, STATE, AND LOCAL REGULATIONS

This project is in compliance with the National Environmental Policy Act of 1969, as amended.

The Fort Bliss Directorate of Environment has prepared a document titled Environmental Assessment (EA) for Army Strategic Mobility Program (ASMP) Facilities at Fort Bliss, dated November 1998. This project site (Air Deployment Facility) is part of a master planning study for five projects in the ASMP. The EA addresses issues regarding water resources, land use, cultural resources, architectural resources, ecological resources,air quality, etc. A Finding of No Significant Impact (FONSI) was determined based on the EA. There is no significant impact to wildlife or its habitat is anticipated. No federal or state listed species are expected to be significantly impacted by construction activities.

The Fort Bliss Point of Contract (POC) for NEPA compliance information is Emil Madura at (915) 568-1385.

PART 8 MAINTENANCE AND INSPECTION PROCEDURES

The Contractorshall conduct inspection or erosion and sediment structural controls at each construction area. All pollution prevention structural controls measures shall be inspected. The specific criteria and frequency includes:

(1) During rainfall season - one every seven (7) days and within 24 hours after any storm event greater than 13 mm (o.5 inches).

(2) During seasonal dry periods where average rainfall is less than 500 mm (20 inches) - once a month and within 24 hours after any storm event greater than 13 mm (0.5 inches).

(3) When sites have been temporarily or final stabilized - once a month.

The inspector shall thoroughly understand the requirements of the Contractor's SWPPP and shall have a basic knowledge of th engineering principles for reducing runoff pollution.

Temporary stabilization or grading shall be inspected for erosion and soil loss from the site. Temporary erosion control measures shall be inspected for bare spots and washouts. Discharge ponts shall be inspected for signs of erosion or sediment. Locations where vehicles enter and leave the site shall be checked for signs of off-site sediment tracking, including erosion control structure at material borrow, disposal, excavated, and stockpiled

areas. The BMP and pollution control maintenance procedures shall be reviewed for adequate erosion control by the Contractor during construction. All deficiencies shall be recorded in the Inspection and Maintenance Report posted at the project bulletin board and submit to the Contracting Officer after each inspection. The Contractor shall implement corrections to these problems within seven (7) days after inspection and revise the SWPPP. After final stabilization has been achieved, the Contractor shall inspect the site once a month until final inspection and project acceptance by the Contracting Officer.

PART 9 MATERIAL INVENTORY

All materials or substances brought on-site during construction shall have a Material Safety Data Sheet (MSDS) available to the Contracting Officer. These materials include concrete, paints, sealants, petroleum-based products, cleaning solvents, fertilizers, tar, asphalt, and steel reinforcing bars. The list of materials shall be stated in the Contractor's detailed SWPPP.

PART 10 NON-STORM WATER DISCHARGE

Non-storm water discharge shall not be allowed during construction in accordance with 63 FR 128, July 6, 1998, except for emergency fire-fighting flows and other flows listed in the following:

(1) vehicle wash water if detergents are not used,
(2) dust control runoff in accordance with permit conditions,
(3) fire hydrant flushing,
(4) potable water sources including water line flushing,
(5) uncontaminated ground water resulting from dewatering activities,
(6) irrigation drainage,
(7) routine external building wash down which does not use detergent,
(8) wash water from pavement with no spilled or leaked toxic or hazardous material and no detergent,
(9) air conditioning condensate,
(10) spring water,
(11) Foundation or footer drain watr where flows are not contaminated with process material such as solvent.

In addition, any spill of a hazardous substance in excess of reporting quantities shall be reported as required under 40 CFR 110. Spill containment, notification, and clean-up in accordance with applicable Federal, State and local regulations, and to the satisfaction of the Contracting Officer shall be required.

PART 11 CONTRACTOR COMPLIANCE

The Contractor shall use this basic SWPPP to prepare a detailed SWPPP that includes both narrative and drawings (Erosion and Sediment Control Plans). The detailed SWPPP shall state the following as a minimum: (1) the project start and completion dates, (2) bid options to be executed with the project, (3) sequence of construction activities and pollution control measures, (4) discussion of the Best Management Practices (BMP) and implementation during project execution, (5) identify the list of materials brought on-site, (6) runoff computation of each drainage area (see paragraph 4.1), and (7) revised Erosion and Sediment Control Plans to include all locations that require structural controls (i.e. site entrance

and exit, staging, stockpiled, borrow, and disposal areas for both on-site and off-site) and the type of storm control structures.

Being responsible for the daily operations at the construction site and inspection of the established controls in accordance with the NPDES permit requirements, the Contractor shall submit the detailed SWPPP (including the revised Stormwater Control Plans), and a Notice of Intent (NOI) for the Stormwater Discharges Associated with Industrial Activity under NPDES General Permit to EPA. The NOI (EPA Form 3510-6) shall be submitted no later than 48 hours before start of construction. A separate NOI is required for each construction contract or each phase of the construction activities. The mailing address for NOI submittal is:

Stormwater Notice of Intent (4203),
USEPA, 401 M Street, SW
Washington, D. C. 20460

The Contractor's detailed SWPPP (including the revised Stormwater Control Plans) and a copy of submitted NOI shall be provided to the Contracting Officer before start of construction. A copy of the U.S. Army Corps of Engineers NOI (obtained from the Contracting Officer), the Contractor's NOI, and a brief project description shall be posted on the project bulletin board. The Contractor's detailed SWPPP shall be kept on-site at all times. During construction, the Contractor shall perform work as required per paragraph, MAINTENANCE AND INSPECTION PROCEDURES in this section.

NO later than 10 working days after acceptance of final stabilization, the Contractor shall submit the Notice of Termination (NOT), EPA Form 3510-7 to EPA. Two copies of the submitted NOT shall be provided to the Contracting Officer's project file. EPA Forms are available on web site at http://www.epa.gov/earth1r6/6en/w/forms.htm. It is not required but the Contractor may choose to provide the NOT to the Environmental Division of the Fort Worth District. The Environmental Division shall file both the USACE and Contractor's NOT to EPA to facilitate project closeout. The mailing address for the Contractor's prepared and signed NOT is:

ATT: Dr. Hank Jarboe,
CESWF-EV-EE (RM 3A14)
U.S.Army Corps of Engineers
819 Taylor Street
Fort Worth, TX 76102-0300

PART 12 ATTACHMENTS

12.1 OWNER CERTIFICATION

OWNER CERTIFICATION
FOR
HOT AMMO LOAD PAD
FORT BLISS, TEXAS

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

MICHAEL J. MOCEK, P.E.
DEPUTY DISTRICT ENGINEER

Date Certified: 7/27/00

Attachments:

Separate volume of drawings are prepared for the Air Deployment and the Fire Station portion of this project.

Sheet No.	Title
C1	PROJECT LOCATION MAP
C27	GRADING PLAN 4
C28	GRADING PLAN 5
C106	EROSION CONTROL PLAN 1
C107	EROSION CONTROL PLAN 2
C108	EROSION CONTROL PLAN 3
C109	EROSION CONTROL PLAN 4
C110	EROSION CONTROL PLAN 5
C111	EROSION CONTROL PLAN 6
C65	EROSION CONTROL DETAILS

12.2 STORMWATER POLLUTION PREVENTION PLAN

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

INSPECTOR:_____ DATE:_____

INSPECTOR'S
QUALIFICATION:_____

_____

_____

_____

_____

DAYS SINCE LAST RAINFALL:_____ AMOUNT OF LAST RAINFALL:_____INCHES

STABILIZATION MEASURES

AREA	DATE SINCE LAST DISTURBANCE	DATE OF NEXT DISTURBANCE	STABILIZED? (YES/NO?)	STABILIZED WITH	CONDITION

_____

STABILIZATION REQUIRED:

_____

_____

TO BE PERFORMED BY:_____ ON or BEFORE:_____

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

OTHER CONTROLS - STABILIZED CONSTRUCTION ENTRANCE

IS MUCH SEDIMENT TRACKED ONTO THE ROAD?	ARE DUST AND SEDIMENT CONTROL MEASURES WORKING?	DOES ALL TRAFFIC USE THE STABILIZED ENTRANCE TO THE SITE?	ARE ASSOCIATED DRAINAGE STRUCTURES WORKING?

MAINTENANCE REQUIRED FOR CONSTRUCTION ENTRANCE:

_____
_____
_____
_____

TO PERFORMED BY:_____ ON OR BEFORE:_____

OTHER CONTROLS - DEVELOP SITE SPECIFIC TABLES AS NEEDED

FOR ALL STABILIZATION MEASURES, STRUCTURAL, AND NON-STRUCTURAL CONTROLS

CHANGES/CORRECTIONS REQUIRED IN POLLUTION PREVENTION PLAN:

_____
_____
_____
_____
_____

REASONS FOR CHANGES:

_____
_____
_____
_____
_____

INSPECTOR'S SIGNATURE:_____ DATE:_____

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

MAINTENANCE REQUIRED FOR SEDIMENT BASIN(S):

_____
_____
_____
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE:_____

STRUCTURAL CONTROLS - SILT FENCE(S)

FROM	TO	IS THE BOTTOM OF THE FABRIC STILL BURIED?	IS THE FABRIC IN GOOD CONDITION?	HOW DEEP IS THE SEDIMENT?

_____

MAINTENANCE REQUIRED FOR THE SILT FENCE (S):

_____
_____
_____
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE:_____

STORMWATER POLLUTION PREVENTION PLAN

INSPECTION AND MAINTENANCE REPORT

STRUCTURAL CONTROLS - EARTH DIKES(S)

FROM	TO	IS DIKED STABILIZED?	IS THERE EVIDENCE OF WASH-OUT OR OVERTOPPING?

MAINTENANCE REQUIRED FOR THE EARTH DIKE(S):

_____
_____
_____
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE:_____

-- End of Section --

THIS FORM REPLACES PREVIOUS FORM 3510-.6 (8-98) Form Approved. OMB No. 2040-0188

NPDES FORM EPA

United States Environmental Protection Agency
Washington, DC 20460

Notice of Intent (NOI) for Storm Water Discharges Associated with CONSTRUCTION ACTIVITY Under a NPDES General Permit

Submission of this Notice of Intent constitutes notice that the party identified in Section I of this form intends to be authorized by a NPDES permit issued for storm water discharges associated with construction activity in the State/Indian Country Land identified in Section 11 of this form. Submission of this Notice of intent also constitutes notice that the party identified in Section I of this form meets the eligibility requirements in Part I.B. of the general permit (including those related to protection of endangered species determined through the procedures in Addendum A of the general permit), understands that continued authorization to discharge is contingent on maintaining permit eligibility, and that implementation of the Storm Water Pollution Prevention Plan required under Part IV of the general permit will begin at the time the permittee commences work on the construction project identified in Section 11 below. IN ORDER TO OBTAIN AUTHORIZATION, ALL INFORMATION REQUESTED MUST BE INCLUDED ON THIS FORM. SEE INSTRUCTIONS ON BACK OF FORM.

I. Owner/Operator (Applicant) Information

Name: US Army Corps of Engineers (CESWF-EV-EE) Phone: 817/978-5068

Address: 819 Taylor Street, P.O. Box 17300 Status Of Owner/Operator: F

City: Fort Worth State: TX Zip Code: 76102

II. Project/Site Information

Is the facility located on Indian Country Lands? Yes No X.

Project Name: Ammo Hot Load Area

Project Address/Location Across from Taxiway F on Biggs Army Airfield

City: Fort Bliss

State: TX Zip Code 79906

Latitude: 31° 50' 55" Longitude: 106° 22' 49" County: El Paso

Has the Storm Water Pollution Prevention Plan (SWPPP) been prepared? Yes X No

Optional: Address of location of SWPPP for viewing Address in Section I above X Address in section 11 above _____ Other address (if known) below:

SWPPP Address _____ Phone: _____

City: _____ State: _____ Zip Code: _____

Name of Receiving Water: Rio Grande River

11	01	2000	12	01	2001
Month	Day	Year	Month	Day	Year
Estimated Construction Start Date			Estimated Completion Date		

Estimate of area to be disturbed (to nearest acre): 80

Estimate of Likelihood of Discharge (choose only one);

1. X Unlikely 3. __ Once per week 5. ___Continual
2. ___ once per month 4. __ Once per day

Based on instruction provided in Addendum A of the permit, are there any endangered or threatened species, or designated critical habitat in the project area?

Yes No X.

I have satisfied permit eligibility with regard to protection of endangered species through the indicated section of Part I.B.3.e.(2) of the permit (check one or more boxes):

(a) X (b) (c) (d)

III. Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel property gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage this system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Print Name: Michael J. Mocek, Deputy District Engineer Date: July 27, 2000

Signature: Michael J. Mocek

EPA Form 3510-9 replaced 3510-6 (8-98)

SECTION 03307

CONCRETE FOR MINOR STRUCTURES
12/92
AMENDMENT NO. 0002

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 basic designation only.

ACI INTERNATIONAL (ACI)

ACI 308	(1992) Standard Practice for Curing Concrete
ACI 318M/318RM	(1992) Building Code Requirements for Reinforced Concrete (Metric)
ACI 347R	(1994) Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1994) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	(1995a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 31	(1991) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1993) Concrete Aggregate
ASTM C 39	(1993) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	(1994) Ready-Mixed Concrete
ASTM C 143	(1990a) Slump of Hydraulic Cement Concrete
ASTM C 150	(1995) Portland Cement
ASTM C 171	(1992) Sheet Materials for Curing Concrete
ASTM C 172	(1990) Sampling Freshly Mixed Concrete
ASTM C 231	(1991b) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 260	(1994) Air-Entraining Admixtures for Concrete
ASTM C 309	(1994) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 618	(1994a) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM C 685	(1994) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM D 75	(1987; R 1992) Sampling Aggregates
ASTM D 1752	(1984; R 1992) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 96	(1995) Water Vapor Transmission of Materials

CORPS OF ENGINEERS (COE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete

1.2 DESIGN AND PERFORMANCE REQUIREMENTS

The Government will maintain the option to sample and test aggregates and concrete to determine compliance with the specifications. The Contractor shall provide facilities and labor as may be necessary to assist the Government in procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Concrete will be sampled in accordance with ASTM C 172. Slump and air content will be determined in accordance with ASTM C 143 and ASTM C 231, respectively, when cylinders are molded. Compression test specimens will be made, cured, and transported in accordance with ASTM C 31. Compression test specimens will be tested in accordance with ASTM C 39. Samples for strength tests will be taken not less than once each shift in which concrete is produced from each class of concrete required. A minimum of three specimens will be made from each sample; two will be tested at 28 days (90 days if pozzolan is used) for acceptance, and one will be tested at 7 days for information.

1.2.1 Strength

Acceptance test results will be the average strengths of two specimens tested at 28 days (90 days if pozzolan is used). The strength of the concrete will be considered satisfactory so long as the average of three consecutive acceptance test results equal or exceed the specified compressive strength, f'c, and no individual acceptance test result falls

below f'c by more than 3.4 MPa.

1.2.2 Construction Tolerances

A Class "C" finish shall apply to all surfaces except those specified to receive a Class "D" finish. A Class "D" finish shall apply to all surfaces which will be permanently concealed after construction. The surface requirements for the classes of finish required shall be as specified in ACI 347R.

1.2.3 Concrete Mixture Proportions

Concrete mixture proportions shall be the responsibility of the Contractor. Mixture proportions shall include the dry weights of cementitious material(s); the nominal maximum size of the coarse aggregate; the specific gravities, absorptions, and saturated surface-dry weights of fine and coarse aggregates; the quantities, types, and names of admixtures; and quantity of water per cubic meter of concrete. All materials included in the mixture proportions shall be of the same type and from the same source as will be used on the project. Specified compressive strength f'c shall be {AM#2} 21.0 MPa at 28 days . The maximum nominal size coarse aggregate shall be 19 mm , in accordance with ACI 318M/318RM. The air content shall be between 4.5 and 7.5 percent. The slump shall be between 76 and 102 mm. The maximum water cement ratio shall be 0.50.

1.3 SUBMITTALS

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Air-Entraining Admixture; FIO. Water-Reducing or Retarding Admixture; FIO. Curing Materials; FIO.

Manufacturer's literature is available from suppliers which demonstrates compliance with applicable specifications for the above materials.

Batching and Mixing Equipment; FIO.

Batching and mixing equipment will be accepted on the basis of manufacturer's data which demonstrates compliance with the applicable specifications.

Conveying and Placing Concrete; FIO.

The methods and equipment for transporting, handling, depositing, and consolidating the concrete shall be submitted prior to the first concrete placement.

SD-09 Reports

Concrete Mixture Proportions; FIO.

Ten days prior to placement of concrete, the contractor shall submit the mixture proportions that will produce concrete of the quality required. Applicable test reports shall be submitted to verify that the concrete mixture proportions selected will produce concrete of the quality specified.

SD-13 Certificates

Cementitious Materials; FIO.

Certificates of compliance attesting that the concrete materials meet the requirements of the specifications shall be submitted in accordance with the Special Clause "CERTIFICATES OF COMPLIANCE". Cementitious material will be accepted on the basis of a manufacturer's certificate of compliance, accompanied by mill test reports that the material(s) meet the requirements of the specification under which it is furnished.

Aggregates; FIO.

Aggregates will be accepted on the basis of certificates of compliance and tests reports that show the material(s) meet the quality and grading requirements of the specifications under which it is furnished.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials shall conform to the appropriate specifications listed:

2.1.1.1 Portland Cement

ASTM C 150, Type I.

2.1.1.2 Pozzolan

Pozzolan shall conform to ASTM C 618, Class C or F, including requirements of Tables 1A and 2A.

2.1.2 Aggregates

Aggregates shall meet the quality and grading requirements of ASTM C 33 Class Designations 4M or better .

2.1.3 Admixtures

Admixtures to be used, when required or approved, shall comply with the appropriate specification listed. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing shall be retested at the expense of the contractor at the request of the Contracting Officer and shall be rejected if test

results are not satisfactory.

2.1.3.1 Air-Entraining Admixture

Air-entraining admixture shall meet the requirements of ASTM C 260.

2.1.3.2 Water-Reducing or Retarding Admixture

Water-reducing or retarding admixture shall meet the requirements of ASTM C 494, Type A, B, or D.

2.1.4 Water

Water for mixing and curing shall be fresh, clean, potable, and free from injurious amounts of oil, acid, salt, or alkali, except that unpotable water may be used if it meets the requirements of COE CRD-C 400.

2.1.5 Expansion Joint Filler Strips, Premolded

Expansion joint filler strips, premolded shall be sponge rubber conforming to ASTM D 1752, Type I.

2.1.6 Formwork

The design and engineering of the formwork as well as its construction, shall be the responsibility of the Contractor.

2.1.7 Form Coatings

Forms for exposed surfaces shall be coated with a nonstaining form oil, which shall be applied shortly before concrete is placed.

2.1.8 Vapor Barrier

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 0.15 mm or other equivalent material having a vapor permeance rating not exceeding 30 nanograms per pascal second square meter as determined in accordance with ASTM E 96.

2.1.9 Curing Materials

Curing materials shall conform to the following requirements.

2.1.9.1 Impervious Sheet Materials

Impervious sheet materials, ASTM C 171, type optional, except polyethylene film, if used, shall be white opaque.

2.1.9.2 Membrane-Forming Curing Compound

ASTM C 309, Type 1-D or 2, Class A .

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 General

Construction joints shall be prepared to expose coarse aggregate, and the surface shall be clean, damp, and free of laitance. Ramps and walkways, as necessary, shall be constructed to allow safe and expeditious access for concrete and workmen. Snow, ice, standing or flowing water, loose particles, debris, and foreign matter shall have been removed. Earth foundations shall be satisfactorily compacted. Spare vibrators shall be available. The entire preparation shall be accepted by the Government prior to placing.

3.1.2 Embedded Items

Reinforcement shall be secured in place; joints, anchors, and other embedded items shall have been positioned. Internal ties shall be arranged so that when the forms are removed all metal will be not less than 50 mm from concrete surfaces permanently exposed to view or exposed to water on the finished structures. Embedded items shall be free of oil and other foreign matters such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. All equipment needed to place, consolidate, protect, and cure the concrete shall be at the placement site and in good operating condition.

3.1.3 Formwork Installation

Forms shall be properly aligned, adequately supported, and mortar-tight. The form surfaces shall be smooth and free from irregularities, dents, sags, or holes when used for permanently exposed faces. All exposed joints and edges shall be chamfered, unless otherwise indicated.

3.1.4 Vapor Barrier Installation

Vapor barriers shall be applied over gravel fill. Edges shall be lapped not less than 150 mm. All joints shall be sealed with pressure-sensitive adhesive not less than 50 mm wide. The vapor barrier shall be protected at all times to prevent injury or displacement prior to and during concrete placement.

3.1.5 Production of Concrete

3.1.5.1 Ready-Mixed Concrete

Ready-mixed concrete shall conform to ASTM C 94 except as otherwise specified.

3.1.5.2 Concrete Made by Volumetric Batching and Continuous Mixing

Concrete made by volumetric batching and continuous mixing shall conform to ASTM C 685.

3.1.5.3 Batching and Mixing Equipment

The contractor shall have the option of using an on-site batching and mixing facility. The facility shall provide sufficient batching and mixing equipment capacity to prevent cold joints. The method of measuring materials, hatching, operation, and mixer shall be as required in Section 02753.

3.2 CONVEYING AND PLACING CONCRETE

Conveying and placing concrete shall conform to the following requirements.

3.2.1 General

Concrete placement shall not be permitted when weather conditions prevent proper placement and consolidation without approval. When concrete is mixed and/or transported by a truck mixer, the concrete shall be delivered to the site of the work and discharge shall be completed within 1-1/2 hours . Concrete shall be conveyed from the mixer to the forms as rapidly as practicable by methods which prevent segregation or loss of ingredients. Concrete shall be in place and consolidated within 15 minutes after discharge from the mixer. Concrete shall be deposited as close as possible to its final position in the forms and be so regulated that it may be effectively consolidated in horizontal layers 450 mm or less in thickness with a minimum of lateral movement. The placement shall be carried on at such a rate that the formation of cold joints will be prevented.

3.2.2 Consolidation

Each layer of concrete shall be consolidated by rodding, spading, or internal vibrating equipment. External vibrating equipment may be used when authorized. Internal vibration shall be systematically accomplished by inserting the vibrator through the fresh concrete in the layer below at a uniform spacing over the entire area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator and overlay the adjacent, just-vibrated area by approximately 100 mm. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the layer below, if such a layer exists. It shall be held stationary until the concrete is consolidated and then withdrawn slowly at the rate of about 75 mm per second.

3.2.3 Cold-Weather Requirements

No concrete placement shall be made when the ambient temperature is below 2 degrees C or if the ambient temperature is below 5 degrees C and falling. Suitable covering and other means as approved shall be provided for maintaining the concrete at a temperature of at least 10 degrees C for not less than 72 hours after placing and at a temperature above freezing for the remainder of the curing period. Salt, chemicals, or other foreign materials shall not be mixed with the concrete to prevent freezing. Any concrete damaged by freezing shall be removed and replaced at the expense of the contractor.

3.2.4 Hot-Weather Requirements

When the rate of evaporation of surface moisture, as determined by use of Figure 1 of ACI 308, is expected to exceed 1 kilogram per square meter per hour, provisions for windbreaks, shading, fog spraying, or covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as finishing operations will allow.

3.3 FORM REMOVAL

Forms shall not be removed before the expiration of 24 hours after concrete placement except where otherwise specifically authorized. Supporting forms and shoring shall not be removed until the concrete has cured for at least 5 days. When conditions on the work are such as to justify the requirement, forms will be required to remain in place for longer periods.

3.4 FINISHING

3.4.1 General

No finishing or repair will be done when either the concrete or the ambient temperature is below 10 degrees C.

3.4.2 Finishing Formed Surfaces

All fins and loose materials shall be removed, and surface defects including tie holes shall be filled. All honeycomb areas and other defects shall be repaired. All unsound concrete shall be removed from areas to be repaired. Surface defects greater than 13 mm in diameter and holes left by removal of tie rods in all surfaces not to receive additional concrete shall be reamed or chipped and filled with dry-pack mortar. The prepared area shall be brush-coated with an approved epoxy resin or latex bonding compound or with a neat cement grout after dampening and filled with mortar or concrete. The cement used in mortar or concrete for repairs to all surfaces permanently exposed to view shall be a blend of portland cement and white cement so that the final color when cured will be the same as adjacent concrete.

3.4.3 Finish for Unformed Concrete Surfaces

3.4.3.1 Float Finish

Surfaces to be float finished shall be screeded and darbied or bullfloated to eliminate the ridges and to fill in the voids left by the screed. In addition, the darby or bullfloat shall fill all surface voids and only slightly embed the coarse aggregate below the surface of the fresh concrete. When the water sheen disappears and the concrete will support a person's weight without deep imprint, floating should be completed. Floating should embed large aggregates just beneath the surface, remove slight imperfections, humps, and voids to produce a plane surface, compact the concrete, and consolidate mortar at the surface.

3.4.3.2 Trowel Finish

A trowel finish shall be applied to surfaces exposed in the finished work.

Trowelling shall be done immediately following floating to provide a smooth, even, dense finish free from blemishes including trowel marks. Finished surfaces shall be protected from damage during the construction period.

3.5 CURING AND PROTECTION

Beginning immediately after placement and continuing for at least 7 days, all concrete shall be cured and protected from premature drying, extremes in temperature, rapid temperature change, freezing, mechanical damage, and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available and at the site of the placement prior to the start of concrete placement. Preservation of moisture for concrete surfaces not in contact with forms shall be accomplished by one of the following methods:

a. Continuous sprinkling or ponding.

b. Application of absorptive mats or fabrics kept continuously wet.

c. Application of sand kept continuously wet.

d. Application of impervious sheet material conforming to ASTM C 171.

e. Application of membrane-forming curing compound conforming to ASTM C 309, Type 1-D, on surfaces permanently exposed to view and Type 2 on other surfaces shall be accomplished in accordance with manufacturer's instructions.

The preservation of moisture for concrete surfaces placed against wooden forms shall be accomplished by keeping the forms continuously wet for 7 days. If forms are removed prior to end of the required curing period, other curing methods shall be used for the balance of the curing period. During the period of protection removal, the temperature of the air in contact with the concrete shall not be allowed to drop more than 15 degrees C within a 24 hour period.

3.6 TESTS AND INSPECTIONS

3.6.1 General

The individuals who sample and test concrete as required in this specification shall have demonstrated a knowledge and ability to perform the necessary test procedures equivalent to the ACI minimum guidelines for certification of Concrete Field Testing Technicians, Grade I.

3.6.2 Inspection Details and Frequency of Testing

3.6.2.1 Preparations for Placing

Foundation or construction joints, forms, and embedded items shall be inspected in sufficient time prior to each concrete placement by the Contractor to certify that it is ready to receive concrete.

3.6.2.2 Air Content

Air content shall be checked at least once during each shift that concrete is placed. Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 231.

3.6.2.3 Slump

Slump shall be checked once during each shift that concrete is produced . Samples shall be obtained in accordance with ASTM C 172 and tested in accordance with ASTM C 143.

3.6.2.4 Consolidation and Protection

The Contractor shall ensure that the concrete is properly consolidated, finished, protected, and cured.

3.6.3 Action Required

3.6.3.1 Placing

The placing foreman shall not permit placing to begin until he has verified that an adequate number of acceptable vibrators, which are in working order and have competent operators, are available. Placing shall not be continued if any pile is inadequately consolidated.

3.6.3.2 Air Content

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment shall be made to the dosage of the air-entrainment admixture.

3.6.3.3 Slump

Whenever a test result is outside the specification limits, the concrete shall not be delivered to the forms and an adjustment should be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the water-cement ratio does not exceed that specified in the submitted concrete mixture proportion.

3.6.4 Reports

The results of all tests and inspections conducted at the project site shall be reported informally at the end of each shift and in writing weekly and shall be delivered within 3 days after the end of each weekly reporting period. See Section 01451 CONTRACTOR QUALITY CONTROL.

-- End of Section --

SECTION 05300

STEEL DECKING
10/89
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec	(1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl	(1996) Cold-Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108	(1995) Steel Bars, Carbon, Cold Finished, Standard Quality
ASTM A 570/A 570M	(1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 611	(1997) Structural Steel (SS), Sheet, Carbon, Cold-Rolled
ASTM A 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 792/A 792M	(1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM C 423	(1990a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM E 795	(1993) Mounting Test Specimens During Sound Absorption Tests

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI Diaphram Mnl	(1987; Amended 1991) Diaphragm Design Manual
SDI Pub No 29	(1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)

1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Deck Units; GA.

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

SD-04 Drawings

Deck Units; GA. Accessories; GA. Attachments; GA. Holes and Openings; GA.

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded [or fastener] connections; and the manufacturer's erection instructions.

SD-13 Certificates

Deck Units; GA. Attachments; GA.

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

SD-14 Samples

Deck Units; FIO. Accessories; FIO.

A 0.19 sq meter sample of the decking material to be used, along with a sample of each of the accessories used.

SD-18 Records

Attachments; GA.

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No 29. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI Cold-Formed Mnl, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.1.1 Roof Deck

Steel deck roofing shall conform to ASTM A 653M. Roof deck units shall be fabricated of 22 GAUGE design thickness or thicker steel and shall be zinc-coated in conformance with ASTM A 653M, G90 coating class.

2.2 TOUCH-UP PAINT

Touch-up paint for zinc-coated units shall be an approved galvanizing repair paint with a high-zinc dust content . Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 1.204 mm ; welding washers, 1.519 mm ; cant strip, 0.749 mm ; other metal accessories, 0.909 mm ; unless otherwise indicated. Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

PART 3 EXECUTION

3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI Pub No 29 SDI Diaphram Mnl and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

3.2 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 16 mm diameter puddle welds to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 29. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall not be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be lapped 50 mm . All partial or segments of deck units shall be attached to structural

supports in accordance with Section 2.5 of SDI Diaphram Mnl.

3.3 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 150 mm across require no reinforcement. Holes and openings 150 to 300 mm across shall be reinforced by 1.204 mm thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Holes and openings larger than 300 mm shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists. Openings must not interfere with seismic members such as chords and drag struts.

-- End of Section --

SECTION 11211

PUMPS: WATER, CENTRIFUGAL

12/88

AMENDMENT NO. 0002

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 basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1989a) 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 D 975	(1994) Diesel Fuel Oils

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.1	(1989) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1988; Errata Oct 1988; B16.5a) Pipe Flanges and Flanged Fittings
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15	Radio Frequency Devices

HYDRAULIC INSTITUTE (HI)

HI-01	(1983) Standards for Centrifugal, Rotary & Reciprocating Pumps

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1993; Rev 1-1993) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(1993) Centrifugal Fire Pumps
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

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)

UNDERWRITERS LABORATORIES (UL)

UL 448	(1994) Pumps for Fire-Protection Service

AMERICAN NATIONAL STANDARD ORGANIZATION

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI A21.15/AWWA C115	Cast/Ductile Iron Pipe with Threaded Flanges
ANSI 253.1	Safety Color-Code for Marking Physical Hazards
ANSI B40.1	Gages, Pressure and Vacuum

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory waterworks operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the jobsite. Pumps and engines of the same types shall each be the product of one manufacturer.

1.2.2 Description

The pumps shall be horizontal centrifugal water pumps of the types

indicated and specified. The single driving units for the pumps shall be diesel engines as indicated and specified.

The pumps shall be horizontal centrifugal water pumps of the types indicated and specified. The single driving unit for the pump shall be a diesel engines indicated and specified. The principal items of equipment shall include one horizontal centrifugal, engine driven pump, one liquid cooled standby engine, valves, and piping. A pump control panel with automatic liquid level control system for normal operation and internal wiring. In addition, a modular pump station enclosure shall be provided as indicated and specified.

1.2.3 Governing Requirements

Fire pumps and appurtenances shall conform in all respects to NFPA 20.

1.2.4 Safety Requirements

Gears, couplings, projecting set-screws, keys, and other rotating parts, so located that any person can come in close proximity thereto, shall be fully enclosed or properly guarded.

1.2.5 Nameplates

Pumps and motors shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each pump shall show the capacity in liters per second at rated speed in rpm and head in millimeters of water. Nameplate for each diesel engine shall show the horsepower and the speed in rpm to produce rated output from the pump. Nameplate for each diesel engine shall show the horsepower and the speed in rpm to produce the rated output from the pump. Such other information as the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.2.6 Selection Criteria

Pumps shall be designed using hydraulic criteria based upon actual model developmental test data. Pumps shall be selected at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency. Pumps having impeller diameters larger than 90 percent of the published maximum diameter of the casing or less than 15 percent larger than the published minimum diameter of the casing will be rejected. Acceptable maximum impeller diameter calculations shall not be based on percentage of impeller diameter range for a given casing.

1.2.7 Conformance With Agency Requirements

Where materials or equipment are specified to be an approved type, the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services, shall be attached thereto. A written certificate from the testing agency shall

accompany the materials or equipment and shall be submitted to the Contracting Officer stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate shall indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered by the Contracting Officer and may be acceptable as evidence that the items conform with agency requirements.

1.2.8 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.2.9 Factory Tests

Pumps shall be tested by the manufacturer or a nationally recognized testing agency in compliance with Hydraulic Institute Standards. Where two or more identical pumps are specified, only one representative pump shall be tested. Certified test results shall be submitted to the Contracting Officer.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Materials and Equipment; FIO.

Manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions. Spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-04 Drawings

Centrifugal Pump System; FIO.

A complete listing of equipment and materials. Drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-06 Instructions

Centrifugal Pump System; FIO.

Proposed diagrams, instructions, and other sheets, prior to posting. Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

Training; FIO.

Training course curriculum and training instructions shall be furnished to the Contracting Officer 14 days prior to the start of training.

SD-09 Reports

Tests; FIO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-13 Certificates

Manufacturer's Field Representative; FIO.

The names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

SD-19 Operation and Maintenance Manuals

Centrifugal Pump System; FIO.

Six complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment. One complete set at the time the tests procedure is submitted; remaining sets before the contract is completed. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the building, name of the Contractor, and contract number. Flysheets shall be placed before instructions covering each subject. Instruction sheets shall be approximately 216 by 279 mm (8-1/2 by 11 inches), with large sheets of drawings folded in. Instructions shall include, but not be limited to, the following:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including lubrication instructions and troubleshooting guide.

e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified below and as shown, and shall be suitable for the service intended. Materials and equipment shall be new and unused, except for tests. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

2.2 CENTRIFUGAL WATER PUMPS

The pumps shall be the centrifugal, single-stage or multi-stage type, designed for waterworks service in the following configurations:

	Pump No.
Horizontal	1

2.2.1 Pump Service

The pumps shall be utilized for the following service:

	Pump No.
Line pressure booster pump	1

2.2.2 Pump Drives

The pumps shall have the following driving units and shall be directly connected to the driving units through solid shafts, flexible couplings, or free wheeling clutches (as appropriate):

	Pump No.
Diesel engine drive	1

2.2.3 Pump Construction

Except as below specified, centrifugal water pumps shall be constructed in accordance with the Hydraulic Institute HI-01.

2.2.4 Pump Characteristics

The pumps shall be capable of discharging quantities at total discharge heads measured at the discharge flange, between the following limits:

Pump No.	liters per second at total discharge head, mm H(2)O
1	3785

Pumps shall operate at optimum efficiencies to produce the most economical pumping system under the conditions encountered and shall be sized to make optimum match with the system head curve as shown. Suction lift on pump No. 1 will be not more than 1,200 mm. Pumps shall furnish not less than 150 percent of rated capacity at a total discharge head of not less than 65 percent of total rated head. The shutoff total head shall be not greater than 120 percent of total rated head.

2.2.5 Pump Casings

Pump casings shall be cast iron of the following design:

	Pump No.
Horizontal shaft, horizontal split casing	1

The casings shall be designed to permit replacement of wearing parts. Horizontal-split casings shall have the suction and discharge nozzles cast integrally with the lower half, so that the upper part of the casings may be removed for inspection of the rotating parts without disturbing pipe connections or pump alignment. Pump casings shall be of uniform quality and free from blowholes, porosity, hard spots, shrinkage defects, cracks and other injurious defects. Defects in casings shall not be repaired except when such work is approved and is done by or under the supervision of the pump manufacturer, and then only when the defects are small and do not adversely affect the strength or use of the casing. Casings shall be single or double volute with flanged piping connections conforming to ASTM 48, Class 40. The direction of shaft rotation shall be conspicuously indicated. The casing shall have tapped openings for air venting, priming, draining, and suction and discharge gauges. A brass or bronze umbrella or

vent cock shall be furnished for venting except where automatic air vents are indicated. Drain openings in the volute, intake, or other passages capable of retaining trapped water shall be located in the low point of such passages.

2.2.6 Impellers

Impellers shall be of enclosed design and shall be constructed of bronze , carefully finished with smooth water passageways, and shall be statically and dynamically balanced. Impellers shall be securely keyed to the pump shaft.

2.2.7 Wearing Rings

Wearing rings of bronze shall be provided for impellers. Wearing rings of a different composition or of a suitable ferrous material shall be provided for pump casings. Casing rings shall be securely fixed in position to prevent rotation. Rings shall be renewable and designed to ensure ease of maintenance.

2.2.8 Shaft

Shaft shall be of high grade steel, accurately machined, and shall be of sufficient size and strength to perform the work required. Bronze renewable shaft sleeves shall be provided for protection of the shaft in contact with water, and in the stuffing boxes. Shaft sleeves shall be keyed to the pump shaft.

2.2.9 Stuffing Boxes

Stuffing boxes exposed to below atmospheric pressure at any operating condition, including starting, shall be provided with a water seal. Water seal shall consist of nonferrous lantern ring or a seal cage and required connections to the pump case.

2.2.10 Mechanical Seals

Mechanical seals shall be balanced or unbalanced, as necessary to conform to specified service requirements. Mechanical seals shall be constructed in a manner and of materials particularly suitable for the temperature service range and quality of water being pumped. Seal construction shall not require external source cooling for pumped-fluid service temperatures up to 120 degrees C. Seal pressure rating shall be suitable for maximum system hydraulic conditions. Materials of construction shall include AISI 300 series stainless steel, solid tungsten-carbide rotating-seal face, and Buna-N vinylidene-fluoride-hexafluoropropylene, EPT, or tetrafluoroethylene seals. Bypass flushing water supply shall be free of iron rust products and other abrasive materials and shall be directed onto face of seal without dead ending. All piping and accessories shall be provided. Throttling bushing shall have clearances to minimize leakage in case of complete seal failure without restriction of flushing water. Mechanical seals shall not be subjected to hydrostatic test pressures in excess of the manufacturer's recommendations.

2.2.11 Couplings

Couplings shall be of the heavy-duty flexible type, keyed and locked to the shaft. The outside surface of the couplings for horizontal pumps and close-coupled vertical pumps shall be machined parallel to the axis of the shaft. The faces of the couplings shall be machined perpendicular to the axis of the shaft. Disconnecting the couplings shall be accomplished without removing the driver half or the pump half of the couplings from the shaft. Couplings for vertical pumps other than close-coupled vertical pumps may be of the universal type. Flexible couplings shall not be used to compensate for misalignment of pump.

2.2.12 Balance

All rotating parts of the equipment shall operate throughout the required range without excessive end thrust, vibration, or noise. Defects of this type that cannot be eliminated by installation adjustments will be sufficient cause for rejection of the equipment. Pump impeller assemblies shall be statically and dynamically balanced to within 1/2 percent of W times R squared, where W equals weight and R equals impeller radius. Shaft construction shall be substantial to prevent seal or bearing failure due to vibration. Total shaft peak-to-peak dynamic deflection measured by vibrometer at pump-seal face shall not exceed 0.051 mm (2.0 mils) under shutoff-head operating conditions. Flow from 8 mm (1/4 inch) iron pipe size (ips) pipe shall be provided during testing.

2.2.13 Bearings

Bearings shall be ball or roller type, and the main bearings shall take all radial and end thrust. Pumps that depend only on hydraulic balance to overcome end thrust will not be acceptable.

2.2.14 Lubrication

Bearings on horizontal-shaft pumps shall be either oil-bath type or grease type. Each oil reservoir shall be liberal in size and provided with an opening for filling, an overflow opening at the proper location to prevent overfilling, an oil-level sight glass, and a drain at the lowest point. Grease type bearings shall be provided with fittings for a grease gun and, if the bearings are not easily accessible, with grease tubing extending to convenient locations. The grease fittings shall be of a type that prevent over lubrication and the buildup of pressure injurious to the bearings.

2.2.15 Base Plates

Horizontal-shaft centrifugal pumps shall be provided with a common base for mounting each pump and driving unit of the pump on the same base. Each base shall be constructed of cast iron with a raised lip tapped for drainage, or of welded steel shapes with suitable drainage pan. The drainage structure shall collect the packing box leakage and shall have a 15 mm (1/2 inch) NPT connection to connect it to a drain.

2.2.16 Cocks, Plugs, and Accessories

The pumps shall be equipped with air cocks, drain plugs, and single gauges indicating discharge pressures for all pumps. Gauges equipped with a shutoff cock and snubber shall conform to ASME B40.1, and shall be calibrated in kilopascal in not more than 13 kPa increments. Gauge ranges shall be appropriate for the particular installation. Normal operating suction and discharge pressures of the pump shall be indicated on the mid-point range of the gauges. Suction lift pipe shall be provided with a foot valve as shown, capable of preventing loss of prime when the pump rotation is stopped.

2.2.17 Piping Connections

The pump suction and discharge shall be provided with flanged connections of suitable size and suitably arranged for piping shown. Pipe flanges shall conform to ASME B16.1 and ASME B16.5. Piping shall be installed to preclude the formation of air pockets.

2.2.18 Finish

Pump shall have painted or enameled finish as is standard with the manufacturer except that fire pumps shall be red in color.

2.3 ELECTRICAL EQUIPMENT

Electrical equipment shall conform to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor driven equipment herein specified shall be provided complete with motors, motor starters, and controls. Motor controls, equipment, and wiring shall be in accordance with NFPA 70.

2.3.1 Control Equipment

Automatically controlled pumps shall have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Additional controls or protective devices shall be as indicated.

2.4 MODULAR PUMP STATION ENCLOSURE

2.4.1 Modular Pump Station Enclosure

A. Enclosure Construction and Design:

1. The enclosure is to be square with outside dimensions of 3658 millimeter long by 3658 millimeter wide and having a maximum outside height of 2997 millimeter at the roof peak.

2. A minimum of (4) four lifting eyes arranged on the corners shall be provided to ease handling and installation onto a concrete pad furnished by the Contractor.

3. Enclosure walls and roof shall be seamless, one-piece sprayed fiberglass panels laminated to form a structural composite as follows: 3.2 millimeter thick fiberglass outside surface, 19 millimeter thick ura-foam

polyurethane core, 13 millimeter marine grade plywood, and 2.4 millimeter thick fiberglass inside surface. Marine grade plywood shall replace foam at all cut-out openings and penetration points.

4. Each wall panel shall overlap at the corner and form an internal connection joint using stainless steel hardware. All panel joints shall be thoroughly sealed with silicone caulk. The enclosure shall have a minimum R-10 insulation factor and shall be capable of withstanding 240 kilometers per hour.

5. All exterior surfaces shall be stucco textured (green, tan, white, light blue, or grey colored) isopthalic gel coat finish incorporating ultra violet inhibitors.

6. All interior surfaces shall be strayed white isopthalic get coat finish offering the same characteristics as the exterior surfaces.

7. The roof panel shall be an arched, one-piece design incorporating the same materials of construction as the side walls. The roof shall be removable as a unit, allowing for complete access to the pumping equipment with a crane. The pitch of the roof shall be sufficient for good moisture drainage.

8. The 915 millimeter wide x 2030 millimeter high entrance door(s) shall be constructed of the same laminated fiberglass and foam core materials as the remainder of the station. Marine grade plywood will replace the insulation in areas where auxiliary equipment will be mounted. Each door shall be hung with (2) two stainless steel ball bearing type hinges. A three point closure system incorporating a lockable door handle and interior override lever shall allow emergency exits even if the door is padlocked from the outside. An adjustable door positioner and holder shall be mounted to withstand 240 kilometers per hour winds. A wall mounted drip molding will be installed above each door.

9. After the pumping equipment is installed, the fully assembled station enclosure shall be positioned on the concrete mounting pad and sealed with butyl autoglass tape as furnished by the pump station manufacturer. The interior base flange shall be drilled positioning and fastened to the pad using expansion anchors on 610 millimeter maximum centers.

B. Enclosure Functional Equipment:

1. The interior of the station shall be illuminated by factory installed 120 volt, 40 watt, two (2) lamp fluorescent light fixtures providing two (2) watts illumination per square foot. All lights will be prewired and run to the control panel through PVC conduit and a weatherproof switch shall be installed adjacent to each station entrance. A length of flexible conduit shall provide for quick connection of the lighting circuit to the pump control panel. The lighting circuit shall be protected by a thermal-magnetic control breaker.

2. A thermostatically controlled 120 VAC exhaust fan with screen and weatherproof shutters shall be installed in the wall approximately

opposite the fresh air intake vent. The fan shall have a minimum capacity of 1600 CFM at free air and be capable of changing the air in the enclosure a minimum of six times per hour. The exhaust fan shall be protected by a thermal-magnetic circuit breaker.

3. Two (2) self-contained, unpowered, thermally actuated fresh air intake vents shall progressively open or close exterior louvers as a result of thermal expansion or contraction of a wax-like material contained in an enclosed plunger actuator. Movement for the plunger rod shall drive the louver vane mechanical linkage. The louvers will progressively open at 24 degrees C, and progressively close at 15.5 degrees C. Operation of the intake louvers shall not require use of motors, solenoids, or other electrically related devices. The plunger actuator shall be mounted out of the incoming air flow, and shall hold the louvers fully open based on the ambient temperature of the pump station interior. The louver vanes and frame shall be constructed of anodized aluminum, with zinc plated steel actuator mounting and linkage. The louver vanes shall pivot on plastic bearings.

4. Two (2) unpowered, thermally actuated exhaust vents shall be supplied for each engine used. The louvers will progressively open at 75 degrees F, and progressively close at 60 degrees F. Operation is the result of thermal expansion or contraction of wax in an enclosed plunger which is used to drive the louver vane mechanical linkage. Functional operation is identical to the intake vents, except the plunger actuator is mounted directly in the path of the air flow in order to sense the ambient temperature of the air exiting the pump station interior.

5. A critical grade spiral muffler and flexible exhaust pipe will be supplied for each engine. The pump station enclosure shall incorporate provisions for installation of the exhaust equipment through the wall panel.

6. The pump control panel for the Auto-start Pump Station shall be shipped completely prewired to the pumps, motors, and engine(s) through conduit secured to the pump base. Upon installation, the Contractor shall remove any temporary shipping hardware and brackets, and anchor the control panel permanently to the concrete station pad.

7. A battery back-up 12 volt DC emergency lighting system shall provide 50 watts of illumination for 1 1/2 hours in the event of power outage. The system shall be fully self-contained for automatic operation of (2) sealed beam lamps powered by a maintenance free pure-lead 12 volt battery. An automatic solid state battery charger with integral transfer circuit shall maintain the battery in a constant state of readiness. A charge rate pilot light and test switch shall be provided. The charging circuit shall be protected by a thermal-magnetic circuit breaker.

8. The pump station enclosure shall incorporate an optional insulation package which increases the standard R10 insulation rating to R20 by doubling the thickness of the ura-foam polyurethane core in the wall and roof panels.

9. The station enclosure shall be furnished with extra wide doors.

A double hung door design with 3-point locking hardware, door closer, and hinges on each section shall allow complete access to the 6'-0" x 6'-8" full door opening without the need for a center sill.

10. A wall mounted duplex GFI utility receptacle providing 120 volt AC power shall be installed and prewired through PVC conduit with the station lighting. The receptacle shall be protected by thermal magnetic circuit breaker.

2.5 VALVES AND PIPING

A. Check Valves: Check valves shall have ductile iron body with Buna-N liner. Aluminum bronze or ductile iron disc plates and dual stainless steel internal springs. Check valve bodies shall be designed for installation between ANSI B16.1 Class 125 flanges. Swing check valves requiring reversal of flow for closure shall not be acceptable.

B. Isolation Valves: Isolation valves shall be butterfly type with resilient seat designed for installation between ANSI B16.1 Class 125 flanges. Valves shall have cast iron body with Buna-N liner. Ductile iron disc with one piece stainless steel shaft and PTFE bushings.

C. Pump Control Valve: The booster pump control valve shall be designed for installation on the discharge of booster pumps to eliminate starting and stopping surges caused by the pump. The valve shall be equipped with a built-in lift type check feature to prevent reverse flow, operating independently of the solenoid control and shall be comprised of the following:

1. The valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern. A resilient synthetic rubber disc shall have a rectangular cross section and shall be retained on three and one-half sides to assure proper gripping under extreme hydraulic conditions. The two piece stainless steel valve stem shall be guided by three bearings located in the cover.

2. The main valve shall consist of two distant operating chambers that are detachable and completely independent of the flow through the main valve body.

3. The valve shall consist of four components: the body with seat installed, the power unit body with center bearing, the cover with the bearing installed, and the diaphragm assembly. The valve body, power unit body and cover shall be of cast material. Ductile iron is standard and other materials shall be available. No fabrication or welding shall be used in the manufacturing process. The diaphragm assembly shall be the only moving part and shall form a seal between the two operating chambers. Packing glands and/or stuffing boxes are not permitted. There shall be no pistons operating the main valve or pilot controls. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition

of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one piece design capable of withstanding line shocks due to abnormal pump stoppage. No hourglass-shaped disc retainers shall be permitted and no V-type disc guides shall be used.

4. The diaphragm assembly containing a non-magnetic two piece stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided by three bearings; in the valve cover, the power unit body, and an integral bearing in the valve seat. The built-in lift type check is designed to prevent pressure reversal caused by power failure. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary.

5. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 41 bar per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity.

6. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position.

7. The main valve seat, the power unit body and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 1.64 millimeter and small size valves shall be threaded into the cover and body. The valve seat in 200 millimeter and larger size valves shall be retained by flat head machine screws for ease of maintenance. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Components, including cast material, shall be of North American manufacture.

8. The valve manufacturer shall warranty the valve to be free of defects in material and workmanship for a period of three years from the date of shipment provided the valve is installed and used in accordance with all applicable instructions. Electrical components shall have a one-year warranty.

9. The valve manufacturer shall be able to supply a complete line of equipment from 50 millimeters through 400 millimeter sizes and a complete selection of complementary equipment.

10. Pilot Control System: The valve operation shall be controlled by an externally mounted pilot control system with a four-way solenoid operated pilot. The solenoid shall be designed to operate on either AC or DC current and have a manual operator installed. Pilot system includes: four-way solenoid pilot valve, opening and closing speed controls, shut off valves, strainers and CVS-1 shuttle valve to provide the highest available

operating pressure to the pilot system.

11. Limit Switch: An adjustable limit switch assembly shall be mounted on the main valve, connected to the main valve stem. It shall be actuated by opening or closing of the valve and easily adjusted to operate at any point of the valve's travel. The limit switch will be used to complete the pump off cycle. The actuating point of the limit switch shall be adjustable. A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

D. Paddle Type Flow Switch. The flow switch shall meet the following requirements:

1. Maximum temperature: 121C (Liquid), 85 C (ambient)
2. Maximum pressure: 31 bar
3. Materials:
   a. Paddle: SS316
   b. Bellows: SS321
   c. Housing: NEMA 4
4. Micro switch: SPDT, 220V, 8A, 1700 VA
5. Cable length as required for construction. Cable length determined by Contractor.
6. Orientation: Horizontal flow
7. Pipe size: 8"
8. NPT connection: 1"

E. Piping:

1. Flanged header pipe shall be centrifugally cast, ductile iron, cement lined, complying with ANSI/AWWA A21.51/C115 and Class 53 thickness.

2. Flanges shall be cast iron class 125 and comply with ANSI B16.1.

3. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.

4. Bolt holes shall be in angular alignment within 1/2 degrees between flanges. Flanges shall be faced with a gasketed finish having concentric grooves a minimum of 0.25 millimeter deep by approximately 0.76 millimeters wide, with a minimum of three grooves on any given surface spaced a maximum of 6 millimeters apart.

F. Service Saddles for Ferrous Metal Piping

1. Iron service saddles shall be used for the installation of the flow switch. Service saddles shall be capable of withstanding 10 bar internal pressure without leakage or overstressing. The run diameter shall be compatible with the outside diameter of the pipe on which the saddle is installed. Taps shall have threads compatible with the attached piping. Saddles shall have epoxy-coated, ASTM A 536 ductile-iron bodies and stainless steel straps, steel hex nuts with washers, and neoprene seals.

2. Corporation stops shall be installed for each service saddle and shall be ball-valve-type.

G. Supports and Thrust Blocks:

1. Contractor must insure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force mainpiping shall be anchored with thrust blocks where shown on the contract drawings.

2.6 DIESEL ENGINES

Diesel engines shall be water-cooled, heavy duty, compression-ignition, cold-starting engines with removable cylinder sleeves. Engines may be 2-cycle or 4-cycle and may be either naturally aspirated, scavenged or turbocharged and shall operate satisfactorily on No. 2D diesel fuel conforming to ASTM D 975. Engines shall be provided with a manual clutch and arranged for connection to the pump through a flexible shaft with a splined joint. Engines shall be current models of a type in regular production and shall be complete with all devices specified and normally furnished with the engine. Engines shall have a published continuous horsepower rating at least 150 percent greater than that required at any point on the pump performance curve at the specified pump speed plus power required for any engine driven accessories. Naturally aspirated ratings shall be decreased by 3 percent for every 300 m of altitude, and 1 percent for every 5 degrees C that the engine performance conditions exceed the published rating conditions. Scavenged or turbocharged engine ratings shall be decreased as indicated by the engine manufacturer's engine performance data. Engine shall be suitable for performance at 49 degrees C (120 degrees F) ambient and 3000 mm (10 ft) elevation. Engine speed shall not exceed 1,800 rpm when driving the pump at rated conditions. Engines shall be capable of starting and assuming full load within 10 to 15 seconds, with a minimum ambient temperature of 4.5 degrees C (40 degrees F). Approved engine jacket water heaters shall be provided as recommended by the manufacturer.

2.7 ENGINE EQUIPMENT AND ACCESSORIES

2.7.1 Governor

Engine shall be equipped with an adjustable constant speed governor set to maintain pump speed within 3 percent of rated speed at rated load. A separate, manual reset, overspeed device shall be provided which shall shut down the engine in the event the speed reaches approximately 15 percent above rated speed.

2.7.2 Cooling System

Cooling system shall be the forced-circulation, closed type and shall include a fan and an engine mounted radiator. Flexible connections shall be used to connect the inlet and outlet radiator connections to the engine. Radiator shall be of sufficient capacity to operate the engine at full

rated load at 49 degrees C (120 degrees F) ambient temperature. Radiator shall be provided with a flange for connection to the exhaust air duct. Closed jacket water circuit shall be thermostatically controlled, and shall include an integral circulating pump. Drain cocks shall be provided at low points of the closed jacket water system. Exhaust manifolds shall be water jacketed or provided with an insulating jacket furnished by the engine manufacturer. Engine cooling system shall be charged with an inhibited ethylene-glycol solution to provide antifreeze protection to 4.5 degrees C (40 degrees F).

2.7.3 Lubrication

Engine lubrication shall be a pressure circulation system with an engine driven pump and engine mounted oil cooler. Full flow type filters with automatic bypass or bypass type filters shall be provided. Filter elements shall be of replaceable type and shall be readily accessible.

2.7.4 Exhaust System

Engine exhaust system shall be equipped with an industrial type silencer with drains and flexible, stainless steel connection. Flexible connector shall be provided with factory fabricated expanded metal personnel protection guards. Silencers shall be mounted outside as indicated and shall be of the straight through, or side inlet type as required to suit the space available and the engine exhaust arrangement. An engine with dual exhaust outlets and provided with one exhaust silencer shall have dual inlets on the silencer or a factory fabricated Y-branch or equivalent fitting to join the two exhausts together.

2.7.5 Air Intake Equipment

Each engine shall be provided with a dry cleanable type intake air cleaner. Filter shall be engine mounted.

2.7.6 Starting Equipment

Engine shall be provided with an electric starting motor suitable for the starting service specified.

2.7.7 Batteries

Each engine shall be provided with heavy-duty nickel-cadmium alkaline or lead acid type starting batteries. Batteries shall have sufficient capacity at 4.5 degrees C (40 degrees F) to provide the necessary cranking speed through 15 minutes of cranking cycles specified. Batteries shall be provided with a battery rack, and if material is not inherently resistant to acid, coating shall be applied to the stand. Connecting cables shall be provided as required. A dual battery set sized to NFPA 20 requirements with rack and cables shall be provided for fire service systems.

2.7.8 Battery Charging

Engine shall be equipped with an engine driven battery charging alternator with a regulator for use when the engine is running. A separately mounted

battery charger shall also be furnished. Battery charger shall be an automatic, float type providing continuous taper charging. Output characteristics shall match the requirements of the battery furnished. Charger shall be suitable for operation on 240 volt, single-phase, 60 Hz current and shall be rated not less than 6 amperes dc. A dual battery charger of proper type for batteries used shall be provided for fire service systems. Where wall mounting is indicated, enclosure shall be suitable for conduit connection, and ventilating openings shall be guarded. An interlock is required between the engine driven charging system and the charger. Battery charger shall have the following features:

a. Direct current voltage regulation shall be within plus or minus 2 percent for variations in line voltage of plus or minus 10 percent.

b. Direct current voltmeter and direct current ammeter, each with numerical scales.

c. Automatic surge suppressor.

d. Automatic current limiting to prevent overloading due to engine cracking, shorted output or reversed battery connections.

e. Alternating current line fusing.

f. Equalize charge rate with manually set timer.

g. Integral protection to prevent battery discharge through the charger on loss of alternating current line voltage.

h. Terminal block with terminals for all external connections.

2.7.9 Safety Controls

Each engine shall be equipped with automatic shut down features to stop the engine for high jacket water temperature, low oil pressure, and engine overspeed. Shutdown features shall be connected to the annunciator on the instrument panel and each shutdown feature will be identified.

2.7.10 AUTOMATIC ENGINE CONTROL PANEL

A. A combination manual and automatic type controller with "manual-Off-Automatic" selector switch shall be provided also, a 115 volt single phase power failure relay or a pressure switch, which will (when the system drops to set point psig) activate all electrical circuits to automatically start the engine.

B. Should the engine fail to start after the required cranking cycles,the controller shall disconnect the starting circuit and activate an alarm system using lights and buzzer and bell. "Low oil pressure" and "high engine temperature" shall also be indicated by a suitable alarm system. The engine shall not shut down if either of these conditions occurs during an operating cycle.

C. The engine shall be started automatically by the controller at least once a week and operate a minimum of 30 minutes. An appropriate timing arrangement shall determine the day and hour of this test.

D. Starting the engine by a flow switch relay shall be included in the controller circuit.

2.7.11 ELECTRICAL CONTROL COMPONENTS

A. The electrical control components shall be provided by the pump station supplier and shall be provided with the following features.

B. Panel Enclosure

1. Enclosure shall be constructed in conformance with applicable section of National Electrical Manufacturers Association (NEMA) standards for Type 1 electrical enclosures. Enclosure shall be fabricated of steel having a minimum thickness of not less than 2 millimeter (14 gauge). All seams shall be continuously welded, and shall be free of burrs and voids. Interior and exterior surfaces shall be white enamel. There shall be no holes through the external walls of the enclosure for mounting the enclosure or any components contained within the enclosure. Panel enclosure up to 1524 x 915 x 305 millimeters shall be mounted on floor stands and secured to pump base.

2. Enclosure shall be equipped with a door mounted on a continuous steel hinge, and sealed around its perimeter. Door shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.

3. Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 2.7 millimeter (12 gauge) which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.

4. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. Self-tapping screws shall not be used to mount any components. All connections from the back panel to door mounted or remote devices shall be made through terminal blocks.

5. Six digit elapsed time meters (non-reset type) shall be connected to each pump motor starter to indicate the total running time of each pump in "hours" and "tenths of hours".

6. A duplex ground fault indicating utility receptacle providing 115 VAC, 60 hertz, single-phase current shall be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

7. Indicating lights shall be oil tight type and equipped with integral step-down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less. Lamps shall be replaceable from

the front without opening the control panel door and without the use of tools. Indicating lights will be provided for the following functions:

a. Pump #1 high pump temperature shutdown
b. High wet well level
c. Alarm silenced
d. Pump #1 run
e. Engine low oil pressure
f. Engine high temperature
g. Engine overspeed
h. Engine overcrank
i. 115 volt power available
j. (Low water alarm optional)

2.7.12 Fuel System

Fuel system consisting of storage tank, day tank, connecting piping, and accessories shall conform to the applicable items of NFPA 30 and NFPA 37. A horizontal underground storage tank with a capacity of 1135 liters (300 gallons) shall be provided for the storage of No. 2 diesel fuel. The storage tank shall be a base mounted integral fuel tank.

2.8 EQUIPMENT APPURTENANCES

2.8.1 Attachments

All necessary bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be furnished with the equipment. Bolts shall conform to the requirements of ASTM A 307 and nuts shall be hexagonal of the same quality as the bolts used. Threads shall be clean-cut and shall conform to ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, shall be zinc coated after being threaded, by the hot-dip process conforming to ASTM A 123 as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel shall be Type 316.

2.8.2 Equipment Guards

Equipment driven by open shafts, belts, chains, or gears shall be provided with all-metal guards enclosing the drive mechanism. Guard shall be constructed of galvanized sheet steel or galvanized woven wire or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment. The guards shall conform in all respects to all applicable safety codes and regulations.

2.8.3 Tools

A complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment shall be furnished. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools shall be high-grade, smooth, forged, alloy, tool steel. One pressure grease gun for each type of grease

required for diesel engines shall also be furnished. All tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such tools until completion of the work, at which time they shall be delivered to the Contracting Officer.

2.8.4 Shop Painting

All motors, pump casings, and similar parts of equipment customarily finished in the shop shall be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Ferrous surfaces not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

PART 3 EXECUTION

3.1 INSTALLATION

Each pump and engine shall be installed in accordance with the written instructions of the manufacturer and under the direct supervision of the manufacturer's representative. Engine fuel supply system shall be installed as indicated and in conformance with NFPA 30 and NFPA 37.

3.1.1 Concrete Foundations

Concrete for equipment foundations and for any required ballast for fuel storage tanks shall be as specified in Section 03300 CONCRETE FOR BUILDING CONSTRUCTION. Concrete foundations shall be integral with and of the same class as that of the building floor unless otherwise indicated. Concrete having a compressive strength of at least 17 MPa shall be used in foundations that are entirely separated from the surrounding floor. A premolded filler strip shall be installed between the foundation and floor slab as shown. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.2 TESTS

After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. The Contractor shall make arrangements to have the manufacturer's representatives present when field equipment tests are made. Each pumping unit shall be given a running field test in the presence of the Contracting Officer for a minimum of 2 hours with each combination of electric motor and engine drive. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. The Contractor shall provide an accurate and acceptable method of measuring the discharge flow. Each engine shall be operated for a minimum of 4 hours at a point of maximum horsepower indicated on the pump head-capacity curve or such other point on the curve selected by the Contracting Officer. For submersible pumping units, an insulation resistance test of the cable and the motor shall be conducted prior to installation of the pump, during installation of the pump, and after installation is complete. The resistance readings shall not be less than 10 megohms. Tests shall assure that the units and

appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.3 FIELD PAINTING

Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted.

3.3.1 Touch-Up Painting

Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and topcoated with the manufacturer's standard factory finish.

3.3.2 Exposed Ferrous Surfaces

Exposed ferrous surfaces shall be painted with two coats of enamel paint conforming to SSPC Paint 21. Factory primed surfaces shall be solvent-cleaned before painting. Surfaces that have not been factory primed shall be prepared and primed with one coat of SSPC Paint 25 or in accordance with the enamel paint manufacturer's recommendations.

3.4 MANUFACTURER'S FIELD SERVICES

The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installation, adjustment, and testing of the equipment. Up to 2 days service shall be provided at no expense to the Government.

3.5 DEMONSTRATION

Upon completion of the work and at a time designated by the Contracting Officer, the services of one or more competent engineers shall be provided by the Contractor for a period of not less than 8 hours to instruct a representative of the Government in the operation and maintenance of equipment furnished under this section of the specifications. These field instructions shall cover all the items contained in the bound instructions.

-- End of Section --

SECTION 13202

FUEL STORAGE SYSTEMS
05/97
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-16	(1996) Standard Specifications for Highway Bridges

AMERICAN PETROLEUM INSTITUTE (API)

API Bull 1529	(1998) Aviation Fueling Hose
API Publ 1581	(1989; R 1994; Addenda July 1995) Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators
API RP 1110	(1997) Pressure Testing of Liquid Petroleum Pipelines
API RP 1615	(1996) Installation of Underground Petroleum Storage Systems
API RP 1631	(1997) Interior Lining of Underground Storage Tanks
API Spec 5L	(1995; Errata Dec 1997) Line Pipe
API Spec 6D	(1994; Supple 1 June 1996; Supple 2 Dec 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)
API Spec 6FA	(1994) Fire Test for Valves
API Std 594	(1997) Check Valves: Wafer, Wafer-Lug and Double Flanged Type
API Std 607	(1993) Fire Test for Soft-Seated Quarter-Turn Valves

API Std 610	(1995) Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M	(1996) Steel Castings, Carbon, for General Application
ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 167	(1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(1995b) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M	(1997c) Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 193/A 193M	(1998) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(1998) Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
ASTM A 216/A 216M	(1998) Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 234/A 234M	(1997) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 276	(1998) Stainless Steel Bars and Shapes
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 312/A 312M	(1995a) Seamless and Welded Austenitic Stainless Steel Pipes

ASTM A 356/A 356M	(1998) Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines
ASTM A 358/A 358M	(1995a) Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service
ASTM A 403/A 403M	(1998) Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 733	(1993) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 743/A 743M	(1995) Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B 26/B 26M	(1997) Aluminum-Alloy Sand Castings
ASTM B 241/B 241M	(1996) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 345	(1996) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube for Gas and Oil Transmission and Distribution Piping Systems
ASTM B 687	(1996) Brass, Copper, and Chromium-Plated Pipe Nipples
ASTM C 33	(1997) Concrete Aggregates
ASTM D 229	(1996) Rigid Sheet and Plate Materials Used for Electrical Insulation
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 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 4021	(1992) Glass-Fiber-Reinforced Polyester Underground Petroleum Storage Tanks
ASTM D 5677	(1995) Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint type, for Aviation Jet Turbine Fuel Lines
ASTM E 94	(1993) Radiographic Testing

ASTM F 436	(1993) Hardened Steel Washers
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 1172	(1988; R 1998) Specification for Fuel Oil Meters of the Volumetric Positive Displacement Type
ASTM F 1199	(1988; R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988; R 1998) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)
ASTM G 62	(1987; R 1998) Standard Test Methods for Holiday Detection in Pipeline Coatings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(1996; B16.34a) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1986; R 1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.3	(1996; B31.3a; B31.3b; B31.3c) Process Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing

Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C203	(1997) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1	(1991) Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.4	(1992) Stainless Steel Electrodes for Shielded Metal Arc Welding
AWS A5.10	(1992) Aluminum and Aluminum Alloy Bare Welding Electrodes and Rods

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-50696	(Basic) Reels, Static Discharge, Grounding, 50 and 75 Foot Cable Lengths

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

MILITARY SPECIFICATIONS (MS)

MS MIL-M-81380	(Basic) (Rev C) Monitor, Contamination, Aviation Fuel Dispensing System

NATIONAL ASSOCIATION OF CORROSION ENGINEERS (NACE)

NACE RP0169	(1996) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
NACE RP0190	(1995) External Protective Coatings for Joints, Fittings, and Valves on Metallic Underground or Submerger PipeLines and Piping Systems
NACE RP0274	(1998) High Voltage Electrical Inspection

of Pipeline Coatings Prior to Installation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996; Errata TIA 96-2) Flammable and Combustible Liquids Code
NFPA 30A	(1996) Automobile and Marine Service Station Code
NFPA 70	(1999) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATING (SSPC)

SSPC SP 6/NACE 3	(1994) Commercial Blast Cleaning

STEEL TANK INSTITUTE (STI)

STI F894	(1997) Specification for External Corrosion Protection of FRP Composite Steel Underground Storage Tanks
STI F911	(1993) Standard for Diked Aboveground Storage Tanks
STI P3	(1997) Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks

UNDERWRITERS LABORATORIES (UL)

UL Gas&Oil Dir	(1996; Supple) Gas and Oil Equipment Directory
UL 58	(1996; Rev thru Jul 1998) Steel Underground Tanks for Flammable and Combustible Liquids
UL 87	(1995; Rev thru Oct 1998) Power-Operated Dispensing Devices for Petroleum Products
UL 142	(1993; Rev Jul 1998) Steel Aboveground Tanks for Flammable and Combustible Liquids
UL 330	(1996; Rev thru Jan 1998) Hose and Hose Assemblies for Dispensing Flammable Liquids
UL 567	(1996; Rev thru Oct 1997) Pipe Connectors for Petroleum Products and LP-Gas

UL 842	(1997; Rev Oct 1997) Valves for Flammable Fluids
UL 913	(1997) Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division I, Hazardous (Classified) Locations
UL 1316	(1994; Rev Apr 1996) Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures
UL 1746	(1993; Rev thru Sep 1998) External Corrosion Protection Systems for Steel Underground Storage Tanks
UL 2085	(1997) Insulated Aboveground Tanks for Flammable and Combustible Liquids

1.2 SYSTEM DESCRIPTION

The work shall include the design, fabrication and installation of the entire fuel storage and dispensing type system in conformance with pertinent federal, state, and local code requirements. The completed installation shall conform to NFPA 30 and NFPA 30A as applicable.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Fueling System; GA.

Manufacturer's standard catalog data, prior to the purchase or installation of the particular component, highlighted to show brand name, model number, size, options, performance charts and curves, etc., in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment.

Permitting; FIO.

Six copies of all required federal, state, and local permits.

Registration; FIO.

Required tank registration forms, 30 days after contract award, in order for the Contracting Officer to submit the forms to the regulatory agency.

Spare Parts Data; FIO.

Spare parts data for each different item of equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

SD-04 Drawings

Fueling System; GA.

Detail drawings including a complete list of equipment and materials. Detail drawings shall contain:

(1) Complete piping and wiring drawings and schematic diagrams of the overall system.

(2) Equipment layout and anchorage.

(3) Clearances required for maintenance and operation.

(4) Any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

Monitoring Systems; GA.

Detail drawings of the monitoring system including a complete list of equipment and materials. Drawings shall contain:

(1) An overview drawing which details the leak detection system operation.

(2) An overview drawing which details the liquid level and setpoint monitoring.

(3) Wiring schematics for each part of the fueling system. The schematics shall indicate each operating device along with their normal ranges of operating values (including pressures, temperatures, voltages, currents, speeds, etc.).

(4) Single line diagrams of the system.

(5) Panel layout along with panel mounting and support details.

SD-06 Instructions

Installation; FIO.

Manufacturer's installation instructions and procedures on all parts and equipment.

Framed Instructions; FIO.

Framed instructions for posting, at least 2 weeks prior to construction completion.

Monitoring Systems; FIO.

System diagrams for posting, at least 2 weeks prior to construction completion, including distance markings so that alarm indications can be correlated to leak location in plan view if a cable detection system is used. The diagrams shall include a piping and wiring display map with schematic diagrams from the leak detection system manufacturer. The diagrams shall be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

SD-07 Schedules

Filter-Separator Factory Tests; FIO.

A schedule, at least 2 weeks prior to the factory tests, which identifies the date, time, and location for the tests.

Tests; FIO.

A letter, at least 10 working days in advance of each test, advising the Contracting Officer of the test. Individual letters shall be provided for each test specified herein.

Demonstrations; GA

A letter, at least 14 working days prior to the proposed training date, scheduling a proposed date for conducting the onsite training.

SD-08 Statements

Experience; FIO.

A letter listing prior projects, the date of construction, a point of contact for each prior project, the scope of work of each prior project, and a detailed list of work performed. The letter shall also provide evidence of prior manufacturer's training, state licensing, and other related information.

Welding; FIO.

A letter listing the qualifying procedures for each welder. The letter shall include supporting data such as test procedures used, what was tested to, etc., and a list of the names of all qualified welders and their identification symbols.

Verification of Dimensions; FIO.

A letter stating the date the site was visited and a listing of all discrepancies found.

Fuel Supply; FIO.

A letter, at least 120 days prior to fuel delivery, stating the amount of fuel required for testing, flushing, cleaning, or startup of the system. The letter shall define the required dates of each fuel delivery necessary.

Exterior Coating for Belowground Steel Piping; FIO.

Certification, prior to performing the exterior coating tests, from the tester manufacturer of the electric holiday detector's latest calibration date and crest voltage testing.

SD-09 Reports

Filter-Separator Factory Tests; GA.

Six copies of the report in bound letter-size booklets. Report shall certify compliance with the testing and qualification procedures defined in API Publ 1581. The report shall contain complete records of the tests including data sheets, performance curves, chronological test records, photographs, sample calculations, test procedures, and a description of the test apparatus. The report shall include color photographs of the sample elements before and after tests.

Tests; GA.

Six copies of each test containing the information described below in bound letter-size booklets. Individual reports shall be provided for the storage tank tests, the piping tests, the system performance tests, the high level alarm test, and the system leak tests. Drawings shall be folded blue lines, with the title block visible.

(1) The date the tests were performed.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken.

(4) The parameters to be verified.

(5) The condition specified for the parameter.

(6) The inspection results, signed, dated, and certified by the installer. The certification shall state that required procedures were accomplished, that the procedures were conducted in compliance with the plans and specifications.

(7) A description of adjustments performed.

SD-19 Operation and Maintenance Manuals

Operation Manuals; FIO.

Six complete copies of operation manuals in bound letter-size booklets

listing step-by-step procedures required for system startup, operation, and shutdown at least two weeks prior to the demonstrations. The manuals shall include the manufacturer's name, model number, service manual, a brief description of each piece of equipment, and the basic operating features of each piece of equipment. The manuals shall include procedures necessary for annual tightness testing of the storage tanks and secondary containment piping.

Maintenance Manuals; FIO.

Six complete copies of maintenance manuals in bound letter-size booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide at least 2 weeks prior to the demonstrations. The manuals shall include piping, equipment layouts, and simplified wiring and control diagrams of the system as installed.

1.4 QUALIFICATIONS

1.4.1 Experience

Each installation Contractor shall have successfully completed at least 3 projects of the same scope and the same size or larger within the last 6 years. Each installation Contractor shall demonstrate specific installation experience in regard to the specific system installation to be performed. Each installation Contractor shall have taken, if applicable, manufacturer's training courses on the installation of piping, leak detection, and tank management systems and meet the licensing requirements in the state.

1.4.2 Welding

Welding shall be in accordance with qualifying procedures using performance qualified welders and welding operators. Welding tests shall be performed at the work site. Procedures and welders shall be qualified in accordance with ASME BPV IX. Each welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.5 REGULATORY REQUIREMENTS

1.5.1 Permitting

Contractor shall obtain necessary permits in conjunction with the installation of belowground storage tanks as required by federal, state, or local authority.

1.5.2 Registration

Contractor shall obtain and complete all required tank registration forms required by federal, state, and local authorities.

1.6 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather and contamination. Proper

protection and care of material before, during, and after installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

After becoming familiar with all details of the project, the Contractor shall verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7.2 Fuel Supply

Fuel required for the flushing, cleaning, and testing of materials, equipment, piping, meters, pumps, instruments, etc., as specified in this section shall be provided by the Contracting Officer. Fuel will be provided by tank trucks. The Contracting Officer will furnish the tank trucks, operators, equipment, and services required for the tank truck operations. The Contractor shall provide the labor, equipment, appliances, and materials required for the flushing, cleaning, and testing operations. Systems shall not be flushed, cleaned, or tested with any fuel or liquid not intended for final system operation. Fuel used in the system shall remain the property of the Government. Fuel shortages not attributable to normal handling losses shall be reimbursed to the Government.

1.7.3 Safety Requirements

Exposed moving parts, parts that produce high operating temperatures and pressures, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The 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. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. 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 manufacturer's factory tests, can be shown. Products shall be supported by a service organization. System components shall be environmentally suitable for the indicated locations. The completed

installation shall conform to the applicable requirements of NFPA 30 or NFPA 30A, as applicable.

2.2 NAMEPLATES

Parts and equipment specified herein shall have an attached nameplate to list the manufacturer's name, address, component type or style, model or serial number, catalog number, capacity or size, and the system which is controlled. Plates shall be durable and legible throughout equipment life and made of anodized aluminum. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

Electrical equipment, motors, and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Electrical bonding of materials shall be performed in accordance with NFPA 70.

2.4 MATERIALS IN CONTACT WITH FUEL

Galvanized materials (zinc coated) shall not be allowed in direct contact with any fuel.

2.5 ABOVEGROUND STORAGE TANK

2.5.1 Secondarily Contained (Concrete Vaulted) Tank

Tank system shall be a factory fabricated, concrete encased storage tank with integral secondary containment. Tank system shall be in accordance with NFPA 30 and NFPA 30A. Tank system shall be designed and manufactured for horizontal installation. Primary storage tank shall be constructed of single wall steel in accordance with UL 142. The primary tank shall be isolated from the exterior concrete vault with either insulation, an inert material, or minimum 50 mm standoffs. Tanks isolated with insulation or an inert material shall then be encased by a minimum of 0.75 mm, high density, polyethylene liner. The lined tank shall be encased by a minimum of 150 mm of 20.7 MPa (3000 psi) strength, monolithically poured, reinforced concrete. Tank system shall have a 2-hour fire rating, and conform to the requirements of UL 2085, and bear the UL 2085 label. No exterior enclosure shall be allowed to cover the reinforced concrete. Tank system shall be skid mounted and provided with lifting lugs which allow tank relocation. Tank system shall include a 19 L (5 gallon) overfill containment to prevent spillage of fuel during tank filling. The tank system shall be provided with the manufacturer's standard ladder and platform assembly, except as modified herein. The assembly shall be constructed of structural steel and shall allow access to the top of the tank system.

2.5.2 Tank Exterior Protective Coating

Tank exterior protective coating shall be Concrete vaulted type tanks shall be provided with a white epoxy exterior coating on the top and sides to resist weather and to reflect sunlight.

2.5.3 Tank Interior Protective Coating

Tank shall be provided with an interior protective coating in accordance with API RP 1631 from the tank bottom up to 1 m off the bottom.

2.5.4 Tank Piping Penetrations

The number and size of tank piping penetrations shall be provided as indicated. Nylon dielectric bushings shall be provided on all pipe connections to a tank. Pipe connections to a tank shall be through welded-in-place double tappered NPT couplings. The termination of fill lines within a tank shall be provided with an antisplash deflector. [Tank suction line shall be provided with a footvalve to prevent line drainage.]

2.5.5 Tank Cleanout and Gauge Connection

Tank shall be provided with a combination cleanout and gauge connection. The connection shall consist of a 50 mm pipe extending downward through the top of the tank to within 75 mm of the tank bottom. The entire length of pipe inside the tank shall be provided with 13 mm wide by 300 mm long slots at alternate locations. The top of the pipe shall be provided with a bronze top-seal type adapter with a corresponding locking type cap. Tank shall have an interior striker/impact plate attached directly under the cleanout and gauge connection. The striker/impact plate shall be a minimum of 6 mm in thickness, be larger in diameter than the tank penetration, and fit the curvature of the tank bottom.

2.5.6 Tank Atmospheric Venting

Vent pipe shall be in accordance with NFPA 30, NFPA 30A, and UL 142. Vent pipe sizing shall be as indicated.

2.5.7 Tank Emergency Venting

Vent shall be the emergency venting, tank manway type designed to relieve at a 13.8 kPa (2 psig) pressure. Vent shall comply with NFPA 30. Each manway shall have a watertight, self-closing type manway cover.

2.5.8 Tank Overfill Alarm System

Tank shall be provided with an overfill alarm system. The system shall include a mechanically-actuated float actuator and an alarm panel. The float actuator shall be field adjustable. The alarm panel shall include an alarm light, an audible alarm, and reset capabilities. The alarm panel shall be mounted adjacent to the tank as indicated. The alarm panel shall initiate a minimum 70 decibel audible alarm when the liquid level within a tank reaches the 90 percent full level. The alarm system shall conform to the requirements of paragraph MONITORING SYSTEM.

2.5.9 Tank Mounted Fuel Dispensing Unit

Fuel dispensing unit with integral UL labeled suction pump shall be as supplied by the tank manufacturer. Unit shall include all necessary appurtenances for operation. Unit shall include a visible register to

indicate individual deliveries up to 999.9 liters with a reset meter. Pump shall have a delivery capacity of 0.95 liters/sec. Hose shall be a minimum 20 mm inside diameter, 4.6 meters long, and fuel resistant. The dispensing nozzle shall be of the automatic shutoff type with graduated notches for various delivery speeds. Dispensing unit shall provide a means for locking of the nozzle to the pump when the pump is shutoff. Diesel fuel dispensing unit cabinet shall be painted yellow from the manufacturer. Units shall be clearly marked for the fuel they are dispensing.

2.6 TANK GAUGES

2.6.1 Stick Gauge

Tank shall be provided with 2 stick gauges graduated in m and mm. Stick gauge shall be of wood and treated after graduating to prevent swelling or damage from the fuel being stored.

2.6.2 Tank Calibration Charts

Tank shall be furnished with 2 copies of calibrated charts which indicate the liquid contents in L for each 3 mm of tank depth.

2.6.3 Analog Tank Gauge

Each storage tank shall be provided with an automatic analog reading gauge which is directly mounted to a tank's manway cover. Gauge shall be a level sensing, mechanically actuated device which provides the necessary readout in a sealed glass cap contained in a gauge box. Gauge shall be accurate to plus or minus 6 mm and be capable of measuring the liquid level over the full range of a tank's height. Gauge shall have vapor tight seals to prevent condensate from fogging the viewing glass.

2.6.4 Hydrostatic Tank Gauge System

System shall be the dial type calibrated in L. Gauge shall be manually actuated using a built-in hand pump. The transmission line from the gauge to the tank shall be seamless copper tubing run in Schedule 80 PVC carrier pipe. The tank assembly (fittings, air bells, and tubing) shall be installed according to the gauge manufacturer's recommendations.

2.6.5 Digital Tank Gauge System

Gauge shall be mechanically or electronically actuated and include a sending unit that transmits a digital signal to a liquid level electronic panel. The electronic panel shall be capable of providing a liquid level readout for each tank in terms of mm and L. Gauge shall be accurate to plus or minus 2 mm and be capable of measuring a tank's liquid level over a tank's full usable liquid level range. Gauge construction shall be compatible with the fuel to be handled. Gauge shall be capable of measuring water accumulation in mmfrom 20 to 125 mm off the bottom of a storage tank. Gauge shall be capable of constantly sensing the fuel level in a storage tank as well as acknowledging 2 programmable liquid level setpoints. The electronic panel shall activate an audible and visual alarm when each setpoint is monitored. The 2 liquid level setpoints to be

monitored shall include a tank's 90 percent liquid level (Setpoint 1) and a tank's 95 percent liquid level (Setpoint 2). The panel shall have a means of delineating between the individual setpoints and the individual tanks.

2.7 ADAPTERS AND COUPLERS

2.7.1 Tight-Fit Fill Adapter

Adapter shall be bronze and be fitted with a Buna-N or Viton gasket. Adapter shall be the API standard 75 mm size. Adapter shall be a top seal adapter and provide a tight-fit connection to prevent vapor emissions during filling. The adapter shall be provided with a locking cap. The cap shall mate with the adapter and have a latching mechanism which provides a water tight seal. The cap shall provide some type of locking provision and be easily attachable and removable. The cap shall be attached to the tight-fit vapor recovery adapter by a 300 mm section of brass cable or fuel resistant rope.

2.7.2 Tight-Fit Vapor Recovery Adapter

Adapter shall be bronze and be fitted with a Buna-N or Viton gasket. Adapter shall be the API standard 100 mm size. Adapter shall provide a tight-fit connection to prevent vapor emissions during filling. Adapter shall have an internal spring loaded poppet which prevents vapor emissions from the storage tank when the locking cap is removed. The poppet shall open immediately during tank fill. The poppet shall operate at a lower pressure/vacuum than the tank's pressure/vacuum relief vent in order for vapors to return to the delivery truck instead of exiting through the vent piping. The poppet, the poppet stem, and the poppet spring shall be stainless steel. The adapter shall be provided with a locking cap. The cap shall mate with the adapter and have a latching mechanism which provides a water tight seal. The cap shall provide some type of locking provision and be easily attachable and removable. The cap shall be attached to the tight-fit vapor recovery adapter by a 300 mmsection of brass cable or fuel resistant rope.

2.8 SUPPLEMENTAL COMPONENTS

2.8.1 Earthwork

Excavation and backfilling for piping shall be as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein. Backfill for FRP tanks and pipe shall be pea gravel or crushed stone. Backfill for steel tanks and pipe, aluminum pipe, and stainless steel pipe shall be pea gravel, crushed stone, or sand.

2.8.1.1 Pea Gravel

Pea gravel shall be between 3 and 20 mm diameter.

2.8.1.2 Crushed Stone

Crushed stone shall be between 3 and 13 mm in diameter in accordance with ASTM C 33.

2.8.1.3 Sand

Sand shall be fine sand aggregate in accordance with ASTM C 33, washed and thoroughly dried, contain no more than 500 PPM chlorides, contain no more than 500 PPM sulfates, and have a pH greater than 7.

2.8.2 Street Manway Assembly

Round street manhole frames and covers shall be the straight traffic type. Frames and covers shall be constructed of cast iron in accordance with ASTM A 27/A 27M, grade 60-30 as a minimum. Covers shall be the solid plate type with a checker pattern. Covers shall form a watertight seal with the manhole frame to prevent surface water inflow. Frame and cover assembly shall be rated to withstand H-20 highway loading as defined by AASHTO HB-16.

2.8.3 Fuel Oil Meter

Meter shall be the volumetric positive displacement type in accordance with ASTM F 1172, except as modified herein. Meter shall indicate the fuel oil flow rate in L/s. Meter shall be provided with overspeed protection and a water escape hole. If meter is not mounted in-line with the piping, then the Contractor shall provide an appropriate pedestal for mounting. Meter installation shall be in accordance with manufacturer's recommendations. Meter shall be capable of providing a 4-20 mA analog output signal for the fuel flow rate.

2.8.4 Electrically Isolating Flanges

Flanges shall be provided with an electrical insulating material of 1000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of the type of fuel to be handled. Gaskets shall be full face and be provided between flanges. Flanges shall have full surface 0.75 mm thick, spiral-wound mylar insulating sleeves between the bolts and the holes in the flanges. Bolts may have reduced shanks of a diameter not less than the diameter at the root of the threads. High-strength 3 mm thick phenolic insulating washers shall be provided next to the flanges with flat circular stainless steel washers over the insulating washers. Bolts shall be long enough to compensate for the insulating gaskets and stainless steel washers.

2.8.5 Electrically Isolating Union

Union shall be provided with an electrical insulating material of 1000 ohms minimum resistance conforming to ASTM D 229. The material shall be resistant to the effects of the type of fuel to be handled.

2.8.6 Concrete Anchor Bolts

Concrete anchor bolts shall be group II, Type A, class 2 in accordance with ASTM A 307.

2.8.7 Bolts

Bolts shall be in accordance with ASTM A 193/A 193M, Grade B8.

2.8.8 Nuts

Nuts shall be in accordance with ASTM A 194/A 194M, Grade 8.

2.8.9 Washers

Washers shall be in accordance with ASTM F 436M, , flat circular stainless steel. Washers shall be provided under each bolt head and nut.

2.8.10 Exterior Coating of Miscellaneous Items

Steel surfaces to be externally coated or painted shall be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6/NACE 3 prior to the application of the coating. Exterior surfaces, other than stainless steel pipe and flexible connectors, which are not otherwise painted and do not require the application of an exterior coating, as well as all items supplied without factory-applied finish paint, not including primer only items, shall be painted as specified in Section 09900PAINTING, GENERAL.

2.8.11 Buried Utility Tape

Detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape shall be provided for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Tape shall be provided in minimum 75 mm width rolls, color coded for the utility involved, with warning identification imprinted in bold black letters continuously and repeatedly over entire tape length. Permanent code and letter coloring shall be used which is unaffected by moisture and other substances contained in trench backfill material.

2.9 MONITORING SYSTEM

2.9.1 Aboveground Vaulted Tanks

The interstitial space of each vaulted tank shall be continuously and automatically monitored to detect breaches in the integrity of the primary tank and the exterior vaulted shell. The interstitial space shall be monitored by an electronic capacitance type liquid sensor capable of distinguishing the difference between hydrocarbons and water. Sensors shall be intrinsically safe for use in Class 1, Division 1, Group D environment as defined by NFPA 70. Sensors shall be easily removed from the tank. Sensors shall be compatible with the electronic monitoring panel.

2.9.2 Electronic Monitoring Panel

panel shall be remotely-mounted where indicated and shall be capable of providing an audible and visual alarm in the event of a detected leak. Audible alarms shall be a buzzer sounding at 70 decibels or greater. Each visual alarm shall indicate the type and location of the alarm condition. Visual alarms shall be capable of delineating between individual alarm conditions. Panel shall provide a means of delineating between individual

alarm conditions. Panel shall be housed in a NEMA 4 rated enclosure in accordance with NEMA 250. Panel shall have a hinged door to swing left or right (doors shall not swing up or down). Panel using computer memory shall be capable of maintaining current programmable information in the event of a power failure. Panel shall be provided with a manual acknowledge switch which shall be capable of deactivating the audible alarm. The acknowledge switch shall not be capable of deactivating subsequent audible alarms unless depressed manually again for each occurrence. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected. Switches shall be an integral component located on the front panel and be either a key switch or push button.

2.10 PIPING COMPONENTS

2.10.1 Product Piping

Piping routinely carrying fuel shall be steel as defined herein.

2.10.2 Vent and Vapor Recovery Piping

Piping shall be single wall steel as defined herein.

2.10.3 Steel Pipe

Carbon steel pipe shall be in accordance with ASTM A 53, Type E or S, Grade B, or API Spec 5L, seamless or electric-weld, Grade B. Pipe smaller than 65 mm shall be Schedule 80. ASTM A 53 pipe 65 mm and larger shall be Schedule 40. API Spec 5L pipe 65 mm and larger shall be Schedule 40S.

2.10.3.1 Connections for Steel Pipe

Connections for pipe or fittings smaller than 65 mm shall be forged, socket weld type, 2000 W.O.G. conforming to ASTM A 182/A 182M and ASME B16.11. Connections for pipe or fittings 65 mm and larger shall be butt weld type conforming to ASTM A 234/A 234M, Grade WPB and ASME B16.9 of the same wall thickness as the adjoining pipe. Piping in inaccessible locations, such as product piping inside of containment piping, shall be welded.

2.10.3.2 Welding Electrodes

Welding electrodes shall be E70XX low hydrogen type conforming to AWS A5.1 or AWS A5.4.

2.10.3.3 Threaded Connections

Threaded connections shall only be used on piping 50 mm in nominal size or smaller and only where indicated. Connections shall be in accordance with ASME B16.3, Class 150. Threaded connections shall be sealed tightly with a thread sealant or lubricant which is compatible with the fuel to be handled.

2.10.4 Valves

Portions of a valve coming in contact with fuel shall be compatible with the fuel to be handled. Valves shall have bodies, bonnets, and covers constructed of cast steel conforming to ASTM A 216/A 216M, Grade WCB. Each valve shall have stainless steel stem and trim. Valves shall be suitable for a working pressure of 1900 kPa (275 psig) at 38 degrees C with a weatherproof housing and be provided with flanged end connections unless indicated otherwise. Seats, body seals, and stem seals shall be Viton or Buna-N.

2.10.4.1 Gate

Valve shall be in accordance with API Spec 6D and conform to the fire test requirements of API Spec 6FA Valve shall be of the flexible wedge disc type, conduit disc type, or double disc type. Valve shall be of the rising stem type with closed yoke, or the non-rising stem type equipped with a device to give positive visual indication of the valve's position.

2.10.4.2 Swing Type Check

Valve shall be swing type conforming to API Spec 6D regular type. Check valves shall be the tilting disc, non-slam type. Discs and seating rings shall be renewable without removing from the line. The disc shall be guided and controlled to contact the entire seating surface.

2.10.4.3 Wafer Type Check

Valves shall conform to API Spec 6D and API Std 594. Wafer type check valves may be provided in lieu of swing check valves in piping sizes larger than 100 mm.

2.10.4.4 Ball

Valves 50 mm and larger shall conform to API Spec 6D. Valves smaller than 50 mm shall have one piece bodies and have a minimum bore not less than 55 percent of the internal cross sectional area of a pipe of the same nominal diameter. The ball shall be stainless steel. Valve shall be fire tested and qualified in accordance with API Spec 6FA or API Std 607. Valve shall be non-lubricated and operate from fully open to fully closed with 90 degree rotation of the ball.

2.10.4.5 Plug

Valve shall be in accordance with API Spec 6D. Valve shall be non-lubricated, resilient, double seated, trunnion mounted type with a tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valve shall have weatherproof operators with mechanical position indicators.

2.10.4.6 Globe

Valve shall conform to ASME B16.34.

2.10.4.7 Pressure\Vacuum Vent Relief

Valve pressure and vacuum capacities shall be in accordance with NFPA 30. Valve shall be factory set for 5.2 kPa (12 ounces per square inch) pressure and 215 Pa (0.5 ounce per square inch) vacuum. Pressure and vacuum relief shall be provided by a single valve. Valve shall be constructed of cast steel or aluminum with flanged or threaded end connections. Trim shall be stainless steel. Inner valve pallet assemblies shall have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats. Pallet seat inserts shall be of a material compatible with the fuel specified to be stored.

2.10.5 Accessories

2.10.5.1 Foot Valve

Foot valve shall be compatible with the fuel to be handled and with the working pressure of the system. Foot valve shall be the double-poppet design. Foot valve shall be provided with a minimum 20 mesh screen on the intake. Foot valve seats shall be the replaceable type. Foot valve shall be capable of passing through a 75 mm pipe or tank flange.

2.10.5.2 Flanges

Flanges installed on equipment, fittings, or pipe shall be Class 150 pound flanges which are rated in accordance with ASME B16.5. Flanges shall be the 1.6 mm (1/16 inch) raised face type, except for connections to FRP pipe. Connections to FRP pipe shall be made with flat face flanges. Stainless steel flanges shall conform to ASTM A 182/A 182M. Aluminum flanges shall conform to ASTM A 182/A 182M, alloy 6061-T6 or alloy 356-T6. Carbon steel flanges shall conform to ASTM A 181/A 181M, Grade 2.

2.10.5.3 Flange Gaskets

Flange gaskets shall be 2 mm (1/16 inch) thick, NBR, and be in accordance with ASME B16.21. Full-face gaskets shall be provided for flat-face flanged pipe joints. Ring gaskets shall be provided for raised-face flanged pipe joints.

2.10.5.4 Steel Coupling

Coupling shall be in accordance with API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.

2.10.5.5 Welded Nipple

Nipple shall be in accordance with ASTM A 733 or ASTM B 687 and of the same material as the product piping.

2.10.5.6 Threaded Union

Threaded unions shall only be used on cast steel piping 50 mm in nominal size or smaller and only where indicated. Union shall be in accordance with ASME B16.39, Class 150.

2.10.5.7 Joint Compound

Joint compounds for any type of piping system shall be resistant to water and suitable for use with fuel containing 40 percent aromatics.

2.10.5.8 Flexible Connector

Connectors shall conform to requirements of UL 567 and be the flexible metal hose, corrugated type with braided wire sheath covering. Connectors shall have close-pitch annular corrugations and be rated for a working pressure of at least 1900 kPa (275 psig) at 38 degrees C. Connectors shall have a minimum 300 mm live length with flanged end connections. Metal for hose and braided wire sheath shall be stainless steel in accordance with ASTM A 167.

2.10.5.9 Strainer

Strainer shall be in accordance with ASTM F 1199 or ASTM F 1200, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, and be the same size as the pipeline. Strainer body shall be fabricated of cast steel or brass with the bottom drilled and tapped. The body shall have arrows clearly cast on the sides indicating the direction of flow. Strainer shall be equipped with a removable cover and sediment screen. Screen shall be 60 mesh wire screen with larger wire mesh reinforcement. Screen shall be [0.76 mm brass or stainless steel. The ratio of net effective strainer area to the area of the connecting pipe shall be not less than 3 to 1.

2.10.5.10 Pipe Hangers and Supports

Hangers and supports shall be of the adjustable type and conform to MSS SP-58 and MSS SP-69, except as modified herein. The finish of rods, nuts, bolts, washers, hangers, and supports shall be hot-dipped galvanized. Nuts, bolts, washers, and screws shall be Type 316 stainless steel when located under any pier. Miscellaneous metal shall be in accordance with ASTM A 36/A 36M, standard mill finished structural steel shapes, hot-dipped galvanized.

a. Pipe Protection Shields. Shields shall conform to MSS SP-58 and MSS SP-69, Type 40, except material shall be Type 316 stainless steel. Shields shall be provided at each slide type pipe hanger and support.

b. Low Friction Supports. Supports shall have self-lubricating anti-friction bearing elements composed of 100 percent virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.05 mm (0.002 inch) under allowable static loads. Bonds between material and steel shall be heat cured, high temperature epoxy. Design pipe hangers and support elements for the loads applied. Anti-friction material shall be a minimum of 2.3 mm (0.09 inch) thick. Steel supports shall be

hot-dipped galvanized. Units shall be factory designed and manufactured.

2.10.5.11 Exterior Coating for Aboveground Steel Piping

Aboveground steel piping shall be painted as specified in Section 09900 PAINTING, GENERAL. Paint shall be rated for use on hot metal surfaces up to 230 degrees C and for surfaces exposed to the weather. Color of the finish coat shall be [aluminum] [light gray] [_____].

2.10.5.12 Pressure Gauge

Gauge shall conform to ASME B40.1. Gauge shall be single style pressure gauge for fuel with 115 mm dial, have brass or aluminum case, bronze tube, stainless steel ball valve, pressure snubbers, and scale range for the intended service.

PART 3 EXECUTION

3.1 INSTALLATION

Storage tanks shall be handled with extreme care to prevent damage during placement and shall be installed in accordance with the manufacturer's installation instructions and NFPA 30 or NFPA 30A, as applicable. The exterior surface of each tank shall be inspected for obvious visual damage prior to and proceeding the placement of each storage tank. Surface damage to a storage tank shall be corrected according manufacturer's requirements before proceeding with the system installation.

3.1.1 Equipment

Equipment shall be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions. Supports shall be provided for equipment, appurtenances, and pipe as required. Floor-mounted pumps shall be provided with mechanical vibration isolators or a vibration isolation foundation. Anchors, bolts, nuts, washers, and screws shall be installed where required for securing the work in place. Sizes, types, and spacings of anchors and bolts not indicated or specified shall be as required for proper installation. Each dispenser and dispenser sump shall be installed in accordance with manufacturers' instructions. Dispensing units shall be isolated from the piping during flushing and cleaning operations.

3.1.2 Piping

Piping shall be inspected, tested, and approved before burying, covering, or concealing. Piping shall be installed straight and true to bear evenly on supports. Piping shall be free of traps, shall not be embedded in concrete pavement, and shall drain toward the corresponding storage tank. Any pipe, fittings, or appurtenances found defective after installation shall be replaced. Piping connections to equipment shall be as indicated or as required by the equipment manufacturer. Pipe and accessories shall be handled carefully to assure a sound, undamaged condition. The interior of the pipe shall be thoroughly cleaned of foreign matter and shall be kept

clean during installation. The pipe shall not be laid in water or stored outside unprotected when weather conditions are unsuitable. When work is not in progress, open ends of pipe and fittings shall be securely closed so that water, earth, or other substances cannot enter the pipe or fittings. Cutting pipe, when necessary, shall be done without damage to the pipe. Pipe shall be reamed to true internal diameter after cutting to remove burrs. Changes in pipe sizes shall be made through tapered reducing pipe fittings. Stainless steel pipe shall in no case be welded directly to carbon steel pipe. Cutting of FRP pipe shall be performed with a hacksaw or circular saw. Fuel supply piping from a storage tank shall extend to within 150 mm of the tank's bottom.

3.1.2.1 Aboveground Piping

Pipe sections shall be installed as indicated and be complete prior to performing any piping tests. FRP shall not be used aboveground.

3.1.2.2 Pipe Hangers and Supports

Seismic requirements shall be in accordance with Sections 13080, SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as shown on the drawings].Additional hangers and supports shall be installed for concentrated loads in piping between hangers and supports, such as for valves. Miscellaneous steel shapes as required shall be installed in accordance with ASTM A 36/A 36M. Pipe supports shall be installed in accordance with MSS SP-58and MSS SP-69. Pipe spacing shall be as follows:

Nominal Pipe Size (mm)	25 and Under	40	50	80	100	150	200	250	300
Maximum Hanger Spacing (m)	2.1	2.7	3	3.7	4.3	5.2	5.8	6.7	7.0

3.1.2.3 Pipe Sleeve

Piping passing through concrete or masonry construction shall be fitted with sleeves. Sleeve shall be of sufficient length to pass through the entire thickness of the associated structural member and be large enough to provide a minimum clear distance of 13 mm between the pipe and sleeve. Sleeves through concrete shall be 0.91 mm steel, fiberglass, or other material as approved by the Contracting Officer. Sleeves shall be accurately located on center with the piping and securely fastened in place. The space between a sleeve and a pipe shall be caulked and sealed as specified in Section 07900 JOINT SEALING. In fire walls and fire floors, both ends of a pipe sleeve shall be caulked with UL listed fill, void, or cavity material.

3.1.2.4 Pipe Anchor

Where steel piping is to be anchored, the pipe shall be welded to the structural steel member of the anchor and the abraded area shall be patched with protective coating or covering as specified.

3.1.3 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted and have identification markings applied as specified in Section 09900 PAINTING, GENERAL. Stainless steel and aluminum surfaces shall not be painted. Prior to any painting, surfaces shall be cleaned to remove dust, dirt, rust, oil, and grease.

3.1.4 Framed Instructions

Framed instructions shall include equipment layout, wiring and control diagrams, piping, valves, control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The framed instructions shall be framed under glass or laminated plastic and be posted where directed by the Contracting Officer. The framed instructions shall be posted before acceptance testing of the system.

3.2 TESTS

3.2.1 Aboveground Storage Tank Tightness Tests

A tightness test shall be performed on each aboveground storage tank. The tests shall be performed prior to making piping connections. Tests shall be capable of detecting a 0.1 mL/s (0.1 gph) leak rate from any portion of the tank while accounting for effects of thermal expansion or contraction. Gauges used in the tightness tests shall have a scale with a maximum limit of 69 kPa. Each storage tank shall be pressurized with air to 35 kPa and monitored for a drop in pressure over a 2-hour period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects. [This pressure shall be maintained and soapsuds or equivalent material applied to the exterior of the tank. While applying the soapsuds, the entire tank shall be visually inspected, including the bottom surfaces, for leaks (bubble formations). Leaks discovered during either the 2-hour waiting period or the soapsuds tests shall be repaired in accordance with manufacturer's instructions.] The pneumatic test shall be performed again in the event a leak is discovered.

3.2.2 [Enter Appropriate Subpart Title Here]

3.2.2.1 Pneumatic Test

Pneumatically pressurize each storage tank's primary chamber to 35 kPa and monitor for a drop in pressure over a 2-hour period during which there shall be no drop in pressure in the tank greater than that allowed for thermal expansion and contraction. Following the 2-hour period, the pressure from the primary chamber shall then be bled over into the interstitial space. This pressure shall be maintained and soapsuds or equivalent material applied to the exterior of the tank. While applying the soapsuds, the entire tank shall be visually inspected, including the

bottom surfaces, for leaks (bubble formations). Leaks discovered in either the primary chamber or the interstitial space shall be repaired in accordance with manufacturer's instructions. The entire pneumatic test shall be performed again in the event a leak is discovered. Gauges used in pneumatic tests shall have a scale with a maximum limit of 69 kPa.

3.2.2.2 Brine Level Test

The interstitial space of each tank shall be completely filled with a brine solution. A riser pipe shall be connected to the interstitial space which shall allow the solution to rise up within the riser at least 300 mm. After filling the interstitial space, the tank shall set approximately 3 hours. Following the 3-hour period the Contractor shall measure and record the level of solution within the riser. After a subsequent 4-hour period, the Contractor shall again measure and record the level of solution within the riser. If the level of solution within the interstitial decreases anytime during the test, the tank is considered leaking and therefore fails the test. If a tank is considered to leak, the tank shall be repaired according to manufacturer's recommendations and a tightness test performed again.

3.2.3 Manufacturer's Tank Tests

Following the tank tightness test, each storage tank shall be leak tested in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is different from the tightness tests already performed. Any test failure shall require corrective action and retest.

3.2.4 Belowground Steel Tank Exterior Coating Tests

3.2.5 Piping Pneumatic and Hydrostatic Tests

Testing shall comply with the applicable requirements of ASME B31.3, NFPA 30, and the requirements specified herein. Care shall be taken not to exceed pressure rating of various fittings. Hydrostatic testing shall be performed using fuel as the liquid. Water shall not be introduced into the system for testing. To facilitate the pneumatic and hydrostatic tests, various sections of the piping system may be isolated and tested separately. Where such sections terminate at flanged valve points, the line shall be closed by means of blind flanges in lieu of relying on the valve. Tapped flanges shall be provided to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Tapped flanges shall also be used for gauge connections. Taps in the permanent line will not be permitted. Gauges shall be subject to testing and approval. In the event leaks are detected, the pipe shall be repaired and the test repeated. Following satisfactory completion of each pneumatic and hydrostatic test, the pressure shall be relieved and the pipe immediately sealed. Provision shall be made to prevent displacement of the piping during testing. Personnel shall be kept clear of the piping during pneumatic testing. Equipment such as pumps, tanks, and meters shall be isolated from the piping system during the testing.

3.2.5.1 Pneumatic Procedures for Product and Vent\Vapor Piping

Piping to be installed underground shall not receive field applied covering at the joints or be covered by backfill until the piping has passed the pneumatic test described herein. A pneumatic test pressure shall be applied in increments. A preliminary 170 kPa test shall be applied. The pressure shall be maintained while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. Following the preliminary test, the piping shall be tested at a pressure of 340 kPa for not less than 2 hours, during which time there shall be no drop in pressure in the pipe greater than that allowed for thermal expansion and contraction. The pressure source shall be disconnected during the final test period. Any leaks revealed by the test shall be repaired and the test repeated.

3.2.5.2 Pneumatic Procedures for Exterior Containment Piping

Exterior containment piping shall undergo a minimum pneumatic pressure of 35 kPa. Pressure in secondary piping shall be maintained for at least 1 hour while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, the entire run of piping, including the bottom surfaces, shall be visually inspected for leaks (bubble formations). Leaks discovered shall be repaired in accordance with manufacturer's instructions and retested. This testing shall be in compliance with the manufacturer's published installation instructions.

3.2.5.3 Hydrostatic Procedures for Product Piping

Upon completion of pneumatic testing and after backfilling, each piping system shall be hydrostatically tested with fuel at not more than 1900 kPa (275 psig) in accordance with ASME B31.3 and API RP 1110, with no leakage or reduction in gauge pressure for 4 hours. The Contractor shall furnish electricity, instruments, connecting devices, and personnel for the test. Fuel will be furnished by the Government. Defects in work performed shall be corrected at the Contractor's expense, and the test repeated until the work is proven to be in compliance with the testing procedures. Any release of fuel (no matter the size) during testing shall be immediately contained, the pressure on the piping relieved, and the piping drained of fuel. The Contracting Officer shall be notified immediately of a fuel release, the exact location, an estimated quantity of release, and a discussion of the containment measures taken.

3.2.6 System Performance Tests

After all components of the system have been properly adjusted, the system shall be tested to demonstrate that the system meets the performance requirements for which it was designed. The maximum rated capacity of the system shall be tested by using several tank trucks simultaneously, if applicable. The use of tank trucks shall be coordinated with the Contracting Officer prior to testing. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is obtained from the Contracting Officer. The

tests shall demonstrate the following:

a. The capability of each fuel pump to deliver the indicated flow of fuel.

b. The alarm and control panels are operational and perform as designed.

c. Each fuel meter is operating accurately.

d. Vent piping is clear of debris and each pressure/vacuum relief vent is operating properly.

e. Vapor recovery systems perform as designed.

3.2.7 High Liquid Level Alarm Test

Each storage tank shall be initially overfilled with the appropriate product in order to verify the high liquid level alarms in the remote alarm panel function as designed. The initial overfill shall also verify that the storage tank overfill protection device functions as designed. Tank overfill shall stop immediately once the overfill device operates. The Contractor shall not overfill any storage more than 98 percent level even if the leak detection and liquid level electronic panel and the overfill device do not function as designed. Any problems with the electronic panel or the overfill device shall be corrected and retested. The system shall be drained below the high liquid levels following all tests.

3.3 FLUSHING, CLEANING AND ADJUSTING

Following installation and equipment testing but prior to system performance testing, the following flushing, cleaning, and adjustments shall be performed.

3.3.1 Preparations for Flushing

3.3.1.1 Initial System Cleaning

The interior of each fuel storage tank shall be visually inspected and cleaned free of debris before filling. In the event of entry into a storage tank, the Contractor shall ensure a safe atmosphere exists. Contractor shall remove all preservatives and foreign matter from valves, line strainers, pumps, and other equipment coming in contact with fuel. No fuel will be delivered to the system until the Contractor has satisfactorily completed this initial system cleaning.

3.3.1.2 Protection of Equipment

Temporary 40 mesh cone type strainers shall be installed in the suction line ahead of each fueling pump as well as ahead of each filter/separator. The strainers shall be constructed of the same material as the piping and shall be compatible with the fuel to be handled. The temporary strainers

shall remain in place for a minimum of 2 days after system startup, after which time the Contractor shall remove the strainers and prepare the piping as intended for final system operation.

3.3.2 System Flushing

3.3.2.1 Initial Fuel Supply

Following the preparations for flushing, each storage tank shall be filled to a 25 percent capacity with the proper fuel according to the fueling system's final operational requirements. Following the initial fuel supply, each storage tank's fuel temperature and liquid level shall be measured and recorded. The liquid level shall be measured using a manual tank gauge.

3.3.2.2 Disposal of Initial Fuel Supply

In the event the fuel contained in the piping system at the conclusion of the flushing operation is not considered by the Contracting Officer to be of satisfactory quality for the desired use, the Contractor shall be responsible for pumping out the entire fuel supply from the storage tanks and the piping system. The filter/separator and piping system shall be completely drained to the storage tank. Disposition of the fuel removed from the system shall be the responsibility of the Government.

3.3.3 Cleaning Equipment

Upon completion of flushing operations, permanent strainers shall be removed, cleaned, and reinstalled. If the pressure differential across the filter/separator elements exceeds that recommended by the manufacturer, the elements shall be replaced with the spare set furnished with the unit.

3.3.4 Initial System Adjustments

Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements. The Government will deliver enough fuel to the storage tanks to enable the Contractor to make final adjustments to equipment and controls. Flow rates and pressures shall be adjusted as required to meet the indicated requirements. The sequence of control for each component shall be adjusted to meet the indicated system requirements. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

3.4 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final system acceptance. The field instructions shall cover all of the items contained in the operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

SECTION 13280

ASBESTOS ABATEMENT
10/99
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z9.2	(1979; R 1991) Fundamentals Governing the Design and Operation of Local Exhaust Systems
ANSI Z87.1	(1989; Errata; Z87.1a) Occupational and Educational Eye and Face Protection
ANSI Z88.2	(1992) Respiratory Protection

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 732	(1995) Aging Effects of Artificial Weathering on Latex Sealants
ASTM D 522	(1993a) Mandrel Bend Test of Attached Organic Coatings
ASTM D 1331	(1989; R 1995) Surface and Interfacial Tension of Solutions of Surface-Active Agents
ASTM D 2794	(1993) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 4397	(1996) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 84	(1998e1) Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 119	(1998) Fire Tests of Building Construction and Materials

ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E 1368	(1997) Visual Inspection of Asbestos Abatement Projects

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 61	National Emissions Standards for Hazardous Air Pollutants
40 CFR 763	Asbestos
42 CFR 84	Approval of Respiratory Protective Devices
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 171	General Information, Regulations and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings

COMPRESSED GAS ASSOCIATION (CGA)

CGA G-7	(1990) Compressed Air for Human Respiration
CGA G-7.1	(1997) Commodity Specification for Air

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) Safety and Health Requirements Manual

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 340/1-90-018	(1990) Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance
EPA 340/1-90-019	(1990) Asbestos/NESHAP Adequately Wet Guidance

EPA 560/5-85-024	(1985) Guidance for Controlling Asbestos-Containing Materials in Buildings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701	(1996; TIA 96-1, 96-2) Methods of Fire Tests for Flame-Resistant Textiles and Films

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH Pub No. 84-100	(1984; Supple 1985, 1987, 1988 & 1990) NIOSH Manual of Analytical Methods

UNDERWRITERS LABORATORIES (UL)

UL 586	(1996) High-Efficiency, Particulate, Air Filter Units

1.2 DEFINITIONS

a. Adequately Wet: A term defined in 40 CFR 61, Subpart M, and EPA 340/1-90-019 meaning to sufficiently mix or penetrate with liquid to prevent the release of particulate. If visible emissions are observed coming from asbestos-containing material (ACM), then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wetted.

b. Aggressive Method: Removal or disturbance of building material by sanding, abrading, grinding, or other method that breaks, crumbles, or disintegrates intact asbestos-containing material (ACM).

c. Amended Water: Water containing a wetting agent or surfactant with a surface tension of at least 29 dynes per square centimeter when tested in accordance with ASTM D 1331.

d. Asbestos: Asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophylite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.

e. Asbestos-Containing Material (ACM): Any materials containing more than one percent asbestos.

f. Asbestos Fiber: A particulate form of asbestos, 5 micrometers or longer, with a length-to-width ratio of at least 3 to 1.

g. Authorized Person: Any person authorized by the Contractor and required by work duties to be present in the regulated areas.

h. Building Inspector: Individual who inspects buildings for asbestos and has EPA Model Accreditation Plan (MAP) "Building

Inspector" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.

i. Certified Industrial Hygienist (CIH): An Industrial Hygienist certified in the practice of industrial hygiene by the American Board of Industrial Hygiene.

j. Class I Asbestos Work: Activities defined by OSHA involving the removal of thermal system insulation (TSI) and surfacing ACM.

k. Class II Asbestos Work: Activities defined by OSHA involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos - containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic. Certain "incidental" roofing materials such as mastic, flashing and cements when they are still intact are excluded from Class II asbestos work. Removal of small amounts of these materials which would fit into a glovebag may be classified as a Class III job.

l. Class III Asbestos Work: Activities defined by OSHA that involve repair and maintenance operations, where ACM, including TSI and surfacing ACM, is likely to be disturbed. Operations may include drilling, abrading, cutting a hole, cable pulling, crawling through tunnels or attics and spaces above the ceiling, where asbestos is actively disturbed or asbestos-containing debris is actively disturbed.

m. Class IV Asbestos Work: Maintenance and custodial construction activities during which employees contact but do not disturb ACM and activities to clean-up dust, waste and debris resulting from Class I, II, and III activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists and cleaning up loose ACM debris from TSI or surfacing ACM following construction.

n. Clean room: An uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.

o. Competent Person: In addition to the definition in 29 CFR 1926, Section .32(f), a person who is capable of identifying existing asbestos hazards as defined in 29 CFR 1926, Section .1101, selecting the appropriate control strategy, has the authority to take prompt corrective measures to eliminate them and has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.

p. Contractor/Supervisor: Individual who supervises asbestos abatement work and has EPA Model Accreditation Plan "Contractor/Supervisor" training; accreditation required by 40 CFR 763, Subpart E, Appendix C.

q. Critical Barrier: One or more layers of plastic sealed over all

openings into a regulated area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a regulated area from migrating to an adjacent area.

r. Decontamination Area: An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

s. Demolition: The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

t. Disposal Bag: A 0.15 mm thick, leak-tight plastic bag, pre-labeled in accordance with 29 CFR 1926, Section .1101, used for transporting asbestos waste from containment to disposal site.

u. Disturbance: Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM. Disturbance includes cutting away small amounts of ACM, no greater than the amount which can be contained in 1 standard sized glovebag or waste bag, not larger than 1.5 m in length and width in order to access a building component.

v. Equipment Room or Area: An area adjacent to the regulated area used for the decontamination of employees and their equipment.

w. Employee Exposure: That exposure to airborne asbestos that would occur if the employee were not using respiratory protective equipment.

x. Fiber: A fibrous particulate, 5 micrometers or longer, with a length to width ratio of at least 3 to 1.

y. Friable ACM: A term defined in 40 CFR 61, Subpart M and EPA 340/1-90-018 meaning any material which contains more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Subpart E, Appendix A, Section 1, Polarized Light Microscopy (PLM), that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. If the asbestos content is less than 10 percent, as determined by a method other than point counting by PLM, the asbestos content is verified by point counting using PLM.

z. Glovebag: Not more than a 1.5 by 1.5 m impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.

aa. High-Efficiency Particulate Air (HEPA) Filter: A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

bb. Homogeneous Area: An area of surfacing material or thermal system insulation that is uniform in color and texture.

cc. Industrial Hygienist: A professional qualified by education, training, and experience to anticipate, recognize, evaluate, and develop controls for occupational health hazards.

dd. Intact: ACM which has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix. Removal of "intact" asphaltic, resinous, cementitious products does not render the ACM non-intact simply by being separated into smaller pieces.

ee. Model Accreditation Plan (MAP): USEPA training accreditation requirements for persons who work with asbestos as specified in 40 CFR 763, Subpart E, Appendix C.

ff. Modification: A changed or altered procedure, material or component of a control system, which replaces a procedure, material or component of a required system.

gg. Negative Exposure Assessment: A demonstration by the Contractor to show that employee exposure during an operation is expected to be consistently below the OSHA Permissible Exposure Limits (PELs).

hh. NESHAP: National Emission Standards for Hazardous Air Pollutants. The USEPA NESHAP regulation for asbestos is at 40 CFR 61, Subpart M.

ii. Nonfriable ACM: A NESHAP term defined in 40 CFR 61, Subpart M and EPA 340/1-90-018 meaning any material containing more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Subpart E, Appendix A, Section 1, Polarized Light Microscopy, that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.

jj. Nonfriable ACM (Category I): A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90-018 meaning asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos as determined using the method specified in 40 CFR 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy.

kk. Nonfriable ACM (Category II): A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90-018 meaning any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos, as determined using the methods specified in 40 CFR 763, Subpart F, Appendix A, Section 1, Polarized Light Microscopy, that when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

ll. Permissible Exposure Limits (PELs):

(1) PEL-Time weighted average(TWA): Concentration of asbestos

not in excess of 0.1 fibers per cubic centimeter of air (f/cc) as an 8 hour time weighted average (TWA), as determined by the method prescribed in 29 CFR 1926, Section .1101, Appendix A, or the current version of NIOSH Pub No. 84-100 analytical method 7400.

(2) PEL-Excursion Limit: An airborne concentration of asbestos not in excess of 1.0 f/cc of air as averaged over a sampling period of 30 minutes as determined by the method prescribed in 29 CFR 1926, Section .1101, Appendix A, or the current version of NIOSH Pub No. 84-100 analytical method 7400.

mm. Regulated Area: An OSHA term defined in 29 CFR 1926, Section .1101 meaning an area established by the Contractor to demarcate areas where Class I, II, and III asbestos work is conducted; also any adjoining area where debris and waste from such asbestos work accumulate; and an area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limit.

nn. Removal: All operations where ACM is taken out or stripped from structures or substrates, and includes demolition operations.

oo. Repair: Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM attached to structures or substrates. If the amount of asbestos so "disturbed" cannot be contained in 1 standard glovebag or waste bag, Class I precautions are required.

pp. Spills/Emergency Cleanups: Cleanup of sizable amounts of asbestos waste and debris which has occurred, for example, when water damage occurs in a building, and sizable amounts of ACM are dislodged. A Competent Person evaluates the site and ACM to be handled, and based on the type, condition and extent of the dislodged material, classifies the cleanup as Class I, II, or III. Only if the material was intact and the cleanup involves mere contact of ACM, rather than disturbance, could there be a Class IV classification.

qq. Surfacing ACM: Asbestos-containing material which contains more than 1% asbestos and is sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.

rr. Thermal system insulation (TSI) ACM: ACM which contains more than 1% asbestos and is applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat loss or gain or water condensation.

ss. Transite: A generic name for asbestos cement wallboard and pipe.

tt. Worker: Individual (not designated as the Competent Person or a supervisor) who performs asbestos work and has completed asbestos

worker training required by 29 CFR 1926, Section .1101, to include EPA Model Accreditation Plan (MAP) "Worker" training; accreditation required by 40 CFR 763, Subpart E, Appendix C, if required by the OSHA Class of work to be performed or by the state where the work is to be performed.

1.3 DESCRIPTION OF WORK

The work covered by this section includes the removal of asbestos-containing materials (ACM) which are encountered during alteration activities associated with this project and describes procedures and equipment required to protect workers and occupants of the regulated area from contact with airborne asbestos fibers and ACM dust and debris. Activities include OSHA Class I work operations involving ACM. The work also includes containment, storage, transportation and disposal of the generated ACM wastes. More specific operational procedures shall be detailed in the required Accident Prevention Plan and its subcomponents, the Asbestos Hazard Abatement Plan and Activity Hazard Analyses required in paragraph SAFETY AND HEALTH PROGRAM AND PLANS.

1.3.1 Abatement Work Tasks

The specific ACM to be abated is identified on the detailed plans and project drawings. A summary of work task data elements for each individual ACM abatement work task to include the appropriate RESPONSE ACTION DETAIL SHEET (item to be abated and methods to be used) and SET-UP DETAIL SHEETS (containment techniques to include safety precautions and methods) is included in Table 1, "Individual Work Task Data Elements" at the end of this section.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Materials and Equipment; FIO.

Manufacturer's catalog data for all materials and equipment to be used in the work, including brand name, model, capacity, performance characteristics and any other pertinent information. Test results and certificates from the manufacturer of encapsulants substantiating compliance with performance requirements of this specification. Material Safety Data Sheets for all chemicals to be used onsite in the same format as implemented in the Contractor's HAZARD COMMUNICATION PROGRAM. Data shall include, but shall not be limited to, the following items:

a. High Efficiency Filtered Air (HEPA) local exhaust equipment

b. Vacuum cleaning equipment

c. Pressure differential monitor for HEPA local exhaust equipment

d. Air monitoring equipment

e. Respirators

f. Personal protective clothing and equipment

(1) Coveralls
(2) Underclothing
(3) Other work clothing
(4) Foot coverings
(5) Hard hats
(6) Eye protection
(7) Other items required and approved by Contractors Designated IH and Competent Person

g. Glovebag

h. Duct Tape

i. Disposal Containers

(1) Disposal bags
(2) Fiberboard drums
(3) Paperboard boxes

j. Sheet Plastic

(1) Polyethylene Sheet - General
(2) Polyethylene Sheet - Flame Resistant
(3) Polyethylene Sheet - Reinforced

k. Wetting Agent

(1) Amended Water
(2) Removal encapsulant

l. Strippable Coating

m. Prefabricated Decontamination Unit

n. Other items

o. Chemical encapsulant

p. Chemical encasement materials

q. Material Safety Data Sheets (for all chemicals proposed)

SD-04 Drawings

Site Layout; GA.

Descriptions, detail project drawings, and site layout to include worksite containment area techniques as prescribed on applicable SET-UP DETAIL SHEETS, local exhaust ventilation system locations, decontamination units and load-out units, other temporary waste storage facility, access tunnels, location of temporary utilities (electrical, water, sewer) and boundaries of each regulated area.

SD-08 Statements

Qualifications; GA.

A written report providing evidence of qualifications for personnel, facilities and equipment assigned to the work.

Training Program; FIO.

A copy of the written project site-specific training material as indicated in 29 CFR 1926, Section .1101 that will be used to train onsite employees. The training document shall be signed by the Contractor's Designated IH and Competent Person.

Medical Requirements; FIO.

Physician's written opinion.

Encapsulants; GA.

Certificates stating that encapsulants meet the applicable specified performance requirements.

SD-09 Reports

Exposure Assessment and Air Monitoring; GA.

Initial exposure assessments, negative exposure assessments, air-monitoring results and documentation.

Local Exhaust Ventilation; FIO.

Pressure differential recordings.

Licenses, Permits and Notifications; GA.

Licenses, permits, and notifications.

SD-13 Certificates

Vacuum, Filtration and Ventilation Equipment; FIO.

Manufacturer's certifications showing compliance with ANSI Z9.2 for:

a. Vacuums.

b. Water filtration equipment.

c. Ventilation equipment.

d. Other equipment required to contain airborne asbestos fibers.

SD-18 Records

Respiratory Protection Program; GA.

Records of the respirator program.

Cleanup and Disposal; GA.

Waste shipment records. Weigh bills and delivery tickets shall be furnished for information only.

1.5 QUALIFICATIONS

1.5.1 Written Qualifications and Organization Report

The Contractor shall furnish a written qualifications and organization report providing evidence of qualifications of the Contractor, Contractor's Project Supervisor, Designated Competent Person, supervisors and workers; Designated IH (person assigned to project and firm name); independent testing laboratory (including name of firm, principal, and analysts who will perform analyses); all subcontractors to be used including disposal transportation and disposal facility firms, subcontractor supervisors, subcontractor workers; and any others assigned to perform asbestos abatement and support activities. The report shall include an organization chart showing the Contractor's staff organization for this project by name and title, chain of command and reporting relationship with all subcontractors. The report shall be signed by the Contractor, the Contractor's onsite project manager, Designated Competent Person, Designated IH, designated testing laboratory and the principals of all subcontractors to be used. The Contractor shall include the following statement in the report: "By signing this report I certify that the personnel I am responsible for during the course of this project fully understand the contents of 29 CFR 1926, Section .1101, 40 CFR 61, Subpart M, and the federal, state and local requirements specified in paragraph SAFETY AND HEALTH PROGRAM AND PLANS for those asbestos abatement activities that they will be involved in."

1.5.2 Specific Requirements

The Contractor shall designate in writing, personnel meeting the following qualifications:

a. Designated Competent Person: The name, address, telephone number, and resume of the Contractor's Designated Competent Person shall be provided. Evidence that the full-time Designated Competent Person is qualified in accordance with 29 CFR 1926, Sections .32 and .1101, has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C, and is experienced in the

administration and supervision of asbestos abatement projects, including exposure assessment and monitoring, work practices, abatement methods, protective measures for personnel, setting up and inspecting asbestos abatement work areas, evaluating the integrity of containment barriers, placement and operation of local exhaust systems, ACM generated waste containment and disposal procedures, decontamination units installation and maintenance requirements, site safety and health requirements, notification of other employees onsite, etc. The duties of the Competent Person shall include the following: controlling entry to and exit from the regulated area; supervising any employee exposure monitoring required by 29 CFR 1926, Section .1101; ensuring that all employees working within a regulated area wear the appropriate personal protective equipment (PPE), are trained in the use of appropriate methods of exposure control, and use the hygiene facilities and decontamination procedures specified; and ensuring that engineering controls in use are in proper operating conditions and are functioning properly. The Designated Competent Person shall be responsible for compliance with applicable federal, state and local requirements, the Contractor's Accident Prevention Plan and Asbestos Hazard Abatement Plan. The Designated Competent Person shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Contractor shall submit evidence that this person has a minimum of 2 years of on-the-job asbestos abatement experience relevant to OSHA competent person requirements. The Designated Competent Person shall be onsite at all times during the conduct of this project.

b. Project and Other Supervisors: The Contractor shall provide the name, address, telephone number, and resume of the Project Supervisor and other supervisors who have responsibility to implement the Accident Prevention Plan, including the Asbestos Hazard Abatement Plan and Activity Hazard Analyses, the authority to direct work performed under this contract and verify compliance, and have EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C. The Project Supervisor and other supervisors shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Contractor shall submit evidence that the Project Supervisor has a minimum of 2 years of on-the-job asbestos abatement experience relevant to project supervisor responsibilities and the other supervisors have a minimum of 1 year on-the-job asbestos abatement experience commensurate with the responsibilities they will have on this project.

c. Designated Industrial Hygienist: The Contractor shall provide the name, address, telephone number, resume and other information specified below for the Industrial Hygienist (IH) selected to

prepare the Contractor's Asbestos Hazard Abatement Plan, prepare and perform training, direct air monitoring and assist the Contractor's Competent Person in implementing and ensuring that safety and health requirements are complied with during the performance of all required work. The Designated IH shall be a person who is [board certified in the practice of industrial hygiene] [or] [board eligible (meets all education and experience requirements)] as determined and documented by the American Board of Industrial Hygiene (ABIH), has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training accreditation required by 40 CFR 763, Subpart E, Appendix C, and has a minimum of 2 years of comprehensive experience in planning and overseeing asbestos abatement activities. The Designated IH shall provide, and the Contractor shall submit, the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training with the employee "Certificate of Worker Acknowledgment" required by this paragraph. The Designated IH shall be completely independent from the Contractor according to federal, state, or local regulations; that is, shall not be a Contractor's employee or be an employee or principal of a firm in a business relationship with the Contractor negating such independent status. A copy of the Designated IH's current valid ABIH [certification] [confirmation of eligibility in writing from the ABIH] shall be included. The Designated IH shall be onsite during tapping of asbestos concrete water main for the duration of asbestos activities and shall be available for emergencies. In addition, the Designated IH shall prepare, and the Contractor shall submit, the name, address, telephone numbers and resumes of additional IH's and industrial hygiene technicians (IHT) who will be assisting the Designated IH in performing onsite tasks. IHs and IHTs supporting the Designated IH shall have a minimum of 2 years of practical onsite asbestos abatement experience. The formal reporting relationship between the Designated IH and the support IHs and IHTs, the Designated Competent Person, and the Contractor shall be indicated.

d. Asbestos Abatement Workers: Asbestos abatement workers shall meet the requirements contained in 29 CFR 1926, Section .1101, 40 CFR 61, Subpart M, and other applicable federal, state and local requirements. Worker training documentation shall be provided as required on the "Certificate of Workers Acknowledgment" in this paragraph.

e. Worker Training and Certification of Worker Acknowledgment: Training documentation will be required for each employee who will perform OSHA Class I, Class II, Class III, or Class IV asbestos abatement operations. Such documentation shall be submitted on a Contractor generated form titled "Certificate of Workers Acknowledgment", to be completed for each employee in the same format and containing the same information as the example certificate at the end of this section. Training course completion certificates (initial and most recent update refresher) required by the information checked on the form shall be attached.

f. Physician: The Contractor shall provide the name, medical qualifications, address, telephone number and resume of the physician who will or has performed the medical examinations and evaluations of the persons who will conduct the asbestos abatement work tasks. The physician shall be currently licensed by the state where the workers will be or have been examined, have expertise in pneumoconiosis and shall be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1926, Section .1101 and paragraph MEDICAL REQUIREMENTS. The physician shall be familiar with the site's hazards and the scope of this project.

g. First Aid and CPR Trained Persons: The names of at least 2 persons who are currently trained in first aid and CPR by the American Red Cross or other approved agency shall be designated and shall be onsite at all times during site operations. They shall be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030 and shall be included in the Contractor's Bloodborne Pathogen Program. These persons may perform other duties but shall be immediately available to render first aid when needed. A copy of each designated person's current valid First Aid and CPR certificate shall be provided.

h. Independent Testing Laboratory: The Contractor shall provide the name, address and telephone number of the independent testing laboratory selected to perform the sample analyses and report the results. The testing laboratory shall be completely independent from the Contractor as recognized by federal, state or local regulations. Written verification of the following criteria, signed by the testing laboratory principal and the Contractor, shall be submitted:

(1) Phase contrast microscopy (PCM): The laboratory is fully equipped and proficient in conducting PCM of airborne samples using the methods specified by 29 CFR 1926, Section .1101, OSHA method ID-160, the most current version of NIOSH Pub No. 84-100 Method 7400, and NIOSH Pub No. 84-100 Method 7402, transmission electron microscopy (TEM); the laboratory is currently judged proficient (classified as acceptable) in counting airborne asbestos samples by PCM by successful participation in each of the last 4 rounds in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program; the names of the selected microscopists who will analyze airborne samples by PCM with verified documentation of their proficiency to conduct PCM analyses by being judged proficient in counting samples as current participating analysts in the AIHA PAT Program, and having successfully completed the Asbestos Sampling and Analysis course (NIOSH 582 or equivalent) with a copy of course completion certificate provided; when the PCM analysis is to be conducted onsite, documentation shall be provided certifying that the onsite analyst meets the same requirements.

(2) Polarized light microscopy (PLM): The laboratory is fully equipped and proficient in conducting PLM analyses of suspect ACM bulk samples in accordance with 40 CFR 763, Subpart E, Appendix E; the laboratory is currently accredited by NIST under the NVLAP for bulk asbestos analysis and will use analysts (names shall be provided) with demonstrated proficiency to conduct PLM to include its application to the identification and quantification of asbestos content.

(3) Transmission electron microscopy (TEM): The laboratory is [fully equipped and proficient in conducting TEM analysis of airborne samples using the mandatory method specified by 40 CFR 763, Subpart E, Appendix E; the laboratory is currently accredited by NIST under the NVLAP for airborne sample analysis of asbestos by TEM; the laboratory will use analysts (names shall be provided) that are currently evaluated as competent with demonstrated proficiency under the NIST NVLAP for airborne sample analysis of asbestos by TEM.

(4) PCM/TEM: The laboratory is fully equipped and each analyst (name shall be provided) possesses demonstrated proficiency in conducting PCM and TEM analysis of airborne samples using NIOSH Pub No. 84-100Method 7400 PCM and NIOSH Pub No. 84-100 Method 7402 (TEM confirmation of asbestos content of PCM results) from the same filter.

i. Disposal Facility, Transporter: The asbestos concrete material shall be disposed of at the Ft. Bliss landfill.

1.5.3 Federal, State or Local Citations on Previous Projects

The Contractor and all subcontractors shall submit a statement, signed by an officer of the company, containing a record of any citations issued by Federal, State or local regulatory agencies relating to asbestos activities (including projects, dates, and resolutions); a list of penalties incurred through non-compliance with asbestos project specifications, including liquidated damages, overruns in scheduled time limitations and resolutions; and situations in which an asbestos-related contract has been terminated (including projects, dates, and reasons for terminations). If there are none, a negative declaration signed by an officer of the company shall be provided.

1.6 REGULATORY REQUIREMENTS

In addition to detailed requirements of this specification, work performed under this contract shall comply with EM 385-1-1, applicable federal, state, and local laws, ordinances, criteria, rules and regulations regarding handling, storing, transporting, and disposing of asbestos waste materials. This includes, but is not limited to, OSHA standards, 29 CFR 1926, especially Section .1101, 40 CFR 61, Subpart M and 40 CFR 763. Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent

requirements shall apply.

1.7 SAFETY AND HEALTH PROGRAM AND PLANS

The Contractor shall develop and submit a written comprehensive site-specific Accident Prevention Plan at least 30 days prior to the preconstruction conference. The Accident Prevention Plan shall address requirements of EM 385-1-1, Appendix A, covering onsite work to be performed by the Contractor and subcontractors. The Accident Prevention Plan shall incorporate an Asbestos Hazard Abatement Plan, and Activity Hazard Analyses as separate appendices into 1 site specific Accident Prevention Plan document. Any portions of the Contractor's overall Safety and Health Program that are referenced in the Accident Prevention Plan, e.g., respirator program, hazard communication program, confined space entry program, etc., shall be included as appendices to the Accident Prevention Plan. The plan shall take into consideration all the individual asbestos abatement work tasks identified in Table 1. The plan shall be prepared, signed (and sealed, including certification number if required), and dated by the Contractor's Designated IH, Competent Person, and Project Supervisor.

1.7.1 Asbestos Hazard Abatement Plan Appendix

The Asbestos Hazard Abatement Plan appendix to the Accident Prevention Plan shall include, but not be limited to, the following:

a. The personal protective equipment to be used;

b. The location and description of regulated areas including clean and dirty areas,access tunnels, and decontamination unit (clean room, shower room, equipment room, storage areas such as load-out unit);

c. Initial exposure assessment in accordance with 29 CFR 1926, Section .1101;

d. Level of supervision;

e. Method of notification of other employers at the worksite;

f. Abatement method to include containment and control procedures;

g. Interface of trades involved in the construction;

h. Sequencing of asbestos related work;

i. Storage and disposal procedures and plan;

j. Type of wetting agent and asbestos encapsulant to be used;

k. Location of local exhaust equipment;

l. Air monitoring methods (personal, environmental and clearance);

m. Bulk sampling and analytical methods (if required);

n. A detailed description of the method to be employed in order to control the spread of ACM wastes and airborne fiber concentrations;

o. Fire and medical emergency response procedures;

p. The security procedures to be used for all regulated areas.

1.7.2 Activity Hazard Analyses Appendix

Activity Hazard Analyses, for each major phase of work, shall be submitted and updated during the project. The Activity Hazard Analyses format shall be in accordance with EM 385-1-1 (Figure 1-1). The analysis shall define the activities to be performed for a major phase of work, identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. Work shall not proceed on that phase until the Activity Hazard Analyses has been accepted and a preparatory meeting has been conducted by the Contractor to discuss its contents with everyone engaged in the activities, including the onsite Government representatives. The Activity Hazard Analyses shall be continuously reviewed and, when appropriate, modified to address changing site conditions or operations.

1.8 PRECONSTRUCTION CONFERENCE AND ONSITE SAFETY

The Contractor and the Contractor's Designated Competent Person, Project Supervisor, and Designated IH shall meet with the Contracting Officer prior to beginning work at a safety preconstruction conference to discuss the details of the Contractor's submitted Accident Prevention Plan to include the Asbestos Hazard Abatement Plan and Activity Hazard Analyses appendices. Deficiencies in the Accident Prevention Plan will be discussed and the Accident Prevention Plan shall be revised to correct the deficiencies and resubmitted for acceptance. Any changes required in the specification as a result of the Accident Prevention Plan shall be identified specifically in the plan to allow for free discussion and acceptance by the Contracting Officer, prior to the start of work. Onsite work shall not begin until the Accident Prevention Plan has been accepted. A copy of the written Accident Prevention Plan shall be maintained onsite. Changes and modifications to the accepted Accident Prevention Plan shall be made with the knowledge and concurrence of the Designated IH, the Project Supervisor, Designated Competent Person, and the Contracting Officer. Should any unforeseen hazard become evident during the performance of the work, the Designated IH shall bring such hazard to the attention of the Project Supervisor, Designated Competent Person, and the Contracting Officer, both verbally and in writing, for resolution as soon as possible. In the interim, all necessary action shall be taken by the Contractor to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Once accepted by the Contracting Officer, the Accident Prevention Plan, including the Asbestos Hazard Abatement Plan and Activity Hazard Analyses will be enforced as if an addition to the contract. Disregarding the provisions of this contract or the accepted Accident Prevention Plan will be cause for stopping of work, at the discretion of the Contracting Officer, until the matter has been rectified.

1.9 TRAINING PROGRAM

1.10 RESPIRATORY PROTECTION PROGRAM

The Contractor's Designated IH shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 1926, Section .1101, 29 CFR 1910, Section .134, ANSI Z88.2, CGA G-7, CGA G-7.1 and DETAIL SHEET 12. The Contractor's Designated IH shall establish minimum respiratory protection requirements based on measured or anticipated levels of airborne asbestos fiber concentrations encountered during the performance of the asbestos abatement work. The Contractor's respiratory protection program shall include, but not be limited to, the following elements:

a. The company policy, used for the assignment of individual responsibility, accountability, and implementation of the respiratory protection program.

b. The standard operating procedures covering the selection and use of respirators. Respiratory selection shall be determined by the hazard to which the worker is exposed.

c. Medical evaluation of each user to verify that the worker may be assigned to an activity where respiratory protection is required.

d. Training in the proper use and limitations of respirators.

e. Respirator fit-testing, i.e., quantitative, qualitative and individual functional fit checks.

f. Regular cleaning and disinfection of respirators.

g. Routine inspection of respirators during cleaning and after each use when designated for emergency use.

h. Storage of respirators in convenient, clean, and sanitary locations.

i. Surveillance of regulated area conditions and degree of employee exposure (e.g., through air monitoring).

j. Regular evaluation of the continued effectiveness of the respiratory protection program.

k. Recognition and procedures for the resolution of special problems as they affect respirator use (e.g., no facial hair that comes between the respirator face piece and face or interferes with valve function; prescription eye wear usage; contact lenses usage; etc.).

l. Proper training in putting on and removing respirators.

1.10.1 Respiratory Fit Testing

A qualitative or quantitative fit test conforming to 29 CFR 1926, Section 1101, Appendix C shall be conducted by the Contractor's Designated IH for each Contractor worker required to wear a respirator, and for the Contracting Officer and authorized visitors who enter a regulated area where respirators are required to be worn. A respirator fit test shall be performed for each worker wearing a negative-pressure respirator prior to initially wearing a respirator on this project and every 6 months thereafter. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, or of full-facepiece air purifying respirators where they are worn at levels at which half-facepiece air purifying respirators are permitted. If physical changes develop that will affect the fit, a new fit test for the worker shall be performed. Functional fit checks shall be performed by employees each time a respirator is put on and in accordance with the manufacturer's recommendation.

1.10.2 Respirator Selection and Use Requirements

The Contractor shall provide respirators, and ensure that they are used as required by 29 CFR 1926, Section .1101 and in accordance with the manufacturer's recommendations. Respirators shall be jointly approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (MSHA/NIOSH), or by NIOSH, under the provisions of 42 CFR 84, for use in environments containing airborne asbestos fibers. Personnel who handle ACM, enter regulated areas that require the wearing of a respirator, or who are otherwise carrying out abatement activities that require the wearing of a respirator, shall be provided with approved respirators that are fully protective of the worker at the measured or anticipated airborne asbestos concentration level to be encountered. For air-purifying respirators, the particulate filter portion of the cartridges or canister approved for use in airborne asbestos environments shall be high-efficiency particulate air (HEPA). The initial respirator selection and the decisions regarding the upgrading or downgrading of respirator type shall be made by the Contractor's Designated IH based on the measured or anticipated airborne asbestos fiber concentrations to be encountered. Recommendations made by the Contractor's Designated IH to downgrade respirator type shall be submitted in writing to the Contracting Officer. The Contractor's Designated Competent Person in consultation with the Designated IH, shall have the authority to take immediate action to upgrade or downgrade respiratory type when there is an immediate danger to the health and safety of the wearer. Respirators shall be used in the following circumstances:

a. During all Class I asbestos jobs.

b. During all Class II work where the ACM is not removed in a substantially intact state.

c. During all Class II and III work which is not performed using wet methods. Respirators need not be worn during removal of ACM from sloped roofs when a negative exposure assessment has been made and ACM is removed in an intact state.

d. During all Class II and III asbestos jobs where the Contractor does not produce a negative exposure assessment.

e. During all Class III jobs where TSI or surfacing ACM is being disturbed.

f. During all Class IV work performed within regulated areas where employees performing other work are required to wear respirators.

g. During all work where employees are exposed above the PEL-TWA or PEL-Excursion Limit.

h. In emergencies

1.10.3 Class I Work

The Contractor shall provide: (1) a tight-fitting, powered air purifying respirator equipped with high efficiency filters, or (2) a full-facepiece supplied air respirator operated in the pressure demand mode, equipped with HEPA egress cartridges, or (3) an auxiliary positive pressure self-contained breathing apparatus, for all employees within the regulated area where Class I work is being performed; provided that a negative exposure assessment has not been produced, and that the exposure level will not exceed 1 f/cc as an 8-hour time weighted average. A full-facepiece supplied air respirator, operated in the pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus shall be provided under such conditions, if the exposure assessment indicates exposure levels above 1 f/cc as an 8-hour time weighted average.

1.10.4 Sanitation

Employees who wear respirators shall be permitted to leave work areas to wash their faces and respirator facepieces whenever necessary to prevent skin irritation associated with respirator use.

1.11 HAZARD COMMUNICATION PROGRAM

A hazard communication program shall be established and implemented in accordance with 29 CFR 1926, Section .59. Material safety data sheets (MSDSs) shall be provided for all hazardous materials brought onto the worksite. One copy shall be provided to the Contracting Officer and 1 copy shall be included in the Contractor's Hazard Communication Program.

1.12 LICENSES, PERMITS AND NOTIFICATIONS

1.12.1 General Legal Requirements

Necessary licenses, permits and notifications shall be obtained in conjunction with the project's asbestos abatement, transportation and disposal actions and timely notification furnished of such actions as required by federal, state, regional, and local authorities. The Contractor shall notify the state's environmental protection agency responsible for asbestos air emissions state OSHA program and the Contracting Officer in writing, at least 10 days prior to the commencement

of work, in accordance with 40 CFR 61, Subpart M, and state and local requirements to include the mandatory "Notification of Demolition and Renovation Record" form and other required notification documents. Notification shall be by Certified Mail, Return Receipt Requested. The Contractor shall furnish copies of the receipts to the Contracting Officer, in writing, prior to the commencement of work. Local fire department shall be notified 3 days before fire-proofing material is removed from a building and the notice shall specify whether or not the material contains asbestos. A copy of the rental company's written acknowledgment and agreement shall be provided as required by paragraph RENTAL EQUIPMENT. For licenses, permits, and notifications that the Contractor is responsible for obtaining, the Contractor shall pay any associated fees or other costs incurred.

1.12.2 Litigation and Notification

The Contractor shall notify the Contracting Officer if any of the following occur:

a. The Contractor or any of the subcontractors are served with notice of violation of any law, regulation, permit or license which relates to this contract;

b. Proceedings are commenced which could lead to revocation of related permits or licenses; permits, licenses or other Government authorizations relating to this contract are revoked;

c. Litigation is commenced which would affect this contract;

d. The Contractor or any of the subcontractors become aware that their equipment or facilities are not in compliance or may fail to comply in the future with applicable laws or regulations.

1.13 PERSONAL PROTECTIVE EQUIPMENT

Three complete sets of personal protective equipment shall be made available to the Contracting Officer and authorized visitors for entry to the regulated area. Contracting Officer and authorized visitors shall be provided with training equivalent to that provided to Contractor employees in the selection, fitting, and use of the required personal protective equipment and the site safety and health requirements. Contractor workers shall be provided with personal protective clothing and equipment and the Contractor shall ensure that it is worn properly. The Contractor's Designated IH and Designated Competent Person shall select and approve all the required personal protective clothing and equipment to be used.

1.13.1 Respirators

Respirators shall be in accordance with paragraph RESPIRATORY PROTECTION PROGRAM.

1.13.2 Whole Body Protection

Personnel exposed to airborne concentrations of asbestos that exceed the

PELs, or for all OSHA Classes of work for which a required negative exposure assessment is not produced, shall be provided with whole body protection and such protection shall be worn properly. The Contractor's Designated IH and Competent Person shall select and approve the whole body protection to be used. The Competent Person shall examine work suits worn by employees at least once per work shift for rips or tears that may occur during performance of work. When rips or tears are detected while an employee is working, rips and tears shall be immediately mended, or the work suit shall be immediately replaced. Disposable whole body protection shall be disposed of as asbestos contaminated waste upon exiting from the regulated area. Reusable whole body protection worn shall be either disposed of as asbestos contaminated waste upon exiting from the regulated area or be properly laundered in accordance with 29 CFR 1926, Section .1101. Whole body protection used for asbestos abatement shall not be removed from the worksite by a worker to be cleaned. Recommendations made by the Contractor's Designated IH to downgrade whole body protection shall be submitted in writing to the Contracting Officer. The Contractor's Designated Competent Person, in consultation with the Designated IH, has the authority to take immediate action to upgrade or downgrade whole body protection when there is an immediate danger to the health and safety of the wearer.

1.13.2.1 Coveralls

Reusable coveralls with a zipper front shall be provided. Sleeves shall be secured at the wrists, and foot coverings secured at the ankles. See DETAIL SHEET 13.

1.13.2.2 Underwear

Disposable underwear shall be provided. If reusable underwear are used, they shall be disposed of as asbestos contaminated waste or laundered in accordance with 29 CFR 1926, Section .1101. Asbestos abatement workers shall not remove contaminated reusable underwear worn during abatement of ACM from the site to be laundered.

1.13.2.3 Work Clothing

An additional coverall shall be provided when the abatement and control method employed does not provide for the exit from the regulated area directly into an attached decontamination unit. Cloth work clothes for wear under the protective coverall, and foot coverings, shall be provided when work is being conducted in low temperature conditions. Cloth work clothes shall be either disposed of as asbestos contaminated waste or properly laundered in accordance with 29 CFR 1926, Section .1101.

1.13.2.4 Gloves

Gloves shall be provided to protect the hands. Where there is the potential for hand injuries (i.e., scrapes, punctures, cuts, etc.) a suitable glove shall be provided and used.

1.13.2.5 Foot Coverings

Cloth socks shall be provided and worn next to the skin. Footwear, as required by OSHA and EM 385-1-1, that is appropriate for safety and health hazards in the area shall be worn. Rubber boots shall be used in moist or wet areas. Reusable footwear removed from the regulated area shall be thoroughly decontaminated or disposed of as ACM waste. Disposable protective foot covering shall be disposed of as ACM waste. If rubber boots are not used, disposable foot covering shall be provided.

1.13.2.6 Head Covering

Hood type reusable head covering shall be provided. In addition, protective head gear (hard hats) shall be provided as required. Hard hats shall only be removed from the regulated area after being thoroughly decontaminated.

1.13.2.7 Protective Eye Wear

Eye protection provided shall be in accordance with ANSI Z87.1.

1.14 HYGIENE FACILITIES AND PRACTICES

The Contractor shall establish a decontamination area for the decontamination of employees, material and equipment. The Contractor shall ensure that employees enter and exit the regulated area through the decontamination area.

1.14.1 Shower Facilities

Shower facilities, when provided, shall comply with 29 CFR 1910, Section .141(d)(3).

1.14.2 Single Stage Decontamination Area

A decontamination area (equipment room/area) shall be provided for Class I work involving less than 7.5 m or 0.9 square meters of TSI or surfacing ACM, and for Class II and Class III asbestos work operations where exposures exceed the PELs or where there is no negative exposure assessment produced before the operation. The equipment room or area shall be adjacent to the regulated area for the decontamination of employees, material, and their equipment which is contaminated with asbestos. The equipment room or area shall consist of an area covered by an impermeable drop cloth on the floor or horizontal working surface. The area must be of sufficient size to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area. Surfaces of the equipment room shall be wet wiped 2 times after each shift. Materials used for wet wiping shall be disposed of as asbestos contaminated waste.

1.14.3 Decontamination Area Entry Procedures

The Contractor shall ensure that employees entering the decontamination area through the clean room or clean area:

a. Remove street clothing in the clean room or clean area and deposit

it in lockers.

b. Put on protective clothing and respiratory protection before leaving the clean room or clean area.

c. Pass through the equipment room to enter the regulated area.

1.14.4 Decontamination Area Exit Procedures

The Contractor shall ensure that the following procedures are followed:

a. Before leaving the regulated area, respirators shall be worn while employees remove all gross contamination and debris from their work clothing using a HEPA vacuum.

b. Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers (see Detail Sheets 9 and 14) for disposal and/or laundering.

c. Employees shall not remove their respirators in the equipment room.

d. Employees shall shower prior to entering the clean room. If a shower has not been located between the equipment room and the clean room or the work is performed outdoors, the Contractor shall ensure that employees engaged in Class I asbestos jobs: a) Remove asbestos contamination from their work suits in the equipment room or decontamination area using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or b) Remove their contaminated work suits in the equipment room, without cleaning worksuits, and proceed to a shower that is not adjacent to the work area.

e. After showering, employees shall enter the clean room before changing into street clothes.

1.14.5 Lunch Areas

The Contractor shall provide lunch areas in which the airborne concentrations of asbestos are below 0.01 f/cc.

1.14.6 Smoking

Smoking, if allowed by the Contractor, shall only be permitted in designated areas approved by the Contracting Officer.

1.15 REGULATED AREAS

All Class I, II, and III asbestos work shall be conducted within regulated areas. The regulated area shall be demarcated to minimize the number of persons within the area and to protect persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, they shall demarcate the regulated area. Access to regulated areas shall be limited to authorized persons. The

Contractor shall control access to regulated areas, ensure that only authorized personnel enter, and verify that Contractor required medical surveillance, training and respiratory protection program requirements are met prior to allowing entrance.

1.16 WARNING SIGNS AND TAPE

Warning signs and tape printed bilingually in English and Spanish shall be provided at the regulated boundaries and entrances to regulated areas. The Contractor shall ensure that all personnel working in areas contiguous to regulated areas comprehend the warning signs. Signs shall be located to allow personnel to read the signs and take the necessary protective steps required before entering the area. Warning signs, as shown and described in DETAIL SHEET 11, shall be in vertical format conforming to 29 CFR 1910 and 29 CFR 1926, Section .1101, a minimum of 500 by 350 mm , and displaying the following legend in the lower panel:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

PELIGRO
ASBESTOS
ENFERMEDADES DEL CANCERY PULMON
SOLAMENTE PERSONAL AUTORIZADO
ROPA PROTECTIVAY RESPIRADORES/SON NECESAVIOS EM EL AREA

Spacing between lines shall be at least equal to the height of the upper of any two lines. Warning tape shall be provided as shown and described on DETAIL SHEET 11. Decontamination unit signage shall be as shown and described on DETAIL SHEET 15.

1.17 WARNING LABELS

Warning labels shall be affixed to all asbestos disposal containers used to contain asbestos materials, scrap, waste debris, and other products contaminated with asbestos. Containers with preprinted warning labels conforming to requirements are acceptable. Warning labels shall be as described in DETAIL SHEET 14, shall conform to 29 CFR 1926, Section .1101 and shall be of sufficient size to be clearly legible displaying the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

PELIGRO
CONTIENE FIBVAS DE ASBESTO
EVITE CREAR POLVO
PELIGRO ENFERMEDADES DEL CANCERY PULMON

1.18 LOCAL EXHAUST VENTILATION

Local exhaust ventilation units shall conform to ANSI Z9.2 and 29 CFR 1926, Section .1101. Filters on local exhaust system equipment shall conform to ANSI Z9.2 and UL 586. Filter shall be UL labeled.

1.19 TOOLS

Vacuums shall be leak proof to the filter, equipped with HEPA filters, of sufficient capacity and necessary capture velocity at the nozzle or nozzle attachment to efficiently collect, transport and retain the ACM waste material. Power tools shall not be used to remove ACM unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation capture and collection system, or has otherwise been approved for use by the Contracting Officer. Residual asbestos shall be removed from reusable tools prior to storage and reuse. Reusable tools shall be thoroughly decontaminated prior to being removed from regulated areas.

1.20 RENTAL EQUIPMENT

If rental equipment is to be used, written notification shall be provided to the rental agency, concerning the intended use of the equipment, the possibility of asbestos contamination of the equipment and the steps that will be taken to decontaminate such equipment. A written acceptance of the terms of the Contractor's notification shall be obtained from the rental agency.

1.21 AIR MONITORING EQUIPMENT

The Contractor's Designated IH shall approve air monitoring equipment to be used to collect samples. The equipment shall include, but shall not be limited to:

a. High-volume sampling pumps that can be calibrated and operated at a constant airflow up to 16 liters per minute when equipped with a sampling train of tubing and filter cassette.

b. Low-volume, battery powered, body-attachable, portable personal pumps that can be calibrated to a constant airflow up to approximately 3.5 liters per minute when equipped with a sampling train of tubing and filter cassette, and a self-contained rechargeable power pack capable of sustaining the calibrated flow rate for a minimum of 10 hours. The pumps shall also be equipped with an automatic flow control unit which shall maintain a constant flow, even as filter resistance increases due to accumulation of fiber and debris on the filter surface.

c. Single use standard 25 mm diameter cassette, open face, 0.8 micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive extension cowl, and shrink bands, to be used with low flow pumps in accordance with 29 CFR 1926, Section .1101 for personal air sampling.

d. Single use standard 25 mm diameter cassette, open face, 0.45

micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive cowl, and shrink bands, to be used with high flow pumps when conducting environmental area sampling using NIOSH Pub No. 84-100 Methods 7400 and 7402, (and the transmission electric microscopy method specified at 40 CFR 763 if required).

e. Appropriate plastic tubing to connect the air sampling pump to the selected filter cassette.

f. A flow calibrator capable of calibration to within plus or minus 2 percent of reading over a temperature range of minus 20 to plus 60 degrees C and traceable to a NIST primary standard.

1.22 EXPENDABLE SUPPLIES

1.22.1 Glovebag

Glovebags shall be provided as described in 29 CFR 1926, Section .1101 and SET-UP DETAIL SHEET 10. The glovebag assembly shall be 0.15 mm thick plastic, prefabricated and seamless at the bottom with preprinted OSHA warning label.

1.22.2 Duct Tape

Industrial grade duct tape of appropriate widths suitable for bonding sheet plastic and disposal container shall be provided.

1.22.3 Disposal Containers

Leak-tight (defined as solids, liquids, or dust that cannot escape or spill out) disposal containers shall be provided for ACM wastes as required by 29 CFR 1926 Section .1101 and DETAIL SHEETS 9A, 9B, 9C and 14.

1.22.4 Disposal Bags

Leak-tight bags, 0.15 mm thick, shall be provided for placement of asbestos generated waste as described in DETAIL SHEET 9A.

1.22.5 Cardboard Boxes

Heavy-duty corrugated cardboard boxes, coated with plastic or wax to retard deterioration from moisture, shall be provided as described in DETAIL SHEET 9C, if required by state and local requirements. Boxes shall fit into selected ACM disposal bags. Filled boxes shall be sealed leak-tight with duct tape.

1.22.6 Sheet Plastic

Sheet plastic shall be polyethylene of 0.15 mm minimum thickness and shall be provided in the largest sheet size necessary to minimize seams ,as indicated on the project drawings. Film shall be clear, frosted or [black] and conform to ASTM D 4397, except as specified below:

1.22.6.1 Flame Resistant

Where a potential for fire exists, flame-resistant sheets shall be provided. Film shall be frosted or black and shall conform to the requirements of NFPA 701.

1.22.6.2 Reinforced

Reinforced sheets shall be provided where high skin strength is required, such as where it constitutes the only barrier between the regulated area and the outdoor environment. The sheet stock shall consist of translucent, nylon-reinforced or woven-polyethylene thread laminated between 2 layers of polyethylene film. Film shall meet flame resistant standards of NFPA 701.

1.22.7 Amended Water

Amended water shall meet the requirements of ASTM D 1331.

1.22.8 Mastic Removing Solvent

Mastic removing solvent shall be nonflammable and shall not contain methylene chloride, glycol ether, or halogenated hydrocarbons. Solvents used onsite shall have a flash point greater than 60 degrees C.

1.22.9 Leak-tight Wrapping

Two layers of 0.15 mm minimum thick polyethylene sheet stock shall be used for the containment of removed asbestos-containing components or materials such as reactor vessels, large tanks, boilers, insulated pipe segments and other materials too large to be placed in disposal bags as described in DETAIL SHEET 9B. Upon placement of the ACM component or material, each layer shall be individually leak-tight sealed with duct tape.

1.22.10 Viewing Inspection Window

Where feasible, a minimum of 1 clear, 3 mm thick, acrylic sheet, 450 by 610 mm , shall be installed as a viewing inspection window at eye level on a wall in each containment enclosure. The windows shall be sealed leak-tight with industrial grade duct tape.

1.23 MISCELLANEOUS ITEMS

A sufficient quantity of other items, such as, but not limited to: scrapers, brushes, brooms, staple guns, tarpaulins, shovels, rubber squeegees, dust pans, other tools, scaffolding, staging, enclosed chutes, wooden ladders, lumber necessary for the construction of containments, UL approved temporary electrical equipment, material and cords, ground fault circuit interrupters, water hoses of sufficient length, fire extinguishers, first aid kits, portable toilets, logbooks, log forms, markers with indelible ink, spray paint in bright color to mark areas, project boundary fencing, etc., shall be provided.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Encapsulants shall conform to USEPA requirements, shall contain no toxic or hazardous substances and no solvent and shall meet the following requirements:

ALL ENCAPSULANTS

Requirement	Test Standard
Flame Spread - 25, Smoke Emission - 50	ASTM E 84
Combustion Toxicity Zero Mortality	University ofPittsburgh Protocol
Life Expantancy, 20 yrs Accelerated Aging Test	ASTM C 732
Permeability, Min. 23 ng per Pa-sec-square m	ASTM E 96

Additional Requirements for Bridging Encapsulant

Requirement	Test Standard
Cohesion/Adhesion Test, 730 N/m	ASTM E 736
Fire Resistance, Negligible affect on fire resistance rating over 3 hour test (Classified by UL for use over fibrous and cementitious sprayed fireproofing)	ASTM E 119
Impact Resistance, Min. 4.7 N-m (Gardner Impact Test)	ASTM D 2794
Flexibility, no rupture or cracking (Mandrel Bend Test)	ASTM D 522

Additional Requirements for Penetrating Encapsulant

Requirement	Test Standard
Cohesion/Adhesion Test, 730 N/m	ASTM E 736
Fire Resistance, Negligible affect on fire resistance rating over 3 hour test (Classified by UL for use over fibrous and cementitious sprayed fireproofing)	ASTM E 119
Impact Resistance, Min. 4.7 N-m (Gardner Impact Test)	ASTM D 2794
Flexibility, no rupture or cracking (Mandrel Bend Test)	ASTM D 522

Additional Requirements for Lockdown Encapsulant

Requirement	Test Standard

Fire Resistance, Negligible affect on fire resistance rating over 3 hour test (Tested with fireproofing over encapsulant applied directly to steel member)	ASTM E 119
Bond Strength, 1.5 kN/m (Tests compatibility with cementitious and fibrous fireproofing)	ASTM E 736

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Asbestos abatement work tasks shall be performed as shown on the detailed plans and drawings, as summarized in paragraph DESCRIPTION OF WORK and including Table 1 and the Contractor's Accident Prevention Plan, Asbestos Hazard Abatement Plan, and the Activity Hazard Analyses. The Contractor shall use the engineering controls and work practices required in 29 CFR 1926, Section .1101(g) in all operations regardless of the levels of exposure. Personnel shall wear and utilize protective clothing and equipment as specified. The Contractor shall not permit eating, smoking, drinking, chewing or applying cosmetics in the regulated area. All hot work (burning, cutting, welding, etc.) shall be conducted under controlled conditions in conformance with 29 CFR 1926, Section .352, Fire Prevention. Personnel of other trades, not engaged in asbestos abatement activities, shall not be exposed at any time to airborne concentrations of asbestos unless all the administrative and personal protective provisions of the Contractor's Accident Prevention Plan are complied with. Power to the regulated area shall be locked-out and tagged in accordance with 29 CFR 1910, and temporary electrical service with ground fault circuit interrupters shall be provided as needed. Temporary electrical service shall be disconnected when necessary for wet removal. The Contractor shall stop abatement work in the regulated area immediately when the airborne total fiber concentration: (1) equals or exceeds 0.01 f/cc, or the pre-abatement concentration, whichever is greater, outside the regulated area; or (2) equals or exceeds 1.0 f/cc inside the regulated area. The Contractor shall correct the condition to the satisfaction of the Contracting Officer, including visual inspection and air sampling. Work shall resume only upon notification by the Contracting Officer. Corrective actions shall be documented.

3.2 PROTECTION OF ADJACENT WORK OR AREAS TO REMAIN

Asbestos abatement shall be performed without damage to or contamination of adjacent work or area. Where such work or area is damaged or contaminated, as verified by the Contracting Officer using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government, as deemed appropriate by the Contracting Officer. This includes inadvertent spill of dirt, dust or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, work shall stop in all effected areas immediately and the spill shall be cleaned. When satisfactory visual inspection and air

sampling analysis results are obtained and have been evaluated by the Contractor's Designated IH and the Contracting Officer, work shall proceed.

3.3 METHODS OF COMPLIANCE

3.3.1 Mandated Practices

The Contractor shall employ proper handling procedures in accordance with 29 CFR 1926 and 40 CFR 61, Subpart M, and the specified requirements. The specific abatement techniques and items identified shall be detailed in the Contractor's Asbestos Hazard Abatement Plan including, but not limited to, details of construction materials, equipment, and handling procedures. The Contractor shall use the following engineering controls and work practices in all operations, regardless of the levels of exposure:

a. Vacuum cleaners equipped with HEPA filters to collect debris and dust containing ACM.

b. Wet methods or wetting agents to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup; except where it can be demonstrated that the use of wet methods is unfeasible due to, for example, the creation of electrical hazards, equipment malfunction, and in roofing.

c. Prompt clean-up and disposalin leak-tight containers of wastes and debris contaminated with asbestos.

d. Inspection and repair of polyethylene in work and high traffic areas.

e. Cleaning of equipment and surfaces of containers filled with ACM prior to removing them from the equipment room or area.

3.3.2 Control Methods

The Contractor shall use the following control methods to comply with the PELs:

a. Local exhaust ventilation equipped with HEPA filter dust collection systems;

b. Enclosure or isolation of processes producing asbestos dust;

c. Ventilation of the regulated area to move contaminated air away from the breathing zone of employees and toward a filtration or collection device equipped with a HEPA filter;

d. Use of other work practices and engineering controls;

e. Where the feasible engineering and work practice controls described above are not sufficient to reduce employee exposure to or below the PELs, the Contractor shall use them to reduce employee exposure to the lowest levels attainable by these controls and shall supplement them by the use of respiratory

protection that complies with paragraph, RESPIRATORY PROTECTION PROGRAM.

3.3.3 Unacceptable Practices

The following work practices and engineering controls shall not be used for work related to asbestos or for work which disturbs ACM, regardless of measured levels of asbestos exposure or the results of initial exposure assessments:

a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.

b. Compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.

c. Dry sweeping, shoveling, or other dry clean-up of dust and debris containing ACM.

d. Employee rotation as a means of reducing employee exposure to asbestos.

3.3.4 Class I Work Procedures

In addition to requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

a. An exposure assessment shall be made prior to outdoor work to determine control requirements.

b. A Competent Person shall supervise the installation and operation of the control system.

c. Where a negative exposure assessment has not been provided or where exposure monitoring shows the PEL was exceeded, the regulated area shall be ventilated to move contaminated air away from the employee's breathing zone toward a HEPA unit or collection device.

3.3.5 Specific Control Methods for Class I Work

In addition to requirements of paragraph Class I Work Procedures, Class I asbestos work shall be performed using the control methods identified in the subparagraphs below.

3.3.5.1 Negative Pressure Enclosure (NPE) System

The NPE system shall be as shown in SETUP DETAIL SHEET 8. The system shall provide at least 4 air changes per hour inside the containment. The local exhaust unit equipment shall be operated 24 hours per day until the containment is removed, and shall be leak-proof to the filter and equipped

with HEPA filters. Air movement shall be directed away from the employees and toward a HEPA filtration device. The NPE shall be smoke tested for leaks at the beginning of each shift. Local exhaust equipment shall be sufficient to maintain a minimum pressure differential of minus 0.5 mm of water column relative to adjacent, unsealed areas. Pressure differential shall be monitored continuously, 24 hours per day, with an automatic manometric recording instrument. Pressure differential recordings shall be provided daily on the same day collected. Readings shall be reviewed by the Contractor's Designated Competent Person and IH prior to submittal. The Contracting Officer shall be notified immediately if the pressure differential falls below the prescribed minimum. The building ventilation system shall not be used as the local exhaust system for the regulated area. The local exhaust system shall terminate outdoors unless an alternate arrangement is allowed by the Contract Officer. All filters used shall be new at the beginning of the project and shall be periodically changed as necessary and disposed of as ACM waste.

3.3.5.2 Glovebag Systems

Glovebag systems shall be as shown in SETUP DETAIL SHEET 10. The glovebag system shall be used to remove ACM from straight runs of piping and elbows and other connections. Glovebags shall be used without modification and shall be smoke-tested for leaks and any leaks sealed prior to use. Glovebags shall be installed to completely cover the circumference of pipe or other structures where the work is to be done. Glovebags shall be used only once and shall not be moved. Glovebags shall not be used on surfaces that have temperatures exceeding 66 degrees C. Prior to disposal, glovebags shall be collapsed by removing air within them using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag operation shall be wrapped and sealed in 2 layers of plastic or otherwise rendered intact. At least 2 persons shall perform Class I glovebag removal. Asbestos regulated work areas shall be established as specified and shown on detailed drawings and plans for glovebag abatement. Designated boundary limits for the asbestos work shall be established with rope or other continuous barriers and all other requirements for asbestos control areas shall be maintained, including area signage and boundary warning tape as specified in SET-UP DETAIL SHEET 11.

a. In addition to requirements for negative pressure glovebag systems above, the Contractor shall attach HEPA vacuum systems or other devices to the bag to prevent collapse during removal of ACM from straight runs of piping and elbows and other connections.

b. The negative pressure glove boxes used to remove ACM from pipe runs shall be fitted with gloved apertures and a bagging outlet and constructed with rigid sides from metal or other material which can withstand the weight of the ACM and water used during removal. A negative pressure shall be created in the system using a HEPA filtration system. The box shall be smoke tested for leaks prior to each use.

3.3.6 Class I Asbestos Work Rsponse Action Detail Sheets

The following Class I Asbestos Work Response Action Detail Sheet is

specified on Table 1 for each individual work task to be performed:

a. Asbestos Cement Pipe: See Sheet 102.

3.3.7 Abatement of Asbestos Contaminated Soil

Asbestos contaminated soil shall be removed from areas to a minimum depth of 50 mm. Soil shall be thoroughly dampened with amended water and then removed by manual shoveling into labeled containers. The workers shall be closely monitored for heat exhaustion. The minimum ventilation shall be 8 air changes per hour through a local exhaust HEPA system. See DETAIL SHEET 73.

3.4 FINAL CLEANING AND VISUAL INSPECTION

Upon completion of abatement, the regulated area shall be cleaned by collecting, packing, and storing all gross contamination; see SET-UP DETAIL SHEETS 9, 14 and 20. A final cleaning shall be performed using HEPA vacuum and wet cleaning of all exposed surfaces and objects in the regulated area. Upon completion of the cleaning, the Contractor shall conduct a visual pre-inspection of the cleaned area in preparation for a final inspection before final air clearance monitoring and recleaning, as necessary. Upon completion of the final cleaning, the Contractor and the Contracting Officer shall conduct a final visual inspection of the cleaned regulated area in accordance with ASTM E 1368 and document the results on the Final Cleaning and Visual Inspection as specified on the SET-UP DETAIL SHEET 19. If the Contracting Officer rejects the clean regulated area as not meeting final cleaning requirements, the Contractor shall reclean as necessary and have a follow-on inspection conducted with the Contracting Officer. Recleaning and follow-up reinspection shall be at the Contractor's expense.

3.5 LOCKDOWN

Prior to removal of plastic barriers and after clean-up of gross contamination and final visual inspection, a post removal (lockdown) encapsulant shall be spray applied to ceiling, walls, floors, and other surfaces in the regulated area.

3.6 EXPOSURE ASSESSMENT AND AIR MONITORING

3.6.1 General Requirements For Exposure

Exposure assessment, air monitoring and analysis of airborne concentration of asbestos fibers shall be performed in accordance with 29 CFR 1926, Section .1101, the Contractor's air monitoring plan, and as specified. Personal exposure air monitoring (collected at the breathing zone) that is representative of the exposure of each employee who is assigned to work within a regulated area shall be performed by the Contractor's Designated IH. Breathing zone samples shall be taken for at least 25 percent of the workers in each shift, or a minimum of 2, whichever is greater. Air monitoring results at the 95 percent confidence level shall be calculated as shown in Table 2 at the end of this section. The Contractor shall provide an onsite independent testing laboratory with qualified analysts and appropriate equipment to conduct sample analyses of air samples using

the methods prescribed in 29 CFR 1926, Section .1101, to include NIOSH Pub No. 84-100 Method 7400. Final clearance environmental air monitoring, shall be performed by the Contractor's Designated IH. Environmental and final clearance air monitoring shall be performed using NIOSH Pub No. 84-100 Method 7400 (PCM) with optional confirmation of results by NIOSH Pub No. 84-100 Method 7402 (TEM). For environmental and final clearance, air monitoring shall be conducted at a sufficient velocity and duration to establish the limit of detection of the method used at 0.005 f/cc. Confirmation of asbestos fiber concentrations (asbestos f/cc) from environmental and final clearance samples collected and analyzed by NIOSH Pub No. 84-100 Method 7400 (total f/cc) may be conducted using TEM in accordance with NIOSH Pub No. 84-100 Method 7402. When such confirmation is conducted, it shall be from the same sample filter used for the NIOSH Pub No. 84-100 Method 7400 PCM analysis. For all Contractor required environmental or final clearance air monitoring, confirmation of asbestos fiber concentrations, using NIOSH Pub No. 84-100 Method 7402, shall be at the Contractor's expense. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. Results of breathing zone samples shall be posted at the job site and made available to the Contracting Officer. The Contractor shall maintain a fiber concentration inside a regulated area less than or equal to 0.1 f/cc expressed as an 8 hour, time-weighted average (TWA) during the conduct of the asbestos abatement. If fiber concentration rises above 0.1 f/cc, work procedures shall be investigated with the Contracting Officer to determine the cause. At the discretion of the Contracting Officer, fiber concentration may exceed 0.1 f/cc but shall not exceed 1.0 f/cc expressed as an 8-hour TWA. The Contractor's workers shall not be exposed to an airborne fiber concentration in excess of 1.0 f/cc, as averaged over a sampling period of 30 minutes. Should either an environmental concentration of 1.0 f/cc expressed as an 8-hour TWA or a personal excursion concentration of 1.0 f/cc expressed as a 30-minute sample occur inside a regulated work area, the Contractor shall stop work immediately, notify the Contracting Officer, and implement additional engineering controls and work practice controls to reduce airborne fiber levels below prescribed limits in the work area. Work shall not restart until authorized by the Contracting Officer.

3.6.2 Initial Exposure Assessment

The Contractor's Designated IH shall conduct an exposure assessment immediately before or at the initiation of an asbestos abatement operation to ascertain expected exposures during that operation. The assessment shall be completed in time to comply with the requirements which are triggered by exposure data or the lack of a negative exposure assessment, and to provide information necessary to assure that all control systems planned are appropriate for that operation. The assessment shall take into consideration both the monitoring results and all observations, information or calculations which indicate employee exposure to asbestos, including any previous monitoring conducted in the workplace, or of the operations of the Contractor which indicate the levels of airborne asbestos likely to be encountered on the job. For Class I asbestos work, until the employer conducts exposure monitoring and documents that employees on that job will not be exposed in excess of PELs, or otherwise makes a negative exposure assessment, the Contractor shall presume that employees are exposed in excess of the PEL-TWA and PEL-Excursion Limit.

3.6.3 Negative Exposure Assessment

The Contractor shall provide a negative exposure assessment for the specific asbestos job which will be performed. The negative exposure assessment shall be provided within 2 days of the initiation of the project and conform to the following criteria:

a. Objective Data: Objective data demonstrating that the product or material containing asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the PEL-TWA and PEL-Excursion Limit under those work conditions having the greatest potential for releasing asbestos.

b. Prior Asbestos Jobs: Where the Contractor has monitored prior asbestos jobs for the PEL and the PEL-Excursion Limit within 12 months of the current job, the monitoring and analysis were performed in compliance with asbestos standard in effect; the data were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the Contractor's current operations; the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job; and these data show that under the conditions prevailing and which will prevail in the current workplace, there is a high degree of certainty that the monitoring covered exposure from employee exposures will not exceed the PEL-TWA and PEL-Excursion Limit.

c. Initial Exposure Monitoring: The results of initial exposure monitoring of the current job, made from breathing zone air samples that are representative of the 8-hour PEL-TWA and 30-minute short-term exposures of each employee. The monitoring covered exposure from operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.

3.6.4 Independent Environmental Monitoring

The air monitoring contractor has been provided a copy of the contract that includes this abatement work. The abatement contractor will provide the air monitoring contractor with an up-to-date copy of the accepted Asbestos Hazard Abatement Plan, Accident Prevention Plan and pertinent detailed drawings. The air monitoring contractor is required to comply with the abatement contractor's safety and health requirements. The abatement contractor will coordinate all onsite activities with the air monitoring contractor, the COR, and other affected parties as directed by the COR. The abatement contractor will provide the air monitoring contractor with an up-to-date schedule of abatement contractor work activities. The air monitoring contractor will coordinate with the abatement contractor and the COR during the performance Government required air monitoring. The abatement contractor is responsible for performing exposure assessment and

personal air monitoring of abatement contractor's work. The air monitoring contractor is responsible for performing these tasks for its employee.

3.6.5 Preabatement Environmental Air Monitoring

Preabatement environmental air monitoring shall be established 1 day prior to the masking and sealing operations for each regulated area to determine background concentrations before abatement work begins. As a minimum, preabatement air samples shall be collected using NIOSH Pub No. 84-100 Method 7400, PCM at these locations: outside the building; inside the building, but outside the regulated area perimeter; and inside each regulated work area. One sample shall be collected for every 185 square meters of floor space. At least 2 samples shall be collected outside the building: at the exhaust of the HEPA unit; and downwind from the abatement site. The PCM samples shall be analyzed within 24 hours; and if any result in fiber concentration greater than 0.01 f/cc, asbestos fiber concentration shall be confirmed using NIOSH Pub No. 84-100 Method 7402 (TEM).

3.6.6 Environmental Air Monitoring During Abatement

Until an exposure assessment is provided to the Contracting Officer, environmental air monitoring shall be conducted at locations and frequencies that will accurately characterize any evolving airborne asbestos fiber concentrations. The assessment shall demonstrate that the product or material containing asbestos minerals, or the abatement involving such product or material, cannot release airborne asbestos fibers in concentrations exceeding 0.01 f/cc as a TWA under those work conditions having the greatest potential for releasing asbestos. The monitoring shall be at least once per shift at locations including, but not limited to, close to the work inside a regulated area; preabatement sampling locations; outside entrances to a regulated area; close to glovebag operations; representative locations outside of the perimeter of a regulated area; inside clean room; and at the exhaust discharge point of local exhaust system ducted to the outside of a containment (if used). If the sampling outside regulated area shows airborne fiber levels have exceeded background or 0.01 f/cc, whichever is greater, work shall be stopped immediately, and the Contracting Officer notified. The condition causing the increase shall be corrected. Work shall not restart until authorized by the Contracting Officer.

3.6.7 Final Clearance Air Monitoring

Prior to conducting final clearance air monitoring, the Contractor and the Contracting Officer shall conduct a final visual inspection of the regulated area where asbestos abatement has been completed. The final visual inspection shall be as specified in SET-UP DETAIL SHEET 19. Final clearance air monitoring shall not begin until acceptance of the Contractor's final cleaning by the Contracting Officer. The Contractor's Designated IH shall conduct final clearance air monitoring using aggressive air sampling techniques as defined in EPA 560/5-85-024 or as otherwise required by federal or state requirements. The sampling and analytical method used will be NIOSH Pub No. 84-100Method 7400 (PCM) and Table 3 with confirmation of results by NIOSH Pub No. 84-100 Method 7402 (TEM).

3.6.7.1 Final Clearance Requirements, NIOSH PCM Method

For PCM sampling and analysis using NIOSH Pub No. 84-100 Method 7400, the fiber concentration inside the abated regulated area, for each airborne sample, shall be less than 0.01 f/cc. The abatement inside the regulated area is considered complete when every PCM final clearance sample is below the clearance limit. If any sample result is greater than 0.01 total f/cc, the asbestos fiber concentration (asbestos f/cc) shall be confirmed from that same filter using NIOSH Pub No. 84-100 Method 7402 (TEM) at Contractor's expense. If any confirmation sample result is greater than 0.01 asbestos f/cc, abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

3.6.7.2 Final Clearance Requirements, EPA TEM Method

For EPA TEM sampling and analysis, using the EPA Method specified in 40 CFR 763, abatement inside the regulated area is considered complete when the arithmetic mean asbestos concentration of the 5 inside samples is less than or equal to 70 structures per square millimeter (70 S/mm). When the arithmetic mean is greater than 70 S/mm, the 3 blank samples shall be analyzed. If the 3 blank samples are greater than 70 S/mm, resampling shall be done. If less than 70 S/mm, the 5 outside samples shall be analyzed and a Z-test analysis performed. When the Z-test results are less than 1.65, the decontamination shall be considered complete. If the Z-test results are more than 1.65, the abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

3.6.7.3 Air Clearance Failure

If clearance sampling results fail to meet the final clearance requirements, the Contractor shall pay all costs associated with the required recleaning, resampling, and analysis, until final clearance requirements are met.

3.6.8 Air-Monitoring Results and Documentation

Air sample fiber counting shall be completed and results provided within 24 hours (breathing zone samples), and 12 hours (environmental/clearance monitoring) after completion of a sampling period. The Contracting Officer shall be notified immediately of any airborne levels of asbestos fibers in excess of established requirements. Written sampling results shall be provided within 5 working days of the date of collection. The written results shall be signed by testing laboratory analyst, testing laboratory principal and the Contractor's Designated IH. The air sampling results shall be documented on a Contractor's daily air monitoring log. The daily air monitoring log shall contain the following information for each sample:

a. Sampling and analytical method used;

b. Date sample collected;

c. Sample number;

d. Sample type: BZ = Breathing Zone (Personal), P = Preabatement, E = Environmental, C = Abatement Clearance;

e. Location/activity/name where sample collected;

f. Sampling pump manufacturer, model and serial number, beginning flow rate, end flow rate, average flow rate (L/min);

g. Calibration date, time, method, location, name of calibrator, signature;

h. Sample period (start time, stop time, elapsed time (minutes);

i. Total air volume sampled (liters);

j. Sample results (f/cc and S/mm square) if EPA methods are required for final clearance;

k. Laboratory name, location, analytical method, analyst, confidence level. In addition, the printed name and a signature and date block for the Industrial Hygienist who conducted the sampling and for the Industrial Hygienist who reviewed the daily air monitoring log verifying the accuracy of the information.

3.7 CLEARANCE CERTIFICATION

When asbestos abatement is complete, ACM waste is remmoved from the regulated areas, and final clean-up is completed, the Contracting Officer will certify the areas as safe before allowing the warning signs and boundary warning tape to be removed. After final clean-up and acceptable airborne concentrations are attained, but before the HEPA unit is turned off and the contaminate removed, the Contractor shall remove all pre-filters on the bulding HVAC system and provide new pre-filters. The Contractor shall dispose of such filters as asbestos contaminated materials. HVAC, mechanical, and electrical systems shall be re-established in proper working order. The Contractor and the Contracting Officer shall visually inspect all surfaces within the containment for residual material or accummulated debris. The Contractor shall reclean all areas showing dust or residual materials. The Contracting Officer will certify in writing that the area is safe before unrestricted entry is permitted. The Government will have the option to perform monitoring to certify the areas are safe before entry is permitted.

3.8 CLEANUP AND DISPOSAL

3.8.1 Title to ACM Materials

ACM material resulting from abatement work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of at the Ft. Bliss landfill.

3.8.2 Collection and Disposal of Asbestos

All ACM waste shall be collected and including contaminated wastewater filters, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing, shall be collected and placed in leak-tight containers such as double plastic bags (see DETAIL SHEET 9A); sealed double wrapped polyethylene sheet (see DETAIL 9B); sealed fiberboard boxes (see DETAIL SHEET 9C); or other approved containers. Waste within the containers shall be wetted in case the container is breeched. Asbestos-containing waste shall be disposed of at the Ft. Bliss landfill. For temporary storage, sealed impermeable containers shall be stored in an asbestos waste load-out unit or in a storage/transportation conveyance (i.e., dumpster, roll-off waste boxes, etc.) in a manner acceptable to and in an area assigned by the Contracting Officer. Procedure for hauling and disposal shall comply with 40 CFR 61, Subpart M, state, regional, and local standards.

3.8.3 Asbestos Waste Shipment Record

The Contractor shall complete and provide the Contracting Officer final completed copies of the Waste Shipment Record for all shipments of waste material as specified in 40 CFR 61, Subpart M and other required state waste manifest shipment records, within 3 days of delivery to the landfill. Each Waste Shipment Record shall be signed and dated by the Contractor, the waste transporter and disposal facility operator.

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet_____ of _____

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER _____
2. LOCATION OF WORK TASK_____
_____
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED:_____
_____

a. Type of Asbestos _____
b. Percent asbestos content _____%

4. ABATEMENT TECHNIQUE TO BE USED_____
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK_____
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
Friable _____ Non-friable Category I _____
Non-friable Category II_____
7. FORM _____ and CONDITION OF ACM: GOOD_____ FAIR_____ POOR_____
8. QUANTITY: METERS_____, SQUARE METERS_____
8a. QUANTITY: LINEAR FT._____, SQUARE FT._____
9. RESPONSE ACTION DETAIL SHEET NUMBER FOR WORK TASK_____
10. SET-UP DETAIL SHEET NUMBERS
FOR WORK TASK _____, _____, _____, _____,
_____, _____, _____, _____.

NOTES:

(1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
(2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
(3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
(4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
(5) Class designation: Class I, II, III, or IV (OSHA designation).
(6) Friability of materials: Check the applicable EPA NESHAP friability designation.
(7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
Condition: Good = G; Fair = F; Poor = P.
(8) Quantity of ACM for each work task in meters or square meters.
(8a) Quantity of ACM for each work task in linear feet or square feet.
(9) Response Action Detail Sheet specifies the material to be abated and the methods to be used. There is only one Response Action Detail Sheet for each abatement task.
(10) Set-up Detail Sheets indicate containment and control methods used

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS
in support of the response action (referenced in the selected Response Action Detail Sheet).

TABLE 2

FORMULA FOR CALCULATION OF THE 95 PERCENT CONFIDENCE LEVEL
(Reference: NIOSH 7400)

Fibers/cc(01.95 percent CL) = X + [(X) * (1.645) * (CV)]

Where: X = ((E)(AC))/((V)(1000))

E = ((F/Nf) - (B/Nb))/Af

CV = The precision value; 0.45 shall be used unless the analytical laboratory provides the Contracting Officer with documentation (Round Robin Program participation and results) that the laboratory's precision is better.

AC = Effective collection area of the filter in square millimeters

V = Air volume sampled in liters

E = Fiber density on the filter in fibers per square millimeter

F/Nf = Total fiber count per graticule field

B/Nb = Mean field blank count per graticule field

Af = Graticule field area in square millimeters

TWA = C1/T1 + C2/T2 = Cn/Tn

Where: C = Concentration of contaminant

T = Time sampled.

TABLE 3

NI0SH METHOD 7400

PCM ENVIRONMENTAL AIR SAMPLING PROTOCOL (NON-PERSONAL)

Sample Location	Minimum No. of Samples	Filter Pore Size (Note 1)	Min. Vol. (Note 2) (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	0.5/140 Square Meters (Notes 3 & 4)	0.45 microns	3850	2-16
Each Room in 1 Abatement Area Less than 140 Square meters		0.45 microns	3850	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.

2. Ensure detection limit for PCM analysis is established at 0.005 fibers/cc.

3. One sample shall be added for each additional 140 square meters. (The corresponding I-P units are 5/1500 square feet).

4. A minimum of 5 samples are to be taken per abatement area, plus 2 field blanks.

TABLE 4

EPA AHERA METHOD: TEM AIR SAMPLING PROTOCOL

Location Sampled	Minimum No. of Samples	Filter Pore Size	Min. Vol. (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	5	0.45 microns	1500	2-16
Outside Abatement Area	5	0.45 microns	1500	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.

2. The detection limit for TEM analysis is 70 structures/square mm.

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME _____ CONTRACT NO. _____
PROJECT ADDRESS _____
CONTRACTOR FIRM NAME _____
EMPLOYEE'S NAME _____,_____,_____,
(Print) (Last) (First) (MI)

Social Security Number: _____-_____-_____,

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH TYPES OF LUNG DISEASE AND CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS, THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NONSMOKING PUBLIC.

Your employer's contract for the above project requires that you be provided and you complete formal asbestos training specific to the type of work you will perform and project specific training; that you be supplied with proper personal protective equipment including a respirator, that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you. The Contractor's Designated Industrial Hygienist will check the block(s) for the type of formal training you have completed. Review the checked blocks prior to signing this certification.

FORMAL TRAINING:
_____ a. For Competent Persons and Supervisors: I have completed EPA's Model Accreditation Program (MAP) training course, "Contractor/Supervisor", that meets this State's requirements.

b. For Workers:
_____ (1) For OSHA Class I work: I have completed EPA's MAP training course, "Worker", that meets this State's requirements.
_____ (2) For OSHA Class II work (where there will be abatement of more than one type of Class II materials, i.e., roofing, siding, floor tile, etc.): I have completed EPA's MAP training course, "Worker", that meets this State's requirements.
(3) For OSHA Class II work (there will only be abatement of one type of Class II material):
_____ (a) I have completed an 8-hour training class on the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls of 29 CFR 1926, Section .1101(g) and hands-on training.
_____ (b) I have completed EPA's MAP training course, "Worker", that meets this State's requirements.
_____ (4) For OSHA Class III work: I have completed at least a 16-hour course consistent with EPA requirements for training of local education agency maintenance and custodial staff at 40 CFR 763, Section .92(a)(2) and

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls at 29 CFR 1926, Section .1101, and hands-on training.

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

_____ (5) For OSHA Class IV work: I have completed at least a 2-hr course consistent with EPA requirements for training of local education agency maintenance and custodial staff at 40 CFR 763, (a)(1), and the elements of 29 CFR 1926, Section .1101(k)(9)(viii), in addition to the specific work practices and engineering controls at 29 CFR 1926, Section .1101(g) and hands-on training.

_____ c. Workers, Supervisors and the Designated Competent Person: I have completed annual refresher training as required by EPA's MAP that meets this State's requirements.

PROJECT SPECIFIC TRAINING:
_____ I have been provided and have completed the project specific training required by this Contract. My employer's Designated Industrial Hygienist and Designated Competent Person conducted the training.

RESPIRATORY PROTECTION:
_____ I have been trained in accordance with the criteria in the Contractor's Respiratory Protection program. I have been trained in the dangers of handling and breathing asbestos dust and in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair and contact lens use policy of my employer.

RESPIRATOR FIT-TEST TRAINING:
_____ I have been trained in the proper selection, fit, use, care, cleaning,maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in the Contractor's Respiratory Program and have received a satisfactory fit. I have been assigned my individual respirator. I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time.

MEDICAL EXAMINATION:
_____ I have had a medical examination within the last twelve months which was paid for by my employer. The examination included: health history, pulmonary function tests, and may have included an evaluation of a chest x-ray. A physician made a determination regarding my physical capacity to perform work tasks on the project while wearing personal protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's Industrial Hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

_____ were no limitations to performing the required work tasks.
_____ were identified physical limitations to performing the required work tasks.

Date of the medical examination _____

Employee Signature _____ date _____

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

Contractor's Industrial
Hygienist Signature _____ date _____

-- End of Section --

SECTION 16264

DIESEL-GENERATOR SET, STATIONARY 15-300 KW, STANDBY APPLICATIONS
02/99
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1997a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 135	(1997) Electric-Resistance-Welded Steel Pipe
ASTM A 181/A 181M	(1995b) Carbon Steel Forgings for General-Purpose Piping
ASTM A 234/A 234M	(1997) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM D 975	(1996a) Diesel Fuel Oils

ASME INTERNATIONAL (ASME)

ASME ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME ANSI/ASME B16.5	(1992) Malleable Iron Threaded Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping

ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ELECTRICAL GENERATING SYSTEMS ASSOCIATION (EGSA)

EGSA 101P	(1995) Performance Standard for Engine Driven Generator Sets

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE Std 1	(1986; R 1992) General Principles for Temperature Limits in the Rating of Electric Equipment and for the Evaluation of Electrical Insulation
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1996) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 120	(1989) Electrical Measurements in Power Circuits
IEEE Std 519	(1992) Harmonic Control in Electrical Power Systems

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC

NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3) Motors and Generators
NEMA PB 1	(1990) Panelboards
NEMA SG 3	(1995) Power Switching Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(1996; Errata TIA 96-2) Flammable and Combustible Liquids Code
NFPA 37	(1998) Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	(1999) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE ARP 892	(1965; R 1994) D-C Starter-Generator, Engine
SAE J 537	(1996) Storage Batteries

UNDERWRITERS LABORATORIES (UL)

UL 489	(1996; Rev thru Nov 1997) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 1236	(1994; Rev thru Dec 1997) Battery Chargers for Charging Engine-Starter Batteries

1.2 SYSTEM DESCRIPTION

Each engine-generator set shall be provided and installed complete and totally functional, with all necessary ancillary equipment to include air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

1.2.1 Engine-Generator Parameter Schedule

The engine-generator shall meet the following:

Service Load	75 kVA
Power Factor	0.8 lagging

Maximum Speed	1800 rpm
Engine-Generator Application	stand-alone
Engine Cooling Type	water/ethylene glycol
Heat Exchanger Type	fin-tube
Governor Type	Isochronous
Frequency Bandwidth steady state	± 0.4%
Voltage Regulation (No load to full load)	± 2% (max.)
Voltage Bandwidth (steady state)	± 0.5%
Frequency	60 Hz
Voltage	480 volts
Phases	3 Phase, Wye
Max Time to Start and be Ready to	10 seconds Assume Load
Max Summer Outdoor Temp (Ambient)	120 degrees
Min Winter Outdoor Temp (Ambient)	30 degrees
Installation Elevation	1200 meters (3900 feet)above sea level

1.2.2 Output Capacity

Each generator set shall provide power equal to the sum of service load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

1.2.3 Power Rating

Standby ratings shall be in accordance with EGSA 101P.

1.3 GENERAL REQUIREMENTS

1.3.1 Engine-Generator Set

Each set shall consist of one engine, one generator, and one exciter, mounted, assembled, and aligned on one base; and all other necessary ancillary equipment which may be mounted separately. Sets shall be

assembled and attached to the base prior to shipping. Set components shall be environmentally suitable for the locations shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. A generator strip heater shall be provided for moisture control when the generator is not operating.

1.3.2 Nameplates

Each major component of this specification shall have the manufacturer's name, type or style, model or serial number, and rating number on a plate secured to the equipment. As a minimum, nameplates shall be provided for: Engines; Relays; Generators; Day tanks; Transformers (CT & PT); Regulators; Pumps and pump motors; Governors; Generator Breaker; Economizers; Heat exchangers (other than base-mounted).

Engines	Relays
Generators	Day tanks
Transformers (CT & PT)	Regulators
Pumps and pump motors	Governors
Generator Breaker	Economizers
Heat exchangers (other than base-mounted)	

Where the following equipment is provided as a standard component by the diesel-engine generator set manufacturer, the nameplate information may be provided in the maintenance manual in lieu of nameplates.

Battery charger	Heaters
Exhaust mufflers	Exciters
Switchgear	Silencers
Battery	

1.3.3 Personnel Safety Device

Exposed moving parts, parts that produce high operating temperatures, parts which may be electrically energized, and parts that may be a hazard to operating personnel during normal operation shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. The safety devices shall be installed so that proper operation of the equipment is not impaired.

1.3.4 Verification of Dimensions

Before performing work, the premises shall be visited and details of the work verified. The Contracting Officer shall be advised in writing of any discrepancies before performing any work.

1.3.5 Conformance to Codes and Standards

Where equipment is specified to conform to requirements of any code or

standard such as UL, the design, fabrication and installation shall conform to the code.

1.3.6 Site Welding

Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by a previously qualified employer may be accepted as permitted by ASME B31.1. Welder qualification tests shall be performed for each welder whose qualifications are not in compliance with the referenced standards. The Contracting Officer shall be notified 24 hours in advance of qualification tests. The qualification tests shall be performed at the work site if practical. The welder or welding operator shall apply the assigned personal symbol near each weld made as a permanent record.

1.3.7 Engine Generator Set Enclosure

The engine generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components and provide ventilation to permit operation at rated load under secured conditions. Doors shall be provided for access to all controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than exhaust system. The enclosure shall reduce the mechanical noise of the generator set to within the limits allowed by the Occupational Safety and Health Act (OSHA) for the occupancy of the facility.

1.3.8 Vibration Isolation

The maximum engine-generator set vibration in the horizontal, vertical and axial directions shall be limited to 0.15 mm (peak-peak RMS), with an overall velocity limit of 24 mm/seconds 0.95 inches/seconds RMS, for all speeds through 110% of rated speed. The engine-generator set shall be provided with vibration-isolation in accordance with the manufacturer's standard recommendation. Where the vibration-isolation system does not secure the base to the structure floor or unit foundation, seismic restraints shall be provided in accordance with the seismic parameters specified.

1.3.9 Experience

Each component manufacturer shall have a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel engine-generator sets for commercial and industrial use. The engine-generator set manufacture/assembler shall have a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

1.3.10 Field Engineer

The engine-generator set manufacturer or assembler shall furnish a qualified field engineer to supervise the complete installation of the

engine-generator set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment. The field engineer shall have attended the engine-generator manufacturer's training courses on installation and operation and maintenance for engine generator sets.

1.3.11 {SM#2} DELETED

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment Performance; FIO.

Calculations of the engine and generator output power capability, including efficiency and parasitic load data.

Sound Power Level ; GA.

Sound power level data for the packaged unit operating at 100% load in a free field environment. The data should demonstrate compliance with the sound limitation requirements of this specification.

Generator Data; GA.

Each generator KW rating and short circuit capacity (both symmetric and asymmetric).

Integral Main Fuel Storage Tank Capacity; FIO.

Calculations for the capacity of each day tank, including allowances for recirculated fuel, usable tank capacity, and duration of fuel supply.

Power Factor Capability Curve; FIO.

Generator capability curve showing generator kVA output (kW vs. kvar) for both leading and lagging power factors ranging from 0 to 1.0.

Heat Rejected to Engine-Generator Space; FIO.

Manufacturers data to quantify heat rejected to the space with the engine generator set at rated capacity.

Alarm Setpoints; FIO.

The magnitude of monitored values which define alarm or action setpoints, and the tolerance (plus and/or minus) at which the device activates the alarm or action.

Cooling Equipment and Performance; FIO.

a. The maximum and minimum allowable inlet temperatures of the coolant fluid.

b. The maximum allowable temperature rise in the coolant fluid through the engine.

c. The minimum allowable inlet fuel temperature.

Manufacturer's Catalog Data; FIO.

Manufacturer's standard catalog data describing and depicting each engine-generator set and all ancillary equipment in sufficient detail to demonstrate specification compliance.

Vibration-Isolation; FIO.

Vibration isolation system performance data for the range of frequencies generated by the engine-generator set during operation from no load to full load and the maximum vibration transmitted to the floor. Description of seismic qualification of the engine-generator mounting, base, and vibration isolation.

SD-04 Drawings

Layout and Shop Drawings; GA.

a. Base-mounted equipment, complete with base and attachments including anchor bolt template and recommended clearances for maintenance and operation.

b. Starting system.

c. Fuel system.

d. Cooling system.

e. Exhaust system.

f. Electric wiring of relays, breakers, programmable controllers, and switches including single line and wiring diagrams.

g. Lubrication system, including piping, pumps, strainers, filters, electric heater, controls and wiring.

h. Location, type, and description of vibration isolation devices.

i. The safety system, including wiring schematics.

j. One-line schematic and wiring diagrams of the generator, exciter, regulator, governor, and all instrumentation.

k. Panel layouts.

l. Mounting and support for each panel and major piece of electrical equipment.

m. Engine-generator set rigging points and lifting instructions.

As-Built Drawings; GA.

Drawings which accurately depict the as-built configuration of the installation, upon acceptance of the diesel-generator set installation. Layout drawings shall be revised to reflect the as-built conditions and submitted with the as-built drawings.

SD-06 Instructions

Posted Data; GA.

Posted data including wiring and control diagrams showing the key mechanical and electrical control elements, and a diagrammatic layout of the system

Instructions; GA.

Instructions including: the manufacturer's pre-start checklist and precautions; startup procedures for test mode, manual-start mode, and automatic-start mode, (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches). Instructions shall be weatherproof, laminated in plastic, framed, and posted where directed.

SD-08 Statements

Component Manufacturer; FIO.

Statement showing that each component manufacturer has a minimum of 3 years experience in the manufacture, assembly and sale of components used with stationary diesel-engine generator sets for commercial and industrial use.

Manufacturer Assembler; FIO.

Statement showing that the engine-generator set manufacturer/assembler has a minimum of 3 years experience in the manufacture, assembly and sale of stationary diesel engine-generator sets for commercial and industrial use.

Cooling System; FIO.

Certification that the engine-generator set and cooling system function properly in the ambient temperatures specified.

Field Engineer; FIO.

A letter listing the qualifications, schools, formal training, and

experience of the field engineer.

Welder Qualification; FIO.

A letter listing the welder qualifying procedures for each welder, complete with supporting data such as test procedures used, what was tested to, and a list of the names of all welders and their qualifications symbols.

Installation Procedures; FIO.

A complete copy of the manufacturer's installation procedures. A detailed description of the manufacturer's recommended break-in procedure.

SD-09 Reports

Onsite Test; GA.

a. A letter giving notice of the proposed dates of all onsite inspections and tests at least 14 days prior to beginning tests.

b. A detailed description of the Contractor's proposed procedures for onsite tests including the test including the test plan and a listing of equipment necessary to perform the tests. Submission shall be at least 14 days prior to beginning tests.

c. Six copies of the onsite test data described below in 216 x 279 mm 3-ring binders with a separate section for each test. Sections shall be separated by dividers with tabs. Data plots shall be full size 216 x 279 mm minimum), showing all grid lines, with full resolution.

(1) A description of the procedures for onsite tests.

(2) A list of equipment used, with calibration certifications.

(3) A copy of measurements taken, with required plots and graphs.

(4) The date of testing.

(5) The parameters verified.

(6) The condition specified for the parameter.

(7) The test results, signed and dated.

(8) A description of all adjustments made.

SD-13 Certificates

Torsional Vibration; FIO.

Torsional analysis including prototype testing or calculations which certify and demonstrate that no damaging or dangerous torsional vibrations will occur when the prime mover is connected to the generator, at

synchronous speeds, plus/minus 10%.

Prototype Tests; FIO.

Manufacturer's standard certification that prototype tests were performed for the generator model proposed.

Reliability and Durability; FIO.

Documentation which cites engines and generators in similar service to demonstrate compliance with the requirements of this specification. Certification does not exclude annual technological improvements made by a manufacturer in the basic standard model set on which experience was obtained, provided parts interchangeability has not been substantially affected and the current standard model meets all the performance requirements of this specification. For each different set, 2 like sets shall have performed satisfactorily in a stationary power application, independent and separate from the physical location of the manufacturer's and assembler's facilities, for a minimum of 2 consecutive years without any failure to start, including periodic exercise. The certification shall state that for the set proposed to meet this specification, there were no failures resulting in downtime for repairs in excess of 72 hours or any failure due to overheating during 2 consecutive years of service. Like sets are of the same model, speed, bore, stroke, number and configuration of cylinders, and output power rating. Like generators are of the same model, speed, pitch, cooling, exciter, voltage regulator and output power rating. A list shall be provided with the name of the installations, completion dates, and name and telephone number of a point of contact.

Emissions; FIO.

A certification from the engine manufacturer stating that the engine exhaust emissions meet federal, state, and local regulations and restrictions specified. At a minimum, this certification shall include emission factors for criteria pollutants including nitrogen oxides, carbon monoxide, particulate matter, sulfur dioxide, non-methane hydrocarbon, and for hazardous air pollutants (HAPs).

Sound limitation; FIO

A certification from the manufacturer stating that the sound emissions meet the specification.

Site Visit; FIO.

A site visit letter stating the date the site was visited and listing discrepancies found.

Flywheel Balance; FIO.

Manufacturer's certification that the flywheel has been statically and dynamically balanced and is capable of being rotated at 125% of rated speed without vibration or damage.

Standards Compliance; FIO.

A letter stating that where materials or equipment are specified to comply with requirements of UL, or other standards, written proof of such compliance has been obtained. The label or listing of the specified agency, or a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency are acceptable as proof.

Factory Tests; FIO.

A certification that each engine generator set passed the factory tests and inspections and a list of the test and inspections.

Functional Facilities; FIO.

A letter certifying that all facilities are complete and functional, that each system is fully functional, and that each item of equipment is complete, free from damage, adjusted, and ready for beneficial use.

1.5 STORAGE AND INSTALLATION

The Contractor shall properly protect material and equipment in accordance with the manufacturers recommended storage procedures, before, during, and after installation. Stored items shall be protected from the weather and contamination. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.6 OPERATION AND MAINTENANCE MANUALS

The operation and maintenance manuals shall be submitted and approved prior to commencing onsite tests.

1.6.1 Operation Manual

Six copies of the manufacturers standard operation manual shall be provided. The manual shall include:

a. Step-by-step procedures for system startup, operation, and shutdown;

b. Drawings, diagrams, and single-line schematics to illustrate and define the electrical, mechanical, and hydraulic systems with their controls, alarms, and safety systems;

c. Procedures for interface and interaction with related systems to include automatic transfer switches.

1.6.2 Maintenance Manual

Six copies of the manufacturers standard maintenance manual shall be provided.

a. Procedures for each routine maintenance item. Procedures for troubleshooting. Factory-service, take-down overhaul, and repair service manuals, with parts lists.

b. The manufacturer's recommended maintenance schedule.

c. A component list which includes the manufacturer's name, address, type or style, model or serial number, rating, and catalog number for the major components listed in paragraph GENERAL REQUIREMENTS.

d. A list of spare parts for each piece of equipment and a complete list of materials and supplies needed for operation.

1.7 SPECIAL TOOLS AND FILTERS

Two sets of special tools and two sets of filters required for maintenance shall be provided. Special tools are those that only the manufacturer provides, for special purposes, or to reach otherwise inaccessible parts. One handset shall be provided for each electronic governor when required to indicate and/or change governor response settings. Two complete sets of filters shall be supplied in a suitable storage box. These filters shall be in addition to filters replaced after testing.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be as specified.

2.1.1 Circuit Breakers, Low Voltage

NEMA AB 1, UL 489, and NEMA SG 3.

2.1.2 Filter Elements (Fuel-oil, Lubricating-oil, and Combustion-air)

Manufacturer's standard.

2.1.3 Instrument Transformers

ANSI C12.11.

2.1.4 Pipe (Sleeves, Fuel/Lube-oil, Compressed-Air, Coolant and Exhaust)

ASTM A 53, ASTM A 106 or ASTM A 135, steel pipe. Pipe smaller than 50 mm shall be Schedule 80. Pipe 50 mm and larger shall be Schedule 40.

2.1.5 Pipe Flanges and Fittings

a. Pipe Flanges and Flanged Fittings: ASTM A 181/A 181M, Class 60, or ASME ANSI/ASME B16.5, Grade 1, Class 150.

b. Pipe Welding Fittings: ASTM A 234/A 234M, Grade WPB or WPC, Class 150, or ASME B16.11, 1360.7 kg.

c. Threaded Fittings: ASME ANSI/ASME B16.3, Class 150.

d. Valves: MSS SP-80, Class 150.

e. Gaskets: Manufacturers Standard.

2.1.6 Pipe Hangers

MSS SP-58 and MSS SP-69.

2.1.7 Electrical Enclosures

2.1.7.1 General

NEMA ICS 6.

2.1.7.2 Panelboards

NEMA PB 1.

2.1.8 Electric Motors

Electric motors shall conform to the requirements of NEMA MG 1. Motors shall have sealed ball bearings, a maximum speed of 1800 rpm and integral automatic or manual reset thermal overload protectors. Motors used indoors shall have drip proof frames; those used outside shall be totally enclosed.

2.1.9 Motor Controllers

Motor controllers and starters shall conform to the requirements of NFPA 70 and NEMA ICS 2.

2.2 ENGINE

Each engine shall operate on No. 2-D diesel conforming to ASTM D 975, shall be designed for stationary applications and shall be complete with ancilliaries. The engine shall be a standard production model described in the manufacturer's catalog. The engine shall be naturally aspirated, scavenged, supercharged or turbocharged. The engine shall be two- or four-stroke-cycle and compression-ignition type. The engine shall be vertical inline, V-, or opposed-piston type, with a solid cast block or individually cast cylinders. The engine shall have a minimum of two cylinders. Opposed-piston type engines shall have no less than four cylinders. Each block shall have a coolant drain port. Each engine shall be equipped with an overspeed sensor.

2.3 FUEL SYSTEM

The fuel system for each engine generator set shall conform to the requirements of NFPA 30 and NFPA 37 and contain the following elements.

2.3.1 Pumps

2.3.1.1 Main Pump

Each engine shall be provided with an engine driven pump. The pump shall supply fuel at a minimum rate sufficient to provide the amount of fuel required to meet the performance indicated within the parameter schedule. The fuel flow rate shall be based on meeting the load requirements and all necessary recirculation.

2.3.2 Filter

A minimum of one full flow fuel filter shall be provided for each engine. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.3.3 Relief/Bypass Valve

A relief/bypass valve shall be provided to regulate pressure in the fuel supply line, return excess fuel to a return line, and prevent the build-up of excessive pressure in the fuel system.

2.3.4 Integral Main Fuel Storage Tank

Each engine shall be provided with an integral main fuel tank. Each tank shall be factory installed and provided as an integral part of the diesel generator manufacturer's product. Each tank shall be provided with connections for fuel supply line, fuel return line, local fuel fill port, gauge, vent line, and float switch assembly. A fuel return line cooler shall be provided as recommended by the manufacturer and assembler. The temperature of the fuel returning to the tank shall be below the flash point of the fuel. Each engine-generator set provided with weatherproof enclosures shall have its tank mounted within the enclosure. The fuel fill line shall be accessible without opening the enclosure.

2.3.4.1 Capacity

Each tank shall have capacity to supply fuel to the engine for an uninterrupted 24-hour period at 75% rated load without being refilled.

2.3.4.2 Local Fuel Fill

Each local fuel fill port on the day tank shall be provided with a screw-on cap.

2.3.4.3 Fuel Level Controls

a. Each tank shall have a float-switch assembly to perform the following functions:

(1) Activate the "Low Fuel Level" alarm at 70% of the rated tank capacity.

(2) Activate the "Overfill Fuel Level" alarm at 95% of the rated tank capacity.

2.3.4.4 Arrangement

Integral tanks may allow gravity flow into the engine. Gravity flow tanks and any tank that allows a fuel level above the fuel injectors shall be provided with an internal or external factory installed valve located as near as possible to the shell of the tank. The valve shall close when the engine is not operating. Integral day tanks shall be provided with any necessary pumps to supply fuel to the engine as recommended by the generator set manufacturer. The fuel supply line from the tank to the manufacturer's standard engine connection shall be welded pipe.

2.4 LUBRICATION

Each engine shall have a separate lube-oil system conforming to NFPA 30 and NFPA 37. Each system shall be pressurized by engine-driven oil pumps. Each system shall be furnished with a relief valve for oil pressure regulation (for closed systems) and a dip-stick for oil level indications. The crankcase shall be vented in accordance with the manufacturer's recommendation except that it shall not be vented to the engine exhaust system. Crankcase breathers, if provided on engines installed in buildings or enclosures, shall be piped to vent to the outside. The system shall be readily accessible for service such as draining, refilling, etc. Each system shall permit addition of oil and have oil-level indication with the set operating. The system shall utilize an oil cooler as recommended by the engine manufacturer.

2.4.1 Filter

One full-flow filter shall be provided for each pump. The filter shall be readily accessible and capable of being changed without disconnecting the piping or disturbing other components. The filter shall have inlet and outlet connections plainly marked.

2.4.2 Lube-Oil Sensors

Each engine shall be equipped with lube-oil pressure sensors. Pressure sensors shall be located downstream of the filters and provide signals for required indication and alarms.

2.5 COOLING

Each engine cooling system shall operate automatically while the engine is running. Each cooling system shall be sized for the maximum summer outdoor design temperature and site elevation. Water-cooled system coolant shall use a combination of water and ethylene-glycol sufficient for freeze protection at the minimum winter outdoor temperature specified. The maximum temperature rise of the coolant across the engine shall be no more than that recommended and submitted in accordance with paragraph SUBMITTALS.

2.5.1 Coolant Pumps

Coolant pumps shall be the centrifugal type. Each engine shall have an engine-driven primary pump. Secondary pumps shall be electric motor driven

and have automatic controllers.

2.5.2 Heat Exchanger

Each heat exchanger shall be of a size and capacity to limit the maximum allowable temperature rise in the coolant across the engine to that recommended and submitted in accordance with paragraph SUBMITTALS for the maximum summer outdoor design temperature and site elevation. Each heat exchanger shall be corrosion resistant, suitable for service in ambient conditions of application.

2.5.2.1 Fin-Tube-Type Heat Exchanger (Radiator)

Heat exchanger may be factory coated with corrosive resistant film providing that corrosion measures are taken to restore the heat rejection capability of the radiator to the initial design requirement via oversizing, or other compensating methods. Internal surfaces shall be compatible with liquid fluid coolant used. Materials and coolant are subject to approval by the Contracting Officer. Heat exchangers shall be pressure type incorporating a pressure valve, vacuum valve and a cap. Caps shall be designed for pressure relief prior to removal. Each heat exchanger and the entire cooling system shall be capable of withstanding a minimum pressure of 48 kPa gauge (7 psi). Each heat exchanger shall be protected with a strong grille or screen guard. Each heat exchanger shall have at least two tapped holes. One tapped hole in the heat exchanger shall be equipped with a drain cock, the rest shall be plugged.

2.5.3 Temperature Sensors

Each engine shall be equipped with coolant temperature sensors. Temperature sensors shall provide signals for pre-high and high indication and alarms.

2.6 SOUND LIMITATIONS

The noise generated by the installed diesel generator set operating at 100 percent load shall not exceed the following sound pressure levels in any of the indicated frequencies when measured at a distance of 22.9 m from the end of the exhaust and air intake piping directly along the path of intake and discharge for horizontal piping; or at a radius of 22.9 m from the engine at 45 degrees apart in all directions for vertical piping.

Frequency Band (Hz)	Maximum Acceptable Pressure Level (Decibels)
31	87
63	77
125	77
250	70
500	64
1,000	61
2,000	60
4,000	60

Frequency Band (Hz)	Maximum Acceptable Pressure Level (Decibels)
8,000	62

2.7 AIR INTAKE EQUIPMENT

Filters and silencers shall be provided in locations that are convenient for servicing. The silencer shall be of the high-frequency filter type, located in the air intake system as recommended by the engine manufacturer. Silencer shall be capable of reducing the noise level at the air intake to a point below the maximum acceptable levels specified in paragraph SOUND LIMITATIONS. A combined filter-silencer unit meeting requirements for the separate filter and silencer items may be provided. Expansion elements in air-intake lines shall be copper or rubber.

2.8 EXHAUST SYSTEM

The system shall be separate and complete for each engine. Piping shall be supported so as to minimize vibration. Where a V-type engine is provided, a V-type connector with necessary flexible sections and hardware shall connect the engine exhaust outlets.

2.8.1 Flexible Sections and Expansion Joints

A flexible section at each engine and an expansion joint at each muffler shall be provided. Flexible sections and expansion joints shall have flanged connections. Flexible sections shall be made of convoluted seamless tube without joints or packing. Expansion joints shall be the bellows type. Expansion and flexible elements shall be stainless steel suitable for diesel-engine exhaust gas at the maximum exhaust temperature that is specified by the engine manufacturer. Expansion and flexible elements shall be capable of absorbing vibration from the engine and compensation for thermal expansion and contraction.

2.8.2 Exhaust Muffler

A chamber type exhaust muffler shall be provided. The muffler shall be constructed of welded steel and designed for outside horizontal mounting. Eyebolts, lugs, flanges, or other items shall be provided as necessary for support in the location and position indicated. Pressure drop through the muffler shall not exceed the recommendations of the engine manufacturer. Outside mufflers shall be zinc coated or painted with high temperature 204 degrees C resisting paint. The muffler and exhaust piping together shall reduce the noise level to less than the maximum acceptable level listed for sound limitations in paragraph SOUND LIMITATIONS. The muffler shall have a drain valve, nipple, and cap at the low-point of the muffler.

2.8.3 Exhaust Piping

Horizontal sections of exhaust piping shall be sloped downward away from the engine to a condensate trap and drain valve. Changes in direction shall be long-radius. Exhaust piping, mufflers and silencers installed inside any building shall be insulated in accordance with paragraph THERMAL

INSULATION and covered to protect personnel. Vertical exhaust piping shall be provided with a hinged, gravity operated, self-closing, rain cover.

2.9 EMISSIONS

The finished installation shall comply with Federal, state, and local regulations and restrictions regarding the limits of emissions.

2.10 STARTING SYSTEM

The starting system for standby engine generator sets used in emergency applications shall be in accordance with NFPA 99 and NFPA 110 and as follows.

2.10.1 Controls

An engine control switch shall be provided with functions including: run/start (manual), off/reset, and automatic mode. Start-stop logic shall be provided for adjustable cycle cranking and cool down operation. The logic shall be arranged for manual starting and fully automatic starting in accordance with paragraph AUTOMATIC ENGINE-GENERATOR SET SYSTEM OPERATION. Electrical starting systems shall be provided with an adjustable cranking limit device to limit cranking periods from 1 second up to the maximum duration.

2.10.2 Capacity

The starting system shall be of sufficient capacity, at the maximum outdoor summer temperature specified to crank the engine without damage or overheating. The system shall be capable of providing a minimum of three cranking periods with 15-second intervals between cranks. Each cranking period shall have a maximum duration of 15 seconds.

2.10.3 Functional Requirements

Starting system shall be manufacturers recommended dc system utilizing a negative circuit ground. Starting motors shall be in accordance with SAE ARP 892.

2.10.4 Battery

A starting battery system shall be provided and shall include the battery, battery rack, intercell connectors, and spacers. The battery shall be in accordance with SAE J 537. Critical system components (rack, protection, etc.) shall be sized to withstand the seismic acceleration forces specified. The battery shall be lead-acid type, with sufficient capacity, at the minimum outdoor winter temperature specified to provide the specified cranking periods. Valve-regulated lead-acid batteries are not acceptable.

2.10.5 Battery Charger

A current-limiting battery charger, conforming to UL 1236, shall be provided and shall automatically recharge the batteries. The charger shall be capable of an equalize charging rate for recharging fully depleted

batteries within 24 hours and a float charge rate for maintaining the batteries in prime starting condition. An ammeter shall be provided to indicate charging rate. A timer shall be provided for the equalize charging rate setting. A battery is considered to be fully depleted when the output voltage falls to a value which will not operate the engine generator set and its components.

2.10.6 Starting Aids

The manufacturer shall provide one or more of the following methods to assist engine starting.

2.10.6.1 Glow Plugs

Glow plugs shall be designed to provide sufficient heat for combustion of fuel within the cylinders to guarantee starting at an ambient temperature of minus 32 degrees C.

2.10.6.2 Jacket-Coolant Heaters

A thermostatically controlled electric heater shall be mounted in the engine coolant jacketing to automatically maintain the coolant within plus or minus 3 degrees of the control temperature. The heater shall operate independently of engine operation so that starting times are minimized. The control temperature shall be the temperature recommended by the engine manufacturer to meet the starting time specified.

2.11 GOVERNOR

Each engine shall be provided with a governor which maintains the frequency within a bandwidth of the rated frequency, over a steady-state load range of zero to 100% of rated output capacity. The governor shall be configured for safe manual adjustment of the speed/frequency during operation of the engine generator set, without special tools, from 90 to 110 % of the rated speed/frequency, over a steady state load range of zero to 100% of rated capacity. Isochronous governors shall maintain the midpoint of the frequency bandwidth at the same value for steady-state loads over the range of zero to 100% of rated output capacity.

2.12 GENERATOR

Each generator shall be of the synchronous type, one or two bearing, conforming to NEMA MG 1, equipped with winding terminal housings in accordance with NEMA MG 1, equipped with an amortisseur winding, and directly connected to the engine. Insulation shall be Class H. Generator design shall protect against mechanical, electrical and thermal damage due to vibration, 25 percent overspeeds, or voltages and temperatures at a rated output capacity of 100 percent. Generator ancillary equipment shall meet the short circuit requirements of NEMA MG 1. Frames shall be the drip-proof type.

2.12.1 Current Balance

At 100 percent rated load, and load impedance equal for each of the three

phases, the permissible current difference between any two phases shall not exceed 2 percent of the largest current on either of the two phases.

2.12.2 Voltage Balance

At any balanced load between 75 and 100 percent of rated load, the difference in line-to-neutral voltage among the three phases shall not exceed 1 percent of the average line-to-neutral voltage. For a single-phase load condition, consisting of 25 percent load at unity power factor placed between any phase and neutral with no load on the other two phases, the maximum simultaneous difference in line-to-neutral voltage between the phases shall not exceed 3 percent of rated line to neutral voltage. The single-phase load requirement shall be valid utilizing normal exciter and regulator control. The interpretation of the 25 percent load for single phase load conditions means 25 percent of rated current at rated phase voltage and unity power factor.

2.12.3 Waveform

The deviation factor of the line-to-line voltage at zero load and at balanced full rated load at 0.8 power factor shall not exceed 10%. The RMS of all harmonics shall be less than 5.0% and that of any one harmonic less than 3.0% at full rated load. Each engine-generator shall be designed and configured to meet the total harmonic distortion limits of IEEE Std 519.

2.13 EXCITER

The generator exciter shall be of the brushless type. Semiconductor rectifiers shall have a minimum safety factor of 300% for peak inverse voltage and forward current ratings for all operating conditions, including 110% generator output at 4O degrees C ambient. The exciter and regulator in combination shall maintain generator-output voltage within the limits specified.

2.14 VOLTAGE REGULATOR

Each generator shall be provided with a solid-state voltage regulator, separate from the exciter. The regulator shall maintain the voltage within a bandwidth of the rated voltage, over a steady-state load range of zero to 100% of rated output capacity. Regulator shall be configured for safe manual adjustment of the engine generator voltage output without special tools, during operation from 90 to 110% of the rated voltage over the steady state load range of zero to 100% of rated output capacity. Regulation drift shall not exceed plus or minus 0.5% for an ambient temperature change of 20 degrees C.

2.14.1 Steady State Performance (Regulation or Voltage Droop).

The voltage regulator shall have a maximum droop of 2% of rated voltage over a load range from 0 to 100% of rated output capacity and automatically maintain the generator output voltage within the specified operational bandwidth.

2.15 GENERATOR PROTECTION

Short circuit and overload protection for the generator shall be provided. The generator circuit breaker (IEEE Device 52) ratings shall be consistent with the generator rated voltage and frequency, with continuous, short circuit and interrupting current ratings to match the generator capacity. The manufacturer shall determine the short circuit current interrupting rating of the breaker. The breaker shall be engine generator base mounted by the engine-generator set manufacturer. Molded case breakers shall be provided with shunt trip. Surge protection shall be provided for each phase of the generator, to be mounted at the generator terminals.

2.16 SAFETY SYSTEM

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions. The safety system shall be provided with a self-test method to verify its operability. Alarm signals shall have manual acknowledgement and reset devices. The alarm signal systems shall reactivate for new signals after acknowledgment is given to any signal. The systems shall be configured so that loss of any monitoring device shall be dealt with as an alarm on that system element.

2.16.1 Audible Signal

The audible alarm signal shall sound at a frequency of 70 Hz at a volume of 75 dB at 3.048 m (10 feet). The sound shall be continuously activated upon alarm and silenced upon acknowledgment. Signal devices shall be located as shown.

2.16.2 Visual Signal Signal

The visual alarm signal shall be a panel light. The light shall be normally off, activated to be blinking upon alarm. The light shall change to continuously light upon acknowledgement. If automatic shutdown occurs, the display shall maintain activated status to indicate the cause of failure and shall not be reset until cause of alarm has been cleared and/or restored to normal condition. Shutdown alarms shall be red; all other alarms shall be amber.

2.16.3 Alarms and Action Logic

2.16.3.1 Shutdown

Simultaneous activation of the audible signal, activation of the visual signal, stopping the engine, and opening the generator main circuit breakers shall be accomplished.

2.16.3.2 Problem

Activation of the visual signal shall be accomplished.

2.16.4 Local Alarm Panel

A local alarm panel shall be provided with the following shutdown and alarm

functions in accordance with NFPA 99 and including the listed Corps of Engineers requirements, mounted either on or adjacent to the engine generator set.

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
Shutdowns W/Alarms					
High engine temperature	Automatic/ jacket water/ cylinder	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Low lube-oil pressure	Automatic/ pressure/ level	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overspeed shutdown $ alarm	(110% (± 2%) of rated speed	SD/CP VA	SD/CP VA	SD/CP VA	SD VA
Overcrank failure to start	Automatic/ Failure to to start	SD/CP VA	SD/CP VA	SD/CP VA	
Air shutdown damper (200-600kW)	When used		SD/CP VA	SD/CP VA	
Day tank overfill limit indication & transfer pump shutdown (95% volume)	Automatic/Day Tank/Level				SD/OPA (Pump)
Red emergency stop switch	Manual Switch		SD/CP VA	SD/CP VA	SD VA
Failure to crank	Corps of Engrs. Required				
Integral Main Fuel Tank low fuel limit Device/ Condition/ indication (70% volume remaining)	Corps of Engrs. Required				

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required
Alarms					
Low lube-oil pressure	Pressure/ level	CP VA	CP VA	CP VAO	CP VA
Low fuel level	Main tank, 3 hours remaining	VA/AA	CP VA	CP VAO	
High fuel level	Integral Main Fuel Storage Tank 95% Volume				CP VA
Low coolant	Jacket water	CP/VA	CP VA	CP VA	
Pre-high temperature	Jacket water/ cylinder	CP VA	CP VA	CP VAO	CP VA
Pre-low lube-oil pressure		CP VA			CP VA
High battery voltage			CP VA	CP VAO	
Low battery voltage			CP VA	CP VAO	
Battery charger AC failure	AC supply not available		CP VA	CP VAO	
Control switch not in AUTO			CP VA	CP VAO	
Low starting air pressure			CP VA	CP VAO	
Low starting hydraulic pressure			CP VA	CP VAO	

SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional

Device/ Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2	Corps of Engrs Required

2.16.5 Time-Delay on Alarms

For startup of the engine-generator set, time-delay devices shall be installed bypassing the low lubricating oil pressure alarm during cranking, and the coolant-fluid outlet temperature alarm. The lube-oil time-delay device shall return its alarm to normal status after the engine starts. The coolant time-delay device shall return its alarm to normal status 5 minutes after the engine starts.

2.16.6 Remote Alarm Panel

A remote alarm panel shall be provided in accordance with NFPA 99 and as follows:

Device/Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2
Remote annunciator panel	Battery powered		Alarms	
Loads on genset		VA		
Battery charger malfunction		VA		
Low lube-oil	Pressure/level	VA/AA	AA	AAO
Low Temperature	Jacket water	VA/AA	AA	AAO
High Temperature	Jacket water/ cylinder	VA/AA	AA	AAO
Low fuel level	Main tank, 3 hr remaining	VA/AA	AA	AAO
Overcrank	Failure to start	VA/AA	AA	AAO
Overspeed		VA/AA	AA	AAO
Pre-high temperature	Jacket water/ cylinder		AA	
Control switch not in AUTO			AA	
Common alarm contacts for local & remote common alarm			X	X

Device/Condition/ Function	What/Where/Size	NFPA 99	NFPA 110 Level 1	NFPA 110 Level 2
Audible alarm silencing switch			X	O
Air shutdown damper	When used		AA	AAO
Common fault alarm			AA	

X - Required
SD - Shut Down
CP - On Control Panel
VA - Visual Alarm
AA - Audible Alarm
O - Optional

2.17 ENGINE GENERATOR SET CONTROLS AND INSTRUMENTATION

Devices, wiring, remote panels, local panels, etc., shall be provided and installed as a complete system to automatically activate the appropriate signals and initiate the appropriate actions.

2.18 PANELS

Each panel shall be of the type necessary to provide specified functions. Panels shall be mounted on the engine generator set base by vibration/shock absorbing type mountings. Instruments shall be mounted flush or semiflush. Convenient access to the back of instruments shall be provided to facilitate maintenance. Instruments shall be calibrated using recognized industry calibration standards. Each panel shall be provided with a panel identification plate which clearly identifies the panel function as indicated. Each instrument and device on the panel shall be provided with a plate which clearly identifies the device and its function as indicated. Panels {AM#2}_____ can be combined into a single panel.

2.18.1 Enclosures

Enclosures shall be designed for the application and environment, conforming to NEMA ICS 6, and provided with locking mechanisms which are keyed alike.

2.18.2 Analog

Analog electrical indicating instruments shall be in accordance with ANSI C39.1 with semiflush mounting. Switchgear, and control-room panel-mounted instruments shall have 250 degree scales with an accuracy of not less than 1 percent. Unit-mounted instruments shall be the manufacturer's standard with an accuracy of not less than 2 percent. The instrument's operating temperature range shall be minus 20 to plus 65 degrees C. Distorted generator output voltage waveform of a crest factor less than 5 shall not affect metering accuracy for phase voltages, hertz and amps.

2.18.3 Electronic

Electronic indicating instruments shall be true RMS indicating, 100 percent solid state, microprocessor controlled to provide all specified functions. Control, logic, and function devices shall be compatible as a system, sealed, dust and water tight, and shall utilize modular components with metal housings and digital instrumentation. An interface module shall be provided to decode serial link data from the electronic panel and translate alarm, fault and status conditions to set of relay contacts. Instrument accuracy shall be not less than 2 percent for unit mounted devices and 1 percent for control room, panel mounted devices, throughout a temperature range of minus 20 to plus 65 degrees C. Data display shall utilize LED or back lit LCD. Additionally, the display shall provide indication of cycle programming and diagnostic codes for troubleshooting. Numeral height shall be 13 mm (1/2 inch).

2.18.4 Parameter Display

Indication or readouts of the lubricating-oil pressure, ac voltmeter, ac ammeter, frequency meter, and coolant temperature.

2.18.5 Exerciser

The exerciser shall be in accordance with Section 16410 AUTOMATIC TRANSFER AND BY-PASS/ISOLATION SWITCHES.

2.19 SURGE PROTECTION

Electrical and electronic components shall be protected from, or designed to withstand the effects of surges from switching and lightning.

2.20 AUTOMATIC ENGINE-GENERATOR-SET SYSTEM OPERATION

Fully automatic operation shall be provided for the following operations: engine-generator set starting and source transfer upon loss of normal source; retransfer upon restoration of the normal source; sequential starting; and stopping of each engine-generator set after cool down. Devices shall automatically reset after termination of their function.

2.20.1 Automatic Transfer Switch

Automatic transfer switches shall be in accordance with Section 16410 AUTOMATIC TRANSFER AND BY-PASS/ISOLATION SWITCHES.

2.20.2 Monitoring and Transfer

Devices shall be provided to monitor voltage and frequency for the normal power source and each engine generator set, and control transfer from the normal source and retransfer upon restoration of the normal source. Functions, actuation, and time delays shall be as described in Section 16410 AUTOMATIC TRANSFER AND BY-PASS/ISOLATION SWITCHES.

2.21 MANUAL ENGINE-GENERATOR SET SYSTEM OPERATION

Complete facilities shall be provided for manual starting and testing of

each set without load, loading and unloading of each set.

2.22 BASE

The base shall be constructed of steel. The base shall be designed to rigidly support the engine-generator set, ensure permanent alignment of all rotating parts, be arranged to provide easy access to allow changing of lube-oil, and ensure that alignment will be maintained during shipping and normal operation. The base shall permit skidding in any direction during installation and shall be provided with suitable holes for foundation bolts. The base shall also withstand and mitigate the effects of synchronous vibration of the engine and generator, and shall be provided with suitable holes for anchor bolts and jacking screws for leveling.

2.23 THERMAL INSULATION

Thermal insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.24 PAINTING AND FINISHING

The engine-generator set shall be cleaned, primed and painted in accordance with the manufacturer's standard color and practice.

2.25 FACTORY INSPECTION AND TESTS

Factory inspection and tests shall be performed on each engine-generator set proposed to meet this specification section. Inspections shall be completed and necessary repairs made prior to testing. Inspectors shall look for leaks, looseness, defects in components, and proper assembly. Factory tests shall be NEMA MG 1 routine tests and the manufacturers routine tests.

PART 3 EXECUTION

3.1 GENERAL

Installation shall provide clear space for operation and maintenance in accordance with NFPA 70 and IEEE C2. Installation of pipe, duct, conduit, and ancillary equipment shall be configured to facilitate easy removal and replacement of major components and parts of the engine-generator set.

3.2 PIPING INSTALLATION

3.2.1 General

Piping shall be welded. Connections at valves shall be flanged. Connections at equipment shall be flanged except that connections to the diesel engine may be threaded if the diesel-engine manufacturer's standard connection is threaded. Except as otherwise specified, flanged fittings shall be utilized to allow for complete dismantling and removal of each piping system from the facility without disconnecting or removing any portion of any other system's equipment or piping. Connections to all equipment shall be made with flexible connectors. Pipes extending through

the roof shall be properly flashed. Piping shall be installed clear of windows, doors, and openings to permit thermal expansion and contraction without damage to joints or hangers, and with a 13 mm drain valve at each low point.

3.2.2 Supports

Hangers, inserts, and supports shall be of sufficient size to accommodate any insulation and shall conform to MSS SP-58 and MSS SP-69. Supports shall be spaced not more than 2.14 m (7 feet) on center for pipes 50.8 mm (2 inches) in diameter or less, not more than 3.6 m (12 feet) on center for pipes larger than 50.8 mm (2 inches) but no larger than 100 mm (4 inches), and not more than 4.27 m (17 feet) on center for pipes larger than 100 mm (4 inches) in diameter. Supports shall be provided at pipe bends or change of direction.

3.2.2.1 Ceiling and Roof

Exhaust piping shall be supported with appropriately sized type 41 single pipe roll and threaded rods; all other piping shall be supported with appropriately sized type 1 clevis and threaded rods.

3.2.2.2 Wall

Wall supports for pipe shall be made by suspending the pipe from appropriately sized type 33 brackets with the appropriate ceiling and roof pipe supports.

3.2.3 Flanged Joints

Flanges shall be Class 125 (125 pound) type, drilled, and of the proper size and configuration to match equipment and diesel-engine connections. Gaskets shall be factory cut in one piece 1.59 mm (1/16 inch) thick.

3.2.4 Cleaning

After fabrication and before assembly, piping interiors shall be manually wiped clean of all debris.

3.2.5 Pipe Sleeves

Pipes passing through construction such as ceilings, floors, or walls shall be fitted with sleeves. Each sleeve shall extend through and be securely fastened in its respective structure and shall be cut flush with each surface. The structure shall be built tightly to the sleeve. The inside diameter of each sleeve shall be 13 mm (1/2 inch), and where pipes pass through combustible materials, 25.4 mm (1 inch) larger than the outside diameter of the passing pipe or pipe covering.

3.3 ELECTRICAL INSTALLATION

Electrical installation shall comply with NFPA 70, IEEE C2, and Section 16415 ELECTRICAL WORK, INTERIOR.

3.3.1 Vibration Isolation

Flexible fittings shall be provided for all conduit, cable trays, and raceways attached to engine-generator sets. Metallic conductor cables installed on the engine generator set and from the engine generator set to equipment not mounted on the engine generator set shall be flexible stranded conductor. Terminations of conductors on the engine generator set shall be crimp-type terminals or lugs.

3.4 FIELD PAINTING

Field painting shall be as specified in Section 09900 PAINTING, GENERAL. The exterior of all equipment shall be finished in the base standard color.

3.5 ONSITE INSPECTION AND TESTS

3.5.1 Test Conditions

3.5.1.1 Data

Measurements shall be made and recorded of parameters necessary to verify that each set meets specified parameters. If the results of any test step are not satisfactory, adjustments or replacements shall be made and the step repeated until satisfactory results are obtained. Unless otherwise indicated, data shall be taken during engine-generator set operation and recorded in 15 minute intervals and shall include: readings of engine-generator set meters and gauges for electrical and power parameters; oil pressure; ambient temperature; and engine temperatures available from meters and gauges supplied as permanent equipment on the engine-generator set. In the following tests where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.Electrical measurements shall be performed in accordance with IEEE Std 120. Definitions and terms are in accordance with IEEE Std 100. Temperature limits in the rating of electrical equipment and for the evaluation of electrical insulation shall be in accordance with IEEE Std 1.

3.5.1.2 Power Factor

Engine-generator set operating tests shall be made utilizing a load with a 0.8 power factor.

3.5.1.3 Contractor Supplied Items

The Contractor shall provide all equipment and supplies required for inspections and tests including fuel, test instruments, and loadbanks at the specified power factors.

3.5.1.4 Instruments

Readings of panel gauges, meters, displays, and instruments, provided under this specification shall be verified during test runs by test instruments

of precision and accuracy greater than the tested items. Test instrument accuracy shall be at least as follows: current, 1.5%; voltage, 1.5%; real power, 1.5%; reactive power, 1.5%; power factor, 3%; frequency, 0.5%. Test instruments shall be calibrated by a recognized standards laboratory within 90 days prior to testing.

3.5.1.5 Sequence

The sequence of testing shall be as specified in the approved testing plan unless variance in authorized by the Contracting Officer. Field testing shall be performed in the presence of the Contracting Officer. Tests may be scheduled and sequenced in order to optimize run-time periods; however the following general order of testing shall be followed: Construction Tests; Inspections; Safety run Tests; and Performance Tests and Final Inspection.

3.5.2 Construction Tests

Individual component and equipment functional tests for fuel piping, coolant piping, and lubricating-oil piping, electrical circuit continuity, insulation resistance, circuit protective devices, and equipment not provided by the engine-generator set manufacturer shall be performed prior to connection to the engine-generator set.

3.5.2.1 Piping Test

a. Lube-oil and fuel-oil piping shall be flushed with the same type of fluid intended to flow through the piping, until the outflowing fluid has no obvious sediment or emulsion.

b. Fuel piping which is external to the engine-generator set shall be tested in accordance with NFPA 30. All remaining piping which is external to the engine generator set shall be pressure tested with air pressure at 150% of the maximum anticipated working pressure, but in no case less than 1 MPa, for a period of 2 hours to prove the piping has no leaks. If piping is to be insulated, the test shall be performed before the insulation is applied.

3.5.2.2 Electrical Equipment Tests

a. Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the automatic transfer switch. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters).

(R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

b. Ground-Resistance Tests. The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

1) Single rod electrode - 25 ohms.

c. Circuit breakers and switchgear shall be examined and tested in accordance with manufacturer's published instructions for functional testing.

3.5.3 Inspections

The following inspections shall be performed jointly by the Contracting Officer and the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts. (I)
2. Governor type and features. (I)
3. Engine timing mark. (I)
4. Starting motor. (I)
5. Starting aids. (I)
6. Coolant type and concentration. (D)
7. Radiator drains. (I)
8. Block coolant drains. (I)
9. Coolant fill level. (I)
10. Coolant line connections. (I)
11. Coolant hoses. (I)
12. Combustion air filter. (I)
13. Intake air silencer. (I)
14. Lube oil type. (D)

15. Lube oil drain. (I)
16. Lube-oil filter. (I)
17. Lube-oil-fill level. (I)
18. Lube-oil line connections. (I)
19. Lube-oil lines. (I)
20. Fuel type. (D)
21. Fuel-level. (I)
22. Fuel-line connections. (I)
23. Fuel lines. (I)
24. Fuel filter. (I)
25. Access for maintenance. (I)
26. Voltage regulator. (I)
27. Battery-charger connections. (I)
28. Wiring & terminations. (I)
29. Instrumentation. (I)
30. Hazards to personnel. (I)
31. Base. (I)
32. Nameplates. (I)
33. Paint. (I)
34. Exhaust system. (I)
35. Access provided to controls. (I)
36. Enclosure. (I)
37. Engine & generator mounting bolts (proper application). (I)

3.5.4 Safety Run Tests

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.

b. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

c. Activate the manual emergency stop switch and verify that the engine stops.

d. Remove the high and pre-high lubricating oil temperature sensing elements from the engine and temporarily install temperature gauge in their normal locations on the engine (required for safety, not for recorded data). Where necessary, provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

e. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize. Monitor the temporarily installed temperature gauges. If temperature reading exceeds the value for an alarm condition, activate the manual emergency stop switch.

f. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the

temperature sensors on the engine.

g. Remove the high and pre-high coolant temperature sensing elements from the engine and temporarily seal their normal location on the engine and temporarily install temperature gauges in their normal locations on the engine (required for safety, not for recorded data). Where necessary provide temporary wiring harness to connect the sensing elements to their permanent electrical leads.

h. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set at no load until the output voltage and frequency stabilize.

i. Immerse the elements in a vessel containing controlled-temperature hot oil and record the temperature at which the pre-high alarm activates and the temperature at which the engine shuts down. Remove the temporary temperature gauges and reinstall the temperature sensors on the engine.

j. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

k. Operate the engine generator-set for at least 30 minutes at 100 percent of service load.

l. Verify proper operation of the governor and voltage regulator.

m. Verify proper operation and setpoints of gauges and instruments.

n. Verify proper operation of ancillary equipment.

o. Manually adjust the governor to increase engine speed past the overspeed limit. Record the RPM at which the engine shuts down.

p. Start the engine, record the starting time, make and record engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of rated load.

q. Manually fill the day tank to a level above the overfill limit. Record the level at which the overfill alarm sounds. Verify shutdown of the fuel transfer pump. Drain the day tank down below the overfill limit.

r. Shut down the engine. Remove the time-delay low lube oil pressure alarm bypass and try to start the engine. Record the results.

s. Attach a manifold to the engine oil system (at the oil sensor pressure port) that contains a shutoff valve in series with a connection for the engine's oil pressure sensor followed by an oil pressure gauge ending with a bleed valve. The engine's oil pressure sensor shall be moved from the engine to the manifold and

its normal location on the engine temporarily sealed. The manifold shutoff valve shall be open and bleed valve closed.

t. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 75 percent of service load.

u. Close the manifold shutoff valve. Slowly allow the pressure in the manifold to bleed off through the bleed valve while watching the pressure gauge. Record the pressure at which the engine shuts down. Catch oil spillage from the bleed valve in a container. Add the oil from the container back to the engine, remove the manifold, and reinstall the engine's oil pressure sensor on the engine.

v. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections and operate the engine generator-set for at least 15 minutes at 100% of service load. Record the maximum sound level in each frequency band at a distance of 22.9 m (75 feet) from the end of the exhaust and air intake piping directly along the path of intake and discharge horizontal piping. The measurements should comply with the paragraph SOUND LIMITATIONS. If a sound limiting enclosure is not provided, the muffler and air intake silencer shall be modified or replaced as required to meet the sound limitations of this specification. If the sound limitations can not be obtained by modifying or replacing the muffler and air intact silencer, the contractor shall notify the Contracting Officer and provide a recommendation for meeting the sound limitations.

w. Manually drain off fuel slowly from the day tank to empty it to below the low fuel level limit and record the level at which the audible alarm sounds. Add fuel back to the day tank to fill it above low level alarm limits.

3.5.5 Performance Tests

3.5.5.1 Continuous Engine Load Run Test

The engine-generator set and ancillary systems shall be tested at service load to: demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. Data taken at 15 minutes intervals shall include the following:

a. Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.

b. Pressure: Lube-oil.

c. Temperature: Coolant.
Lube-oil.
Ambient.

(1) Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.

(2) Start the engine; make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

(3) Operate the engine generator-set for at least 2 hours at 75 percent of service load.

(4) Increase load to 100%of service load and operate the engine generator-set for at least 2 hours.

(5) Remove load from the engine-generator set.

3.5.5.2 Load Acceptance Test

Engine manufacturer's recommended prestarting checks and inspections shall be performed and recorded. The engine shall be started, and engine manufacturer's after-starting checks and inspections made and recorded during a reasonable warm-up period. For the following steps, the output line-line and line-neutral voltages and frequency shall be recorded after performing each step instruction (after stabilization of voltage and frequency). Stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings.

a. Apply load in steps no larger than the Maximum Step Load Increase to load the engine-generator set to 100 of Service Load.

b. Verify that the engine-generator set responds to the load addition and that the output voltage returns to and stabilizes within the rated bandwidths.

3.5.6 Automatic Operation Tests for Stand-Alone Operation

The automatic loading system shall be tested to demonstrate automatic starting of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

a. Ambient temperature (at 15 minute intervals).

b. Generator output current (before and after load changes).

c Generator output voltage (before and after load changes).

d. Generator output frequency (before and after load changes.)

1. Initiate loss of the primary power source and verify automatic sequence of operation.

2. Restore the primary power source and verify sequence of operation.

3. Verify resetting of controls to normal.

3.6 FINAL INSPECTION AND TESTING

a. Start the engine, record the starting time, make and record all engine manufacturer's after-starting checks and inspections during a reasonable warm-up period.

b. Increase the load in steps no greater than the maximum step load increase to 100% of service load, and operate the engine-generator set for at least 30 minutes. Measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the same range as previous measurements and is within the required range.

c. Remove load and shut down the engine-generator set after the recommended cool down period. Perform the pre-test inspections and take necessary corrective actions.

d. Remove the lube oil filter and have the oil and filter examined by the engine manufacturer for excessive metal, abrasive foreign particles, etc. Any corrective action shall be verified for effectiveness by running the engine for 4 hours at service load, then re-examining the oil and filter.

e. Remove the fuel filter and examine the filter for trash, abrasive foreign particles, etc.

f. Visually inspect and check engine and generator mounting bolts for tightness and visible damage.

g. Replace air, oil, and fuel filters with new filters.

3.7 MANUFACTURER'S FIELD SERVICE

3.7.1 Onsite Training

The Contractor shall conduct training course for operating staff as designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and shall start after the system

is functionally completed but prior to final acceptance. The course instructions shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations such as oil change, oil filter change, and air filter change.

3.7.2 Manufacturer's Representative

The engine generator-set manufacturer shall furnish a qualified representative to supervise the installation of the engine generator-set, assist in the performance of the onsite tests, and instruct personnel as to the operational and maintenance features of the equipment.

3.8 INSTRUCTIONS

Two sets of instructions shall be typed in 216 x 279 mm format, laminated in weatherproof plastic, and placed in three-ring vinyl binders. The binders shall be placed as directed by the Contracting Officer. The instructions shall be in place prior to acceptance of the engine generator set installation. First set of instructions shall include a one-line diagram, wiring and control diagrams and a complete layout of the system. Second set of instructions shall include the condensed operating instructions describing manufacturer's pre-start checklist and precautions; startup procedures for test-mode, manual-start mode, and automatic-start mode (as applicable); running checks, procedures, and precautions; and shutdown procedures, checks, and precautions. Instructions shall include procedures for interrelated equipment (such as heat recovery systems, co-generation, load-shedding, and automatic transfer switches).

3.9 ACCEPTANCE

Final acceptance of the engine-generator set will not be given until the Contractor has successfully completed all tests and after all defects in installation material or operation have been corrected.

-- End of Section --

SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND
11/92
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C57.12.21	(1995) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVa and Smaller
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI O5.1	(1992) Specifications and Dimensions for Wood Poles

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 496	(1992) Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Mahhole Sections (Metric)
ASTM D 923	(1991) Sampling Electrical Insulating Liquids
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994) Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE ANSI/IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE ANSI/IEEE C37.20.2	(1993; C37.20.2b) Metal-Clad and Station-Type Cubicle Switchgear
IEEE ANSI/IEEE C37.20.3	(1987; R 1992) Metal-Enclosed Interrupter Switchgear
IEEE ANSI/IEEE C37.34	(1994) Test Code for High-Voltage Air Switches

IEEE ANSI/IEEE C37.41	(1994; C37.41e) Design Tests for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories
IEEE ANSI/IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE ANSI/IEEE C37.98	(1987; R 1990) Seismic Testing of Relays
IEEE ANSI/IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE ANSI/IEEE C57.13	(1993) Instrument Transformers
IEEE ANSI/IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems
IEEE C62.11	(1993) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 48	(1996) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1996) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 404	(1993; errata) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable

	Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FB 1	(1993) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA LA 1	(1992) Surge Arresters
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA WC 7	(1991; Rev 1) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1991; Rev 1; Rev 2) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 467	(1993; Rev thru Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 489	(1996; Rev thru Nov 1997) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 510	(1994; Rev thru Nov 1997) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

UL 514A	(1996; Rev Jul 1998) Metallic Outlet Boxes
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 1072	(1995; Rev Mar 1998) Medium-Voltage Power Cable
UL 1242	(1996; Rev Apr 1997) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 {AM#2} DELETED

1.3 SUBMITTALS

Governmental approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Fault Current and Protective Devices Coordination Studies; GA.

The study shall be submitted with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog Data; FIO.

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists; FIO.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Procedures; FIO.

As a minimum, installation procedures for transformers, substations, switchgear, and medium-voltage cable terminations and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-04 Drawings

Electrical Distribution System; FIO.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.

b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

a. Medium-voltage cables and accessories including cable installation plan.

b. Transformers.

c. Substations.

d. Switchgear.

e. Pad-mounted loadbreak switches.

f. Busways.

g. Surge arresters.

As-Built Drawings; FIO.

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

SD-09 Reports

Factory Test; FIO.

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing; FIO.

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Test Reports; FIO.

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings, including a separate

section for each test. Sections shall be separated by heavy plastic dividers with tabs.

a. A list of equipment used, with calibration certifications.

b. A copy of measurements taken.

c. The dates of testing.

d. The equipment and values to be verified.

e. The condition specified for the test.

f. The test results, signed and dated.

g. A description of adjustments made.

Cable Installation Reports; FIO.

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

a. Site layout drawing with cable pulls numerically identified.

b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

c. The cable manufacturer and type of cable.

d. The dates of cable pulls, time of day, and ambient temperature.

e. The length of cable pull and calculated cable pulling tensions.

f. The actual cable pulling tensions encountered during pull.

SD-13 Certificates

Materials and Equipment; FIO.

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA), the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published

catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Splicer Qualification; FIO.

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications; FIO.

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-19 OPERATION AND MAINTENANCE MANUALS

Electrical Distribution System; FIO.

Six copies of operation and maintenance manuals, within 14 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate

different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Wood poles held in storage for more than 2 weeks shall be stored in accordance with ANSI O5.1. Handling of wood poles shall be in accordance with ANSI O5.1, except that pointed tools capable of producing indentations more than 25 mm (1 inch) in depth shall not be used. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE ANSI/IEEE C57.12.00. Nameplates shall indicate the number of liters and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 2 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.59 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072 with insulation and shielding, as specified, using an aluminum interlocked tape armor and thermoplastic jacket. Cables shall be manufactured for use in duct or direct burial applications.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 8 and AEIC CS6. A 133 percent insulation level shall be used on 5 kV, 15 kV and 25 kV rated cables.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper shield for each phase.

2.4.1.6 Neutrals

Neutral conductors of shall be copper employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable. Concentric neutrals conductors shall be tinned copper, having a combined ampacity equal to 1/3 of the phase conductor ampacity rating.

2.4.1.7 Jackets

Cables shall be provided with a PVC jacket. Direct buried cables shall be rated for direct burial.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 Direct Buried

Single and multi-conductor cables shall be of a type identified for direct burial. Service entrance cables shall conform to UL 854 for Type USE service entrance cable.

2.4.2.5 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and

larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level.

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 315 mm (12-1/2 inches) long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Ducts shall be single, round-bore type, with wall thickness and fittings suitable for the application. Duct lines shall be concrete-encased, thin-wall type.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Bituminized Fiber Duct

Use shall not be permitted.

2.6.2.2 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.2.3 Direct Burial

UL 651 Schedule 40 or NEMA TC 6 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), shall neither slump at a temperature of 150 degrees C (300 degrees F), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 {AM#2}_____ HANDHOLES AND PULLBOXES

{AM#2}_____ Handholes and pullboxes shall be as indicated. Frames and gratings, or frames and covers shall be ductile iron, meeting the requirements of ASTM A 536 with tensile strength not less than Class 35. Shape and size shall be as indicated. Each casting, frame and cover shall be capable of withstanding a minimum working load of 1,793 kPa over a 140,000 square millimeter contact area. The minimum factor of safety shall be 2.5. Working load testing shall be in accordance with federal specification RR-R-621C. Results of proof loads shall be submitted. {AM#2} _____. {AM#2}_____. {AM#2}_____. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 69 MPa (10,000 psi) and a flexural strength of at least 34.5 MPa (5000 psi). Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 TRANSFORMERS {AM#2}_____ AND SWITCHGEAR

Transformers {AM#2}_____ and switchgear shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be {AM#2}15 kV between phases for 133 percent insulation level.

2.8.1 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the radial type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.8.1.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, oil-immersed, current-limiting, bayonet-type fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stencilled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert.

2.8.1.2 Load-Break Switch

Radial-feed oil-immersed type rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 ampere, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment.

ARRANGEMENT #	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW OPEN	LINE A SW CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR SW OPEN	XFMR SW CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X		X		X

ARRANGEMENT #	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION LINE A SW OPEN	LINE A SW CLOSE	LINE B SW OPEN	LINE B SW CLOSE	XFMR SW OPEN	XFMR SW CLOSE
3	Transformer connected to Line B only		X		X		X
4	Transformer open and loop closed		X		X		X
5	Transformer open and loop open		X		X		X

2.8.1.3 Transformer Tank Sections

Transformers shall comply with IEEE ANSI/IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the mineral oil-insulated type. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity..... .....75 kVA.

Impedance..... 4.20%.

Temperature Rise.....65 degrees C.

High-voltage winding..... 13.8 kv

High-voltage winding connections.....Delta.

Low-voltage winding..... 480Y/277 volts.

Low-voltage winding connections.....WYE

2.8.1.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.8.1.5 Accessories

High-voltage warning signs shall be permanently attached to each side of

transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Circuit Breakers, Low-Voltage

2.9.1.1 Molded-Case Circuit Breakers

NEMA AB 1 and UL 489.

2.9.2 Fuses, Medium-Voltage, Including Current-Limiting

2.9.2.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.9.2.2 Ratings

Current-limiting power fuses shall have ratings in accordance with ANSI C37.46 and as follows:

Nominal voltage.....13.8 kv.

Rated maximum voltage.....15.5 kv.

Maximum symmetrical interrupting capacity.....1800.

Rated continuous current.....6.

2.9.2.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to ANSI C37.46.

2.9.2.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.9.3 Fuses, Low-Voltage, Including Current-Limiting

Low-voltage fuses shall conform to NEMA FU 1. Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilizes fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the

equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination.

2.10 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters for use at elevations in excess of 1.8 km (6000 feet) above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor type.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 19.05 mm (3/4 inch) in diameter by 3.048 m (10 feet) in length. Sectional type rods may be used.

2.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.12 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

2.13 {AM#2} DELETED

2.14 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.14.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods

used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.14.2 Fireproofing Tape

Fireproofing tape shall be at least 50.8 mm (2 inches) wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.14.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 0.254 mm (10 mil) thick, conforming to UL 510.

2.15 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 2 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 2 ppm shall be replaced.

2.16 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

a. Transformers: Manufacturer's standard routine tests in accordance with IEEE ANSI/IEEE C57.12.00.

b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE ANSI/IEEE C57.98.

c. High-Voltage Air Switches: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C37.34 and IEEE ANSI/IEEE C37.41.

d. Protective Relays: Seismic tests in accordance with IEEE ANSI/IEEE C37.98. Surge withstand tests in accordance with IEEE ANSI/IEEE C37.90.1.

e. Relaying Current Transformers: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C57.13.

f. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C57.13.

g. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.

h. Outdoor Switchgear: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C37.20.1, IEEE ANSI/IEEE C37.20.2, and IEEE ANSI/IEEE C37.20.3.

i. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Circuits installed aerially shall conform to the requirements of Section 16370 ELECTRICAL DISTRIBUTION SYSTEM, AERIAL. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall have minimum 20 MPa compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then prepare a checklist of significant requirements which shall be

submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 6.4 mm (1/4 inch) less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 131 cubic centimeters (8 cubic inches) of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manilla rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 10 degrees C (50 degrees F) temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

a. Site layout drawing with cable pulls identified in numeric order

of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall thrust pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing.

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 101.6 mm per 30.48 m (4 inches per 100 feet). Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 457.2 mm (18 inches) for ducts of less than 76.2 mm (3 inch) diameter, and 900 mm (36 inches) for ducts 76.2 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.62 m shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 152.4 mm (6 inches) in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface loadings. Tops of concrete encasements shall be not less than 1.52 m (5 feet) below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15.24 m (50 feet) in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1.22 m (4 feet) on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 152.4 mm (6 inches) vertically.

3.5.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.5 Duct Line Markers

Duct line markers shall be provided as indicated at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil) brightly colored plastic tape, not less than 76.2 mm (3 inches) in width and suitably inscribed at not more than 3.048 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 304.8 mm (12 inches) below finished grade levels of such lines.

3.6 {AM#2}_____ HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 12.7 mm (1/2 inch) above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

{AM#2} In paved areas, frames and covers for handhole extrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole coveres shall be approximately 12.7 mm (1/2 inch) above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the handhole cover to existing grade level. All duct lines entering handholes must be installed on compact soil or otherwise supported when entering a handhole to prevent shear stress on theduct at the point of entrance to the handhole. Duct lines entering cast-in-place concrete handholes shall be cast in-place with the handhole. Duct lines entering

precast concrete handholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precase handholes through a PVC endbell shall be solvent welded to the endbell. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 {AM#2} DELETED

3.6.3 {AM#2} DELETED

3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 12.7 mm (1/2 inch) above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 101.6 mm (4 inches) of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

{AM#2) A ground rod shall be installed at the handholes and pullboxes. Ground rods shall be driven into the earth before the handhole is poured so that approximately 101.6 mm (4 inches) of the ground rod will extend above the handhole floor. When precast concrete handholes are used, the top of the ground rod may be below the handhole floor and a No. 1/0 AWG ground conductor brought into the handhole through a watertight sleeve in the handhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment, shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment shall be poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 101.6 mm (4 inches) above finished paving or grade and sloped to drain. Edges of concrete pads shall have 19.05 mm (3/4 inch) chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 20 MPa compressive strength and comform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200 CONCRETE REINFORCEMENT.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment and for each fence gate. Padlocks shall be keyed as directed by the Contracting Officer.

3.8 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 2 connections shall be provided from a transformer to the ground mat. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.8.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 304.8 mm (12 inches) below finished grade.

b. Ground mat - A ground mat shall be installed as shown consisting of bare copper conductors installed 304.8 mm (12 inches), plus or minus 76.2 mm (3 inches), below the finished top of soil grade. Mat conductors shall be bonded to all rod electrodes, electrolytic electrodes, and to all other intersecting mat conductors. Mat conductors shall be sized as shown on the drawings.

c. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed 304.8 mm (12 inches) plus or minus 76.2 mm (3 inches), below finished top of soil grade. Ground ring conductors shall be No. 2 AWG, minimum.

d. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three, 3.048 m (10 feet) rods spaced a minimum of 3.66 m (12 feet) apart, driven perpendicular to grade. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately.

3.8.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.8.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.8.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as

practicable with no kinks or sharp bends.

{AM#2} Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode with a #1/0 bare copper conductor. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.8.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 50.8 mm (2 inches) above and 152.4 mm (6 inches) below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.9 FIELD TESTING

3.9.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 14 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.9.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.9.3 Ground-Resistance Tests

The resistance of the ground ring shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of

electrodes must still be provided.

a. Single rod electrode - 25 ohms.

3.9.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.9.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.9.6 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

a. Insulation resistance test phase-to-phase.

b. Insulation resistance test phase-to-ground.

c. Closed breaker contact resistance test.

d. Power factor test.

e. High-potential test.

f. Manual operation of the breaker.

3.9.7 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2 years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

a. Secondary unit substation

b. Pad-mounted transformers

c. Panelboards

d. Switchboards

e. Metal-enclosed switchgear

f. Busways

g. Switches

3.9.8 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.10 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

-- End of Section --

SECTION 16403

MOTOR CONTROL CENTERS, SWITCHBOARDS AND PANELBOARDS
08/95
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 187	(1994) Copper Bar, Bus Bar, Rod and Shapes

ASME INTERNATIONAL (ASME)

ASME B1.1	(1989) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA PB 1	(1990) Panelboards
{AM#2}____	{AM#2}_____

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 44	(1997; R 1998, Bul. 1997) Rubber-Insulated Wires and Cables
UL 50	(1992) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru May 1994) Panelboards
UL 489	(1996; Rev thru Nov 1997) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

{AM#2}_____ {AM#2}_____

UL 1063 (1993; Rev thru Oct 1994) Machine-Tool Wires and Cables

1.2 SYSTEM DESCRIPTION

These specifications include the design, fabrication, assembly, wiring, testing, and delivery of the items of equipment and accessories and spare parts listed in the Schedule and shown on the drawings.

1.2.1 Rules

The equipment shall conform to the requirements of NFPA 70 unless more stringent requirements are indicated herein or shown. NEMA rated and UL listed equipment has been specified when available. Equipment must meet NEMA and UL construction and rating requirements as specified. No equivalent will be acceptable. The contractor shall immediately notify the Contracting Officer of any requirements of the specifications or contractor proposed materials or assemblies that do not comply with UL or NEMA. International Electrotechnical Commission (IEC) rated equipment will not be considered an acceptable alternative to specified NEMA ratings.

1.2.2 Coordination

The general arrangement of the {AM#2}_____ panelboards is shown on the contract drawings. Any modifications of the equipment arrangement or device requirements as shown on the drawings shall be subject to the approval of the Contracting Officer. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. All equipment shall be completely assembled at the factory. {AM#2}_____.

1.2.3 Standard Products

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications. Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designated. All materials, supplies, and articles not manufactured by the Contractor shall be the products of other recognized reputable manufacturers. If the Contractor desires for any reason to deviate from the standards designated in these specifications, he shall, after award, submit a statement of the exact nature of the deviation, and shall submit, for the approval of the Contracting Officer, complete specifications for the materials which he proposes to use.

1.2.4 Nameplates

Nameplates shall be made of laminated sheet plastic or of anodized aluminum approximately 4 millimeters (1/8 inch) thick, engraved to provide white

letters on a black background. The nameplates shall be fastened to the panels in proper positions with anodized round-head screws. Lettering shall be minimum 15 millimeters (1/2 inch) high. Nameplate designations shall be in accordance with lists on the drawings, and as a minimum shall be provided for the following equipment:

{AM#2}_____

{AM#2}_____

{AM#2}_____

{AM#2}_____

{AM#2}_____

{AM#2}a. Panelboards

{AM#2}b. Mini-Power Centers

{AM#2}c. Individually-mounted circuit breakers in Panelboard and Mini

Equipment of the withdrawal type shall be provided with nameplates mounted on the removable equipment in locations visible when the equipment is in place.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation. Equipment, materials, and articles installed or used without such approval shall be at the risk of subsequent rejection. Submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment; GA.

The Contractor shall within 60 calendar days after date of award submit for approval six (6) copies of such descriptive cuts and information as are required to demonstrate fully that all parts of the equipment will conform to the requirements and intent of the specifications. Data shall include descriptive data showing typical construction of the types of equipment proposed, including the manufacturer's name, type of molded case circuit breakers or motor circuit protectors, performance capacities and other information pertaining to the equipment.

SD-04 Drawings

Outline Drawings; GA.

The Contractor shall, within 60 calendar days after date of award submit for the approval of the Contracting Officer six (6) copies of outline drawings of all equipment to be furnished under this contract, together

with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the motor control centers, switchboards, and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

{AM#2} The Contractor shall, within 60 calendar days after the date of award submit for the approval of the Contracting Officer six (6) copies of outline drawings of all equipment to be furnished under this contract, together with weights and overall dimensions. Drawings shall show the general arrangement and overall dimensions of the mini-power centers and panelboards. These drawings shall show space requirements, details of any floor supports to be embedded in concrete and provisions for conduits for external cables.

{AM#2}Mini-Power Centers; GA. Panelboards; GA.

The Contractor shall, within 60 calendar days after date of award submit for the approval of the Contracting Officer six (6) copies of electrical equipment drawings. A single-line diagram, equipment list and nameplate schedule shall be provided for each {AM#2}_____ panelboard.

SD-08 Statements

{AM#2}_____.

SD-09 Reports

Factory Tests; FIO.

The Contractor shall submit six (6) complete reproducible copies of the factory inspection results and six (6) complete reproducible copies of the factory test results in booklet form, including all plotted data curves, all test conditions, a listing of test equipment complete with calibration certifications, and all measurements taken. Report shall be signed and dated by the Contractor's and Contracting Officer's Representatives.

1.4 DELIVERY, STORAGE, AND HANDLING

The equipment shall be shipped as completely assembled and wired as feasible so as to require a minimum of installation work. Each shipping section shall be properly match marked to facilitate reassembly, and shall be provided with removable lifting channels with eye bolts for attachment of crane slings to facilitate lifting and handling. Any relay or other device which cannot withstand the hazards of shipment when mounted in place on the equipment shall be carefully packed and shipped separately. These devices shall be marked with the number of the panel which they are to be mounted on and fully identified. All finished painted surfaces and metal work shall be wrapped suitably or otherwise protected from damage during shipment. All parts shall be prepared for shipment so that slings for handling may be attached readily while the parts are in a railway car or transport truck. All spare parts and accessories shall be carefully packaged and clearly marked.

1.5 MAINTENANCE

1.5.1 Accessories and Tools

A complete set of accessories and special tools unique to equipment provided and required for erecting, handling, dismantling, testing and maintaining the apparatus shall be furnished by the Contractor.

1.5.2 Spare Parts

Spare parts shall be furnished as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished.

a. 2 - Fuses of each type and size.

b. 1 - Circuit breaker auxiliary switch.

c. 2 - Operating coils for each size ac contactor.

d. 1 - Operating coil for each size dc contactor.

e. 2 - Complete sets of 3-pole stationary and moving contact assemblies for each size ac contactor.

f. 1 - Complete set of 2-pole stationary and moving contact assemblies for each size dc contactor.

g. 3 - Contactor overload relays of each type and rating, each relay with a complete set of contact blocks.

h. 1 - spare set of heater elements for each heater rating provided.

i. 2 - Indicating lamp assemblies of each type.

j. 1 - Control transformer of each type and rating.

k. 1 - Control relay of each type and rating.

l. 1 - Contactor auxiliary contact of each type.

m. 4 - One quart containers of finish paint for indoor equipment.

n. 2 - One quart containers of the paint used for the exterior surfaces of outdoor equipment.

o. 4 - Keys for motor control center door lock.

{AM#2} Spare parts shall be furnished as specified below. All spare parts shall be of the same material and workmanship, shall meet the same requirements, and shall be interchangeable with the corresponding original parts furnished.

a. 4 - One quart containers of finish paint for indoor equipment.

b. 2 - One quart containers of the paint used for the exterior surfaces of outdoor equipment.

PART 2 PRODUCTS

2.1 CONNECTIONS

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1. The sizes and threads of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1. All ferrous fasteners shall have rust-resistant finish and all bolts and screws shall be equipped with approved locking devices. Manufacturer's standard threads and construction may be used on small items which, in the opinion of the Contracting Officer, are integrally replaceable, except that threads for external connections to these items shall meet the above requirements.

2.2 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to the applicable requirements of NEMA AB 1 and UL 489. The circuit breakers shall be manually-operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position {AM#2}_____. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size.

2.2.1 Trip Units

Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic or solid state trip units. The Government reserves the right to change the indicated trip ratings, within frame limits, of the trip devices at the time the shop drawings are submitted for approval. The breaker trip units shall be interchangeable and the instantaneous magnetic trip units shall be adjustable on frame sizes larger than 150 amperes. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

2.2.2 480-Volt AC Circuits

Circuit breakers for 480-volt or 277/480-volt ac circuits shall be rated 600 volts ac, and shall have an UL listed minimum interrupting capacity of 14,000 symmetrical amperes at 600 volts ac.

2.2.3 120/240-Volt AC Circuits

Circuit breakers for 120-volt ac circuits shall be rated not less than 120/240 or 240 volts ac, and shall have a UL listed minimum interrupting capacity of 10,000 symmetrical amperes.

2.3 WIRING

All control wire shall be stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44 or Type MTW meeting UL 1063, and shall pass the VW-1 flame tests included in those standards. Hinge wire shall have Class K stranding. Current transformer secondary leads shall be not smaller than No. 10 AWG. The minimum size of control wire shall be No. 14 AWG. Power wiring for 480-volt circuits and below shall be of the same type as control wiring and the minimum size shall be No. 12 AWG. Special attention shall be given to wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.4 {AM#2} DELETED

2.4.1 {AM#2} DELETED

2.4.1.1 {AM32} DELETED

2.4.1.2 {AM#2} DELETED

2.4.2 {AM#2} DELETED

2.5 {AM#2} DELETED

2.5.1 {AM#2} DELETED

2.5.2 {AM#2} DELETED

2.5.3 {AM#2} DELETED

2.5.4 {AM #2} DELETED

2.6 PANELBOARDS

Panelboards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 480 volts ac or less. Panelboards shall be UL 67 labeled. "Loadcenter" type panels are not acceptable. Panelboards shall be designed for installation in surface-mounted or flush-mounted cabinets accessible from the front only, as shown on the drawings. Panelboards shall be fully rated for a short-circuit current of 14,000 symmetrical amperes RMS ac.

2.6.1 Enclosure

Enclosures shall be NEMA 12/3R and meet the requirements of UL 50. All cabinets shall be fabricated from sheet steel of not less than 3.5 millimeters (No. 10 gage) if flush-mounted or mounted outdoors, and not

less than 2.7 millimeters (No. 12 gage) if surface-mounted indoors, with full seam-welded box ends. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication. Cabinets shall be painted in accordance with paragraph PAINTING. Outdoor cabinets shall be of NEMA 12/3R raintight. Front edges of cabinets shall be form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front. All cabinets shall be so fabricated that no part of any surface on the finished cabinet shall deviate from a true plane by more than 3 millimeters (1/8 inch). Holes shall be provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 15 millimeter (1/2 inch) clear space between the back of the cabinet and the wall surface. Flush doors shall be mounted on hinges that expose only the hinge roll to view when the door is closed. Each door shall be fitted with a combined catch and lock, except that doors over 600 millimeters (24 inches) long shall be provided with a three-point latch having a knob with a T-handle, and a cylinder lock. Two keys shall be provided with each lock, and all locks shall be keyed alike. Finished-head cap screws shall be provided for mounting the panelboard fronts on the cabinets. Enclosure shall have nameplates in accordance with paragraph NAMEPLATES. Directory holders, containing a neatly typed or printed directory under a transparent cover, shall be provided on the inside of panelboard doors.

2.6.2 Buses

All panelboards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All buses shall be made of copper. Copper bars and shapes for bus conductors shall conform to the applicable requirements of ASTM B 187. The sizes of buses and the details of panelboard construction shall meet or exceed the requirements of NEMA PB 1. Suitable provisions shall be made for mounting the bus within panelboards and adjusting their positions in the cabinets. Terminal lugs required to accommodate the conductor sizes shown on the drawing, shall be provided for all branch circuits larger than No. 10 AWG. A grounding lug suitable for 1/0 AWG wire shall be provided for each panelboard.

2.6.3 Components

Each branch circuit, and the main buses where so specified or shown on the drawings, shall be equipped with molded-case circuit breakers having overcurrent trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to buses in a panelboard assembly, and shall meet the requirements of paragraph MOLDED CASE CIRCUIT BREAKERS. Circuit breakers of the same frame size and rating shall be interchangeable.

2.7 {AM#2} MINI POWER CENTERS

{AM#2} The mini power center shall be built according to the latest revision of ANSI C 89.2 (ST-20). It shall feature a self-contained indoor outdoor non-ventilated enclosure that incorporates a primary breaker, dry type transformer, secondary main breaker and a secondary distribution section. Units shall be designed for continuous operation at rated KVA,

for 24 hours a day, 365 days a year operation with normal life expectancy as defined in ANSI C 57.96.

2.7.1 {AM#2} Transformer

{AM#2} Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings: 0 to 9 KVA - no more than 40 db.

2.7.2 {AM#2} Insulation Systems

{AM#2} a. Transformers shall be insulated with a 185 degrees C insulation system minimum.

b. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C ambient, with a 30 degrees C average over 24 hours.

c. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

2.7.3 {AM#2} Core and Coil Assemblies

{AM#2} a. Transformer core shall be constructed with high-grade, nonaging, grain-oriented silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction.

b. The core and coil assembly shall be completed encapsulated in a proportioned mixture of resin and aggregate to provide a moisture-proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.

c. The core of the transformer shall be grounded to the enclosure.

d. Provide minimum two (2) FCBN taps.

2.7.4 {AM#2} Bus

{AM#2} Secondary bus shall be aluminum.

2.7.5 {AM#2} Wiring/Terminations

{AM#2} a. All interconnecting wiring between the primary circuit breaker and transformer, secondary main circuit breaker and transformer and distribution section shall be factory installed and terminated.

b. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring.

2.7.6 {AM#2} Main Devices

{AM#2} Each mini power center shall include a main primary circuit breaker with an interrupting rating of 14 KA at 277/480 volts; and a secondary panelboard with a main circuit breaker rated 10 KA at 120/240; or 208Y/120 as applicable.

2.7.7 {AM#2} Feeder Devices

{AM#2} The secondary distribution section shall accommodate standard panelboard circuit breakers with 10 KA interrupting capacity.

2.7.8 {AM#2} Enclosure

{AM#2} a. The enclosure shall be made of heavy-gauge steel and the maximum temperature of the enclosure shall not exceed 90 degrees C.

b. The enclosure shall be totally enclosed, nonventilated, with lifting eyes.

c. Unless specified otherwise on the drawings, enclosure rating shall be NEMA 3R. Enclosure door shall accept padlock.

2.8 PAINTING

Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Light Grey. All touch-up work shall be done with manufacturer's coatings as supplied under paragraph SPARE PARTS.

2.9 FACTORY TESTS

Each item of equipment supplied under this contract shall be given the manufacturer's routine factory tests and tests as specified below, to insure successful operation of all parts of the assemblies. All tests required herein shall be witnessed by the Contracting Officer unless waived in writing, and no equipment shall be shipped until it has been approved for shipment by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of 14 days prior to the proposed date of the tests so that arrangements can be made for the Contracting Officer to be present at the tests. The factory test equipment and the test methods used shall conform to the applicable NEMA Standards, and shall be subject to the approval of the Contracting Officer. Reports of all witnessed tests shall be signed by witnessing representatives of the Contractor and Contracting Officer. The cost of performing all tests shall be borne by the Contractor and shall be included in the prices bid in the schedule for equipment.

2.9.1 {AM#2}_____ Tests

2.9.1.1 {AM#2} DELETED

2.9.1.2 {AM#2} Panelboards and Mini Power Center Tests

{AM#2} Each panelboard and mini power center shall be assembled with cabinet and front to the extent necessary to check the fit and provisions for installing all parts in the field. Each panelboard shall be given a dielectric test in accordance with NEMA PB 1. All circuit breakers shall be operated to check mechanical adjustments. All doors and locks shall be checked for door clearances and fits and the performance of lock and latches.

2.9.1.3 {AM#2} Short Circuit Tests

{AM#2} If the unit is not UL labeled for the specified short circuit, the contractor may submit design tests demonstrating that satisfactory short-circuit tests have been made on a switchboard of similar type of construction and of the same short-circuit rating as the switchboards specified to be furnished under these specifications.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 16410

AUTOMATIC TRANSFER SWITCH AND BY-PASS/ISOLATION SWITCH
05/99
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90.1	(1989; R 1991) IEEE Standard Surge Withstanding Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 602	(1996) Recommended Practices for Electric Systems in Health Care Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 4	(1993) Industrial Control and Systems Terminal Blocks
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA ICS 10	(1993) Industrial Control and Systems: AC Transfer Switch Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

NFPA 110	(1999) Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES (UL)

UL 1008	(1996; Rev Sep 1997) Transfer Switch Equipment
UL 1066	(1997) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

1.2 GENERAL REQUIREMENTS

1.2.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Contracting Officer's opinion, reasonably convenient to the site.

1.2.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 3 mm tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

1.3 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Drawings

Switches; FIO.

Schematic, external connection, one-line schematic and wiring diagram of each ATS assembly. Interface equipment connection diagram showing conduit and wiring between ATS and related equipment. Device, nameplate, and item numbers shown in list of equipment and material shall appear on drawings wherever that item appears. Diagrams shall show interlocking provisions and cautionary notes, if any. Operating instructions shall be shown either on one-line diagram or separately. Unless otherwise approved, one-line and elementary or schematic diagrams shall appear on same drawing.

Equipment; FIO.

Dimensioned plans, sections and elevations showing minimum clearances,

weights, and conduit entry provisions for each ATS.

SD-07 Schedules

Material, Equipment, and Fixture Lists; FIO.

List of proposed equipment and material, containing a description of each separate item.

SD-09 Reports

Tests; GA.

A description of proposed field test procedures, including proposed date and steps describing each test, its duration and expected results, not less than two weeks prior to test date.

Certified factory and field test reports, within 14 days following completion of tests. Reports shall be certified and dated and shall demonstrate that tests were successfully completed prior to shipment of equipment.

SD-13 Certificates

Equipment and Materials; FIO.

Certificates of compliance showing evidence of UL listing and conformance with applicable NEMA standards. Such certificates are not required if manufacturer's published data, submitted and approved, reflect UL listing or conformance with applicable NEMA standards.

Switching Equipment; FIO.

Evidence that ATS withstand current rating (WCR) has been coordinated with upstream protective devices as required by UL 1008. Upon request, manufacturer shall also provide notarized letter certifying compliance with requirements of this specification, including withstand current rating.

SD-19 Operation and Maintenance Manuals

Switching Equipment; FIO.

Six copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Six copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

1.4 SERVICE CONDITIONS

{AM#2}_____. ATS shall be suitable for prolonged performance

under following service conditions:

a. Altitude: 1200 m above mean sea level.

b. Relative Humidity: {AM#2} 85 percent, continuous.

c. Temperature: Minus 20 to {AM#2} 43 degrees C.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in tandby systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. {AM#2}_____. {AM#2}_____.
ATS shall have following characteristics:

a. Voltage: 480 volts ac.

b. Number of Phases: Three.

c. Number of Wires: Four.

d. Frequency: 60 Hz.

e. Poles: Three switched.

f. ATS WCR: Rated to withstand short-circuit current of 30,000 amperes, RMS symmetrical.

g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.

h. Main Contacts: Contacts shall have silver alloy composition.

2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from 0.5 to 6 seconds and factory set at 1 second. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 25 percent of nominal between any two normal source conductors and initiate transfer action to emergency source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 85 percent of

nominal.

2.1.2 Transfer Time Delay

Time delay before transfer to emergency power source shall be adjustable from 0 to 5 minutes and factory set at 0 minutes. ATS shall monitor frequency and voltage of emergency power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

2.1.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 30 minutes and factory set at 15 minutes. Time delay shall be automatically defeated upon loss or sustained under voltage of emergency power source, provided that normal supply has been restored.

2.1.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 30 minutes and shall be factory set at 15 minutes.

2.1.5 Exerciser

A generator exerciser timer is not required.

2.1.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 10 amperes at 120 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to emergency source.

2.1.7 Supplemental Features

ATS shall be furnished with the following:

a. Engine start contact.

b. Emergency source monitor.

c. Test switch to simulate normal power outage.

d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.

e. Time delay bypass switch to override return time delay to normal.

f. Manual return-to-normal switch.

g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal

starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.1.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to emergency power source, regardless of condition of normal source. If emergency source fails and normal source is available, ATS shall automatically retransfer to normal source.

2.1.10 Green Indicating Light

A green indicating light shall supervise/provide normal power source switch position indication and shall have a nameplate engraved NORMAL.

2.1.11 Red Indicating Light

A red indicating light shall supervise/provide emergency power source switch position indication and shall have a nameplate engraved EMERGENCY.

2.2 ENCLOSURE

ATS and accessories shall be installed in wall-mounted NEMA ICS 6, Type 4, smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Thermostatically controlled heater shall be provided within enclosure to prevent condensation over temperature range stipulated in paragraph SERVICE CONDITIONS. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 4 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from bottom of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external copper conductors shown.

2.2.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components. Enclosure of ATS with BP/IS shall be constructed to protect personnel from energized BP/IS components during ATS maintenance.

2.2.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.

2.3 TESTING

2.3.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

a. Insulation resistance test to ensure integrity and continuity of entire system.

b. Main switch contact resistance test.

c. Visual inspection to verify that each ATS is as specified.

d. Mechanical test to verify that ATS sections are free of mechanical hindrances.

e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

2.3.2 Factory Test Reports

Manufacturer shall provide three certified copies of factory test reports.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Contracting Officer not less than 5 working days prior to scheduled date for site testing, and shall provide certified field test reports within 2 calendar weeks following successful completion of site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.

b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.

c. Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.

d. Low phase-to-ground voltage shall be simulated for each phase of normal source.

e. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.

f. Manual and automatic ATS {AM#2}_____ functions shall be verified.

-- End of Section --

SECTION 16526

AIRFIELD LIGHTING AND VISUAL NAVIGATION AIDS
09/92
AMENDMENT NO. 0002

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 C57.12.13	(1982) Conformance Requirements for Liquid-Filled Transformers Used in Unit Installations, Including Unit Substations
ANSI C57.12.50	(1981; R 1989) Ventilated Dry-Type Distribution Transformers 1 to 500 kVA, Single-Phase: and 15 to 500 kVA, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 Volts
ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 780	(1993a) Repair of Damaged and Uncoated areas of Hot-Dipped Galvanized Coatings
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM D 709	(1992; R 1997) Laminated Thermosetting Materials
ASTM D 1248	(1984; R 1989) Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994; CS5a-1995) Cross Linked-Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825b	(1998) Approval Guide Electrical Equipment

FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev J) Obstruction Marking and Lighting
FAA AC 150/5345-3	(Rev E) L-821 Panels for (Rev E) Control of Airport Lighting
FAA AC 150/5345-5	(Rev A) Circuit Selector Switch
FAA AC 150/5345-7	(Rev D; Change 1) L-824 Underground Electrical Cable for Airport Lighting Circuits
FAA AC 150/5345-10	(Rev E) Constant Current Regulators Regulator Monitors
FAA AC 150/5345-12	(Rev C) Airport and Heliport Beacons
FAA AC 150/5345-13	(Rev A) L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits
FAA AC 150/5345-26	(Rev B; Changes 1 & 2) L-823 Plug and Receptacle, Cable Connectors
FAA AC 150/5345-27	(Rev C) Wind Cone Assemblies
FAA AC 150/5345-28	(Rev D) Precision Approach Path Indicator (PAPI) Systems
FAA AC 150/5345-42	(Rev C; Change 1) Airport Light Bases, Transformer Houses, Junction Boxes and Accessories
FAA AC 150/5345-43	(Rev E) Obstruction Lighting Equipment
FAA AC 150/5345-44	(Rev F;) Taxiway and Runway Signs
FAA AC 150/5345-45	(Rev A) Lightweight Approach Light Structure

FAA AC 150/5345-46	(Rev B) Runway and Taxiway Light Fixtures
FAA AC 150/5345-47	(Rev A) Isolation Transformers for Airport Lighting Systems
FAA AC 150/5345-51	(Basic; Change 1) Discharge-Type Flashing Light Equipment
FAA AC 150/5370-10	(Rev A; Changes 1 thru 11) Specifying Construction of Airports
FAA C-6046	(1978) Frangible Coupling Type I and Type 1A, Details
FAA E-982	(Rev H; Notice 1) PAR-56 Lampholder
FAA E-2159	(Rev D) Runway End Identifier Lighting System (REIL) with Remote Monitoring Subsystem
FAA E-2325	(Rev D) Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR)
FAA E-2628	(Rev B) Sequenced Flashing Lighting System, Elevated and Semiflush with Dimming and Monitoring
FAA E-2702	(1979) (REV A) Low Impact Resistant Structures
FAA E-2756	(1985) (REV A) Four-Box Precision Approach Path Indicator

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code
IEEE C62.11	(1998) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE STD 48	(1998) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enlcosures for Electrical Equipment (1000 volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and

	Molded Case Switches
NEMA ICS 2	(1993) Industrial Control and Systems Controller, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LA 1	(1992) Surge Arresters
NEMA PB 1	(1995) Panelboards
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) 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 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA WC 3	(1992) Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 7	(1991; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1991; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

RURAL UTILITIES SERVICE (RUS)

REA Bulletin 1753F-205 (PE-39)	(1993) REA Specification for Filled Telephone Cables

THE SOCIETY FOR PROTECTIVE COATING (SSPC)

SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - "Inorganic" and Type II - "Organic")

UNDERWRITERS LABORATORIES (UL)

UL 1	(1993; Rev thru Jan 1995) Flexible Metal Conduit
UL 6	(1997) Rigid Metal Conduit
UL 44	(1997; Rev Mar 1999) Thermoset-Insulated Wires and Cables
UL 83	(1998) Thermoplastic-Insulated Wires and Cables
UL 360	(1996; Rev thru Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 486A	(1991; Rev thru Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL-489	(1996; thru Dec 1998) Molded-Case Circuit Breakers Molded-Case Switches and Circuit-Breaker Enclosures
UL 510	(1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(1996; Rev Jul 1998)) Metallic Outlet Boxes
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL Elec Const Dir	(1998) Electrical Construction Equipment Directory

1.2 GENERAL REQUIREMENTS

Items of the same classification shall be identical including equipment, assemblies, parts, and components.

1.2.1 Code Compliance

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 and local codes where required.

1.2.2 Standard Product

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.3 Prevention of Corrosion

1.2.3.1 Metallic Materials

Metallic materials shall be protected against corrosion as specified. Aluminum shall not be used in contact with earth or concrete.

1.2.3.2 Ferrous Metal Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 123/A 123M and ASTM A 153/A 153M.

1.2.3.3 Luminaires Fabricated from Ferrous Metals

Luminaires fabricated from ferrous metals, unless hot-dip galvanized or of porcelain enamel finish shall be factory finished with a weather-resistant finish in accordance with paragraphs FACTORY COATING and FINISHING, except exposure shall be 200 hours. Finish color shall be the manufacturer's standard, unless otherwise indicated.

1.2.4 Unusual Service Conditions

Items furnished under this section shall be specifically suitable for the following unusual service conditions:

1.2.4.1 Altitude

Any equipment shall be suitable for operation up to an altitude of 1200 m.

1.2.4.2 Other

Material or equipment to be installed in handholes, manholes; orin light bases shall be suitable for submerged operation.

1.2.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.3 SYSTEM DESCRIPTION

The airfield lighting and visual navigation aids shall consist of taxiway

lights, taxiway signs and the lighting power supply and control.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Materials and Equipment; FIO.

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each itemization shall include an item number, the quantity of items proposed, and the name of the manufacturer. 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.

Protection Plan; FIO.

Detailed procedures to prevent damage to existing facilities or infrastructures. If damage does occur, the procedures shall address repair and replacement of damaged property at the Contractor's expense.

Training; FIO.

Information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules of training, two weeks before training is scheduled to begin.

Special Tools; FIO.

List of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor.

Parts List; FIO.

A list of parts and components for the system by manufacturer's name, part number, nomenclature, and stock level required for maintenance and repair necessary to ensure continued operation with minimal delays.

SD-04 Drawings

Lighting and Navigation Aids; FIO.

Coordination drawings consisting of composite drawings showing coordination of work of one trade with that of other trades and with the structural and architectural elements of the work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between the various trades.

As-Built Drawings; FIO.

Drawings that provide current factual information including deviations from, and amendments to the drawings and changes in the work, concealed and visible, shall be provided as instructed. The as-built drawings shall show installations with respect to fixed installations not associated with the systems specified herein. Cable and wire shall be accurately identified as to direct-burial or in conduit and shall locate the connection and routing to and away from bases, housings, and boxes.

SD-06 Instructions

Repair Requirements; FIO.

Instructions necessary to check out, troubleshoot, repair, and replace components of the systems, including integrated electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting after acceptance of the system shall be provided.

Posted Instructions; GA.

A typed copy of the proposed posted instructions showing wiring, control diagrams, complete layout and operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system. Proposed diagrams, instructions, and other sheets shall be submitted prior to posting.

SD-09 Reports

Test Results; FIO.

Upon completion and testing of the installed system, performance test reports are required in booklet form showing all field tests performed to adjust each component and all field tests performed to provide compliance with the specified performance criteria. Each test shall indicate the final position of controls.

Field test reports shall be written, signed and provided as each circuit or installation item is completed. Field tests shall include resistance-to-ground and resistance between conductors, and continuity measurements for each circuit. For each series circuit the input voltage and output current of the constant current regulator at each intensity shall be measured. For multiple circuits the input and output voltage of the transformer for each intensity setting shall be measured. A visual inspection of the lights operation, or of the markings appearance, or of the installation of fixtures or units installed shall be reported.

Inspection; FIO.

Inspection reports shall be prepared and provided as each stage of installation is completed. These reports shall identify the activity by contract number, location, quantity of material placed, and compliance with

requirements.

SD-13 Certificates

Qualifications; FIO.

Certifications, when specified or required, Certified Factory and Field Test Reports, and Certificates of Compliance submitted in lieu of other proofs of compliance with these contract provisions.

Materials and Equipment; FIO.

When equipment or materials are specified to conform to the standards or publications and requirements of AASHTO, ANSI, ASTM, AEIC, FM, IEEE, IES, NEMA, NFPA, or UL, or to an FAA, FS, or MS, proof that the items furnished under this section of the specifications conform to the specified requirements shall be included. The label or listing in UL Elec Const Dir or in FM P7825a, FM P7825b or the manufacturer's certification or published catalog specification data statement that the items comply with applicable specifications, standards, or publications and with the manufacturer's standards will be acceptable evidence of such compliance. Certificates shall be prepared by the manufacturer when the manufacturer's published data or drawings do not indicate conformance with other requirements of these specifications.

SD-19 Operation and Maintenance Manuals

Equipment; FIO.

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set shall be furnished prior to performance testing and the remainder shall be furnished upon acceptance. Operating manuals shall detail the step-by-step procedures required for system startup, operation, and shutdown. Operating manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include conduit and equipment layout and simplified wiring and control diagrams of the system as installed.

PART 2 PRODUCTS

2.1 MATERIALS

Equipment and materials shall be new unless indicated or specified otherwise. Materials and equipment shall be labelled when approved by Underwriters Laboratories (UL) or Factory Mutual (FM) System. Askarel and insulating liquids containing polychlorinated biphenyls (PCB's) will not be allowed in any equipment. Equipment installed below grade in vaults, manholes, and handholes shall be the submersible type.

2.1.1 Electrical Tape

Electrical tape shall be UL 510 plastic insulating tape.

2.1.2 Nameplates

Each major component of equipment shall have as a minimum the manufacturer's name, address, and catalog or style number on a nameplate securely attached to the item of equipment. Laminated plastic nameplates shall be provided for equipment, controls, and devices to identify function, and where applicable, position. Nameplates shall be 3.2 mm (1/8 in.) thick laminated cellulose paper base phenolic resin plastic conforming to ASTM D 709 sheet type, grade ES-3, white with black center core. Surface shall be a matte finish with square corners. Lettering shall be engraved into the black core. Size of nameplates shall be 25.4 by 63.5 mm (1 by 2-1/2 in.) minimum with minimum 6.4 mm (1/4 in.) high normal block lettering. Nameplates provided as indicated. Nameplates shall be fastened to the device with a minimum of two sheet metal screws or two rivets.

2.1.3 Conduit, Conduit Fittings, and Boxes

2.1.3.1 Rigid Steel or Intermediate Metal Conduit (IMC) and Fittings

The metal conduit and fittings shall be UL 6 and UL 1242, respectively, coated with a polyvinylchloride (PVC) sheath bonded to the galvanized exterior surface, nominal 1.0 mm (40 mils) thick, conforming to NEMA RN 1.

2.1.3.2 Plastic Duct for Concrete Encased Burial

These ducts shall be provided as specified in Section 16375, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.1.3.3 Frangible Couplings and Adapters

These frangible couplings shall be in accordance with FAA C-6046. Upper section of frangible coupling shall be provided with one of the following:

a. Unthreaded for slip-fitter connections.

b. 61.1 mm (2-13/32 in.) 16N-1A modified thread for nut and compression ring to secure 50 mm (2 in.) EMT.

c. 50 mm (2 in.) 11-1/2-N.P.T. (tapered) with 5.6 mm (7/32 in.) nominal wall thickness to accept rigid conduit coupling.

d. Frangible Couplings for specialized applications as approved.

e. Electrical Metallic Tubing UL 797, where indicated for use with frangible couplings and adapters.

2.1.4 Wire and Cable for Airfield Lighting Systems

a. Airfield lighting cable shall be FAA AC 150/5345-7, Type L-824, crosslinked polyethylene, Type C5000-volt cable. Series airfield lighting cable shall be unshielded.

b. Counterpoise Wire. No. 4 AWG bare stranded copper, annealed or soft drawn.

2.1.5 Cable Tags

Cable tags for each cable or wire shall be installed at duct entrances entering or leaving manholes, handholes, and at each terminal within the lighting vault. Cable tags shall be stainless steel, bronze, lead strap, or copper strip, approximately 1.6 mm (1/16 in.) thick or hard plastic 3.2 mm (1/8 in.) thick suitable for immersion in salt water and impervious to petroleum products and shall be of sufficient length for imprinting the legend on one line using raised letters. Cable tags shall be permanently marked or stamped with letters not less than 6.4 mm (1/4 in.) in height as indicated. Two-color laminated plastic is acceptable. Plastic tags shall be dark colored with markings of light color to provide contrast so that identification can be easily read. Fastening material shall be of a type that will not deteriorate when exposed to water with a high saline content and to petroleum products.

2.1.6 Ground Rods

Ground rods shall be copper-clad steel, 19.1 mm (3/4 in.) in diameter and 3.048 meters (10 feet) long, unless indicated otherwise.

2.1.7 Lightning Arresters

These lightning arresters shall be in accordance with IEEE C62.11 and IEEE C62.41 as applicable with ratings as indicated.

2.1.8 Surge Protection

Surge protection shall be metal oxide varistors (MOV) in accordance with NEMA LA 1 for power and signal circuits with ratings as recommended by the system manufacturer.

2.1.9 Cable Connectors and Splices

Cable connectors in accordance with FAA AC 150/5345-26, Item L-823 shall be used for connections and splices appropriate for FAA L-824, Type C lighting cable.

2.1.10 Transformers

2.1.10.1 Encapsulated Isolation Transformers

These transformers shall be FAA AC 150/5345-47, Type L-830. Each transformer shall be provided with rating as shown on the contract drawings.

2.1.11 Light Bases

Light bases shall be FAA AC 150/5345-42 Type L-868. Steel bases, Class 1, Size A, B, or C shall be provided as indicated or as required to accommodate the fixture or device installed thereon if diameter is not

shown.

2.1.11.1 Accessories

Base plates, cover plates, and adapter plates shall be provided to accommodate various sizes of fixtures. Bolts shall be stainless steel.

2.1.12 Constant Current Regulator

The regulator shall be FAA AC 150/5345-10, Type L-828, without monitoring system and with ratings as indicated.

2.1.12.1 Regulator Options

Regulators shall operate on 60 Hz, have internal primary switch included, have input voltage of 480 and be controlled by existing computer control system. Three brightness steps shall be provided.

2.1.12.2 Series Plug Cutouts

Series plug cutouts shall be rated for use at 5000 Volts AC. The plug cutout shall short circuit the airfield loop and regulator output when the plug assembly is removed. Install in a WEMA one lockable enclosure as shown on the plans.

2.1.13 Lamps and Filters

Lamps shall be of size and type indicated, or as required by fixture manufacturer for each lighting fixture required under this contract. Filters shall be of colors as indicated and conforming to the specification for the light concerned or to the standard referenced.

2.1.14 Lighting Fixtures

The lighting fixtures for the airfield and heliport lighting shall be as shown in the contract drawings or as required in other contract documents.

2.2 TAXIWAY LIGHTING SYSTEMS

Taxiway lighting systems shall include edge lights, guidance signs, and hold position lights and signs. These systems shall also include the associated equipment, power supplies and controls, mounting devices, and interconnecting wiring to provide complete systems as specified.

2.2.1 Taxiway Edge Lights

Taxiway edge light shall emit aviation blue light provided by filters or globes for both airfields and heliports. The edge lights shall meet the requirements of FAA AC 150/5345-46, Type L-852E, semiflush, lights.

2.2.2 Taxiway Guidance Signs

The taxiway guidance signs shall meet the requirements of FAA AC 150/5345-44, Type L-858Y for information andType L-858R for mandatory signs. The size

and information on the signs shall be as shown on contract drawings. The power supply to connect to series circuits shall be as approved by the manufacturer.

2.2.3 Hold Position Lights and Signs

The hold positions shall be marked by painted lines and signs as specified or indicated on the contract drawings. Hold position signs shall meet the requirements of FAA AC 150/5345-44, Type L-858R, with the size and information as indicated on the contract drawings.

2.3 FACTORY COATINGS

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finish shall be provided with corrosion-resistant finishes which shall withstand 200 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 in.) from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (Procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with zinc rich paint conforming to SSPC Paint 20 in accordance with ASTM A 780.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Circuits installed underground shall conform to the requirements of Section 16375, ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND, except as required herein. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. {AM#2}_____.

3.2 CABLES, GENERAL REQUIREMENTS

The type of installation, size and number of cables shall be as indicated. Conductors shall be stranded. Loads shall be divided as evenly as practicable on the various phases of the system. Maximum length of cable pull and cable pulling tensions shall not exceed the cable manufacturer's recommendations.

3.2.1 Duct Line Installation

Cables shall be installed in duct lines where indicated. Counterpoise cable shall be installed in a separate duct or direct-burial not less than _ 152.4 mm above the uppermost duct containing electrical cable. Electrical metallic tubing shall not be installed underground or enclosed in concrete.

3.2.2 Connection to Buildings

Cables shall be extended into the lighting vault as indicated, and shall be properly connected to the first applicable termination point. After

installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.3 MEDIUM-VOLTAGE CABLES

Medium-voltage cables shall be suitable for a rated circuit voltage of 5 kV. Other parts of the cable system such as joints and terminations shall have ratings not less than the rating of the cables on which they are installed. Separable insulated connectors shall have nominal voltage ratings coordinated to associated apparatus ratings rather than cable ratings when used to connect cable to apparatus. Cables shall be provided with 100 percent insulation level.

3.3.1 Types

Separable insulated connectors of suitable construction or standard splice kits shall be used for single-conductor and two-conductor cables. The connectors shall be of FAA AC 150/5345-26, L-823 type. Cable joints for which acceptable separable connector kits are not available may use cast splices if approved.

3.4 DUCT LINES

Duct lines shall be concrete-encased, thin-wall type.

3.4.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 101.6 mm per 30.48 meters. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhold, or between manholes or handholes. Manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 457.2 mm (18 in.) for ducts of less than 78 mm (3 in.) diameter, and 914.4 mm (36 in.) for ducts 7.62 mm (3 in.) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 meters (25 ft.) shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends as required, but the maximum curve shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes. In lieu of markers, a 0.127 mm (5 mil) brightly colored plastic tape not less than 76.2 mm in width and suitably inscribed at not more than 3.05 meters on centers with a continuous metallic backing and a corrosion-resistant 0.025 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 304.8 mm below finished grade levels of such lines.

3.4.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. After a duct line is completed, a standard flexible mandrel shall be used for cleaning followed by a brush with stiff

bristles. Mandrels shall be at least 304.8 mm long and shall have diameters 6.35 mm (1/4 in.) less than the inside diameter of the duct being cleaned. Pneumatic rodding may be used to draw in lead wires. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.4.3 Concrete Encasement

Each single duct shall be completely encased in concrete with a minimum of 7 6.2 mm of concrete around each duct, except that only 50.8 mm of concrete are required between adjacent electric power or adjacent communication ducts, and 101.6 mm of concrete shall be provided between adjacent electric power and communication ducts. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad crossings, tops of concrete encasements shall be not less than 457 mm below finished grade or paving. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not further apart than 1.22 meters on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 152.4 mm vertically.

3.4.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved. In the absence of specific recommendations, various types of duct joint couplings shall be made watertight as specified.

3.4.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick one-quarter-turn twist to set the joint tightly.

3.5 MANHOLES AND HANDHOLES

The manholes and handholes shall be as specified in Section 16375ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.6 WELDING

The welding of supports and metallic ducts and welding or brazing of electrical connections shall be formed by qualified welders.

3.7 CABLE MARKERS

Cable markers or tags shall be provided for each cable at duct entrances

entering or leaving manholes or handholes and at each termination within the lighting vault. Cables in each manhole or handhole shall have not less than two tags per cable, one near each duct entrance hole. Immediately after cable installation, tags shall be permanently attached to cables and wires so that they cannot be accidentally detached.

3.8 FRANGIBLE REQUIREMENTS

Frangible supports, couplings, and adapters shall be installed as indicated or specified.

3.9 SEMIFLUSH AIRFIELD LIGHTS

Water, debris, and other foreign substances shall be removed prior to installing semiflush light base and light. Positioning jigs shall be used to hold the light bases and/or lights to ensure correct orientation and leveling until the concrete, adhesive, or sealant can provide permanent support.

3.10 SPLICES FOR AIRFIELD LIGHTING CABLE

3.10.1 Connectors

Kit type connectors, FAA AC 150/5345-26, Item L-823, shall be used to splice 5 kV single-conductor series lighting cables. During installation , mating surfaces of connectors shall be cleaned and covered until plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint. Connector installation shall conformto FAA AC 150/5345-26.

3.11 GROUNDING SYSTEMS

3.11.1 Counterpoise Installation

Counterpoise wire shall be laid for entire length of circuits supplying airfield lighting. Wire shall be in one piece, except where distance exceeds the length usually supplied. Counterpoise shall be installed on top of the envelope of concrete-encased duct . Where trenches or duct lines intersect, counterpoise wires shall be electrically interconnected by exothermic welding or brazing. Counterpoise to earth ground shall be connected at every 600 meters of cable run, at lighting vault, and at feeder connection to light circuit by means of ground rods as specified. Counterpoise shall be installed in a separate duct under roads, railroads, and paved areas above the highest duct containing electrical or communications circuits.

3.11.2 Light Base

Steel light bases or grounding bushings on steel conduits shall be connected to the counterpoise system.

3.12 ISOLATION TRANSFORMERS

Transformer lead connections shall conform to FAA AC 150/5345-26. Transformer secondary connectors shall plug directly into a mating connector on the edge light secondary leads. During installation, mating surfaces of connectors shall be clean and covered until plugged together. At joint where connectors come together, heat shrinkable tubing shall be installed with waterproof sealant or with two half-lapped layers of tape over the entire joint. Joint shall prevent entrapment of air which might subsequently loosen the joint.

3.13 TAXIWAY LIGHTING SYSTEMS

3.13.1 Runway and Taxiway Edge Lights

Edge lights shall be semiflush type as indicated on the contract drawings and each light supplied power through an isolation transformer. The taxiway lights shall be omnidirectional and only require leveling.

3.14 FIELD QUALITY CONTROL

The Contracting Officer shall be notified five working days prior to each test. Deficiencies found shall be corrected and tests repeated.

3.14.1 Operating Test

Each completed circuit installation shall be tested for operation. Equipment shall be demonstrated to operate in accordance with the requirements of this Section. One day and one night test shall be conducted for the Contracting Officer.

3.14.2 Distribution Conductors, 600-Volt Class

Test shall verify that no short circuits or accidental grounds exist using an instrument which applies a voltage of approximately 500 volts providing a direct reading in resistance.

3.14.3 Counterpoise System Test and Inspection

Continuity of counterpoise system shall be visually inspected at accessible locations. Continuity of counterpoise system to the vault grounding system shall be tested in manhole closest to the vault.

3.14.4 Electrical Acceptance Tests

Acceptance tests shall be performed for series lighting circuits only on complete lighting circuits. Each series and multiple lighting circuit shall receive a high voltage insulation test.

3.14.4.1 Low-Voltage Continuity Tests

Each series circuit shall be tested for electrical continuity. Faults indicated by this test shall be eliminated before proceeding with the high-voltage insulation resistance test.

3.14.4.2 High-Voltage Insulation Resistance Tests

Each series lighting circuit shall be subjected to a high-voltage insulation resistance test by measurement of the insulation leakage current with a suitable high-voltage test instrument which has a steady, filtered direct current output voltage and limited current. High-voltage tester shall include an accurate voltmeter and microammeter for reading voltage applied to the circuit and resultant insulation leakage current. Voltages shall not exceed test values specified below.

a. Test Procedure: Both leads shall be disconnected from regulator output terminals and support so that air gaps of several inches exist between bare conductors and ground. Cable sheaths shall be cleaned and dried for a distance of 300 mm from ends of cables and exposed insulation at ends of cables. Ends of both conductors of the circuit shall be connected together and to high-voltage terminals of test equipment, and test voltage applied as specified in the following tabulation between conductors and ground for a period of 5 minutes.

	Test Voltage, dc	
Series Lighting Circuits	First Test on New Circuits	Test on Existing Circuits
Medium Intensity Series Lighting Circuits (5,000 volt leads, 30/45 watt transformers)	6000	3000
600-Volt Circuits	1800	600

b. Leakage Current: Insulation leakage current shall be measured and recorded for each circuit after a 1 minute application of the test voltage. If leakage current exceeds values specified below, the circuit shall be sectionalized and retested and the defective parts shall be repaired or replaced. Leakage current limits include allowances for the normal number of connectors and splices for each circuit as follows:

(1) Three microamperes for each 300 meters of cable.

(2) Two microamperes for each 200 watt and each 500 watt 5,000-volt series transformer.

(3) Two microamperes for each 30/45-Watt 5,000 volt series transformer.

If measured value of insulation leakage current exceeds calculated value, the circuit shall be sectionalized and tested as specified for each section. Defective components shall be repaired or replaced until repeated

tests indicate an acceptable value of leakage current for the entire circuit.

3.14.5 Constant Current Regulators

Each constant current regulator shall be examined to ensure that porcelain bushings are not cracked, no shipping damage has occurred, internal and external connections are correct, switches and relays operate freely and are not tied or blocked, fuses, if required, are correct, and liquid level of liquid-filled regulators is correct. Relay panel covers shall be removed only for this examination; it is not necessary to open the main tank of liquid-filled regulators. The instructions on the plates attached to the regulators shall be followed. Covers shall be replaced tightly after completing examinations and tests.

3.14.6 Regulator Electrical Tests

Supply voltage and input tap shall correspond. With the loads disconnected, regulator shall be energized and the open circuit protector observed to ensure that it de-energizes the regulator within 3 seconds. After testing circuits for open circuit and ground fault and corrections, if any, and after determining that lamps are serviceable and in place, the loads shall be connected for each circuit or combination of circuits to be energized by the regulator and the voltage and current measured simultaneously for each brightness tap. Voltmeter and ammeter shall have an accuracy of plus or minus 1 percent of meter full scale. Readings shall be recorded during the day and night in order to obtain the average supply voltage. Output current on each brightness tap shall be within plus or minus 2 percent full scale of the nameplate values after making necessary correction in the supply voltage. Late model regulators have automatic supply voltage correction in lieu of input taps, and output current does not change as supply voltage varies. When output current on highest intensity setting deviates from nameplate value by more than 2 percent of meter full scale and the regulator is not overloaded, internal adjustment shall be checked as described on regulator instruction plate. Since adjustment may be rather delicate, a deviation of up to plus or minus 5 percent of meter full scale is allowed for lower intensity settings before attempting to readjust the regulator.

3.14.7 Final Operating Tests

After completion of installations and the above tests, circuits, control equipment, and lights covered by the contract shall be demonstrated to be in acceptable operating condition. Taxiway lighting circuit shall be switched on and off at least twice from the touch screen in the control tower. During this process, lights and associated equipment shall be observed to determine that each selection properly controls the corresponding circuit. Telephone or radio communication shall be provided between the operator and the observer. Tests shall be repeated from the alternate control station, from the remote control points, and again from the local control switches on the regulators. Each lighting circuit shall be tested by operating the lamps at maximum brightness for not less than 30 minutes. At the beginning and at the end of this test the correct number of lights shall be observed to be burning at full brightness. One day and

one night operating test shall be conducted for the Contracting Officer.

3.15 FINISHING

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as required in Section 09900 PAINTING, GENERAL.

-- End of Section --

SECTION 16528

EXTERIOR LIGHTING INCLUDING SECURITY APPLICATIONS
02/95
AMENDMENT NO. 0002

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 basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-3	(1994) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide Lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Metal-Halide Lamps
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C119.1	(1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C78.1352	(1990) Electric Lamps 1000 Watt, 480 Volt, 852 Single Ended High Pressure Medium Lamps
ANSI C136.2	(1996) Luminaires, Voltage Classification Roadway Lighting Equipment
ANSI C136.3	(1995) Roadway Lighting Equipment-Luminaire Attachments
ANSI C136.6	(1997) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies - Mechanical and Optical Interchangeability

ANSI C136.9	(1990) Roadway Lighting - Socket Support Assemblies for Use in Metal Heads - Mechanical Interchangeability
ANSI C136.10	(1996) Roadway Lighting- Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
ANSI C136.15	(1986) Roadway Lighting, High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaires -

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 575	(1996) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 2	(1994) Medium-Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(1983; R 1993) Roadway Lighting

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 9	(1990) Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 44	(1997; Rev Mar 1999) Rubber-Insulated Wires and Cables
UL 98	(1994; Rev thru Jun 1998) Enclosed and Dead-Front Switches
UL 467	(1993; Rev Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997; Rev thru Dec 1998) Wire Connectors

	and Soldering Lugs for Use with Copper Conductors
UL 514B	(1996; R Oct 1998) Fittings for Conduit and Outlet Boxes
UL 651	(1995; Rev thru Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 870	(1995; Rev Jun 1998) Wireways, Auxiliary Gutters, and Associated Fittings
UL 1029	(1994; Rev thru Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1449	(1996; Rev thru Oct 1998) Transient Voltage Surge Suppressors
UL 1571	(1995; Rev thru Jun 1997) Incandescent Lighting Fixtures
UL 1572	(1995; Rev thru Jun 1997) High Intensity Discharge Lighting Fixtures

1.2 SYSTEM DESCRIPTION

1.2.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.2.2 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.2.3 Power Line Surge Protection

Transient voltage surge suppressors shall be provided for all electronic equipment. Surge suppressors shall meet the requirements of IEEE C62.41, and be UL listed as having been tested in accordance with UL 1449. Surge suppressor ratings shall be as indicatedFuses shall not be used as surge suppression.

1.2.4 Interface Between Lighting System and Power Distribution

Conductors shall be as indicated.

1.2.5 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.2.6 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.2.7 Unusual Service Conditions

Equipment and materials furnished under this section shall be suitable for the following unusual service conditions: altitude 1190 m.

1.2.8 Protection of Security Lighting System Components

1.2.8.1 Components and Conductors

Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed in raceways or by means of concrete encased duct as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire guards shall be provided to protect security lighting luminaries mounted below 6.1 m. A NEMA ICS 6, Type 4 enclosure shall house exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors. Where only one piece of equipment is being provided at a location, the equipment shall be provided with its own enclosure.

1.3 CORROSION PROTECTION

1.3.1 Aluminum Materials

Aluminum shall not be used in contact with earth or concrete. Aluminum conductors shall not be used.

1.3.2 Ferrous Metal Materials

1.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

1.3.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 120 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark.

The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Equipment and Materials; FIO.

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

Spare Parts; FIO.

Spare parts data for each item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

SD-04 Drawings

Lighting System; GA.

Detail drawings for the complete system and for poles,lighting fixtures, bracket arms, cable boxes, handholes, controllers, fuse and transient voltage suppressors. Detail drawings for precast handholes shall include a design analysis to determine that strength is equivalent to indicated cast-in-place concrete handholes. Drawings shall indicate bonding method for concrete encasement.

As-Built Drawings; FIO.

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

Operating Test; GA.

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Ground Resistance Measurements; FIO.

The measured resistance to ground of each separate grounding installation, indicating the location of the rods, the resistance of the soil in ohms per millimeter and the soil conditions at the time the measurements were made. The information shall be in writing.

SD-19 Operation and Maintenance Manuals

Lighting System; FIO.

A draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 BRACKET ARMS

2.2.1 On Aluminum, Steel, Fiberglass, and Concrete Poles

Poles shall be provided with bracket arms of the support arm style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.2.2 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.3 CABLE

The Contractor shall provide all wire and cable not indicated as government furnished equipment. Wire and cable components shall be able to withstand the jobsite environment for a minimum of 20 years.

2.3.1 Insulated Cable

Cable shall be type USE conforming to UL 854, with copper conductors and type RHW or XHHW insulation conforming to UL 44, and shall include green ground conductor. Cable shall be rated 600 volts. Parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors shall be stranded.

2.3.2 Bare Copper Conductors

Medium-hard-drawn copper conductors shall conform to ASTM B 2 and ASTM B 8.

2.4 CABLE SPLICES AND CONNECTORS

Cable splices and connectors shall conform to UL 486A. Underground splices and connectors shall also conform to the requirements of ANSI C119.1.

2.5 CABLE BOXES

Boxes and covers shall be made of cast iron with zinc coated or aluminized finish, and shall be of the sizes indicated on drawings. The minimum inside dimensions shall be not less than 304.8 mm (12 inches) square by 152.4 mm (6 inches) deep and not less than required to house the cable splice. A suitable gasket shall be installed between the box and cover for watertightness. A sufficient number of screws shall be installed to hold the cover in place along the entire surface of contact. Grounding lugs shall be provided.

2.6 MANHOLES, HANDHOLES, AND PULLBOXES

Frames and gratings, or frames and covers shall be ductile iron, meeting the requirements of ASTM A 536 with tensile strength not less than Class 35. Shape and size shall be as indicated. Each casting, frame and cover shall be capable of withstanding a minimum working load of 1,793 kPa over a 140,000 square millimeter contact area. The minimum factor of safety shall be 2.5. Working load testing shall be in accordance with federal specification RR-R-621C. Results of proof loads shall be submitted.

2.7 CONDUIT, DUCTS AND FITTINGS

2.7.1 Conduit, Rigid Steel

Rigid steel conduit shall conform to ANSI C80.1 and UL 6.

2.7.2 Conduit Fittings and Outlets

2.7.2.1 Boxes, Metallic Outlets

NEMA OS 1 and UL 514A.

2.7.2.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.7.2.3 Boxes, Switch (Enclosed), Surface Mounted

UL 98.

2.7.2.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.7.2.5 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.7.3 Non-Metallic Duct

Non-metallic duct lines and fittings utilized for underground installation shall be suitable for the application. Duct shall be thick-wall, single, round-bore type. Material of one type shall be used. Acrylonitrile-butadiene-styrene (ABS) duct shall conform to NEMA TC 6and NEMA TC 9. High-density conduit shall conform to UL 651A. Schedule 40 polyvinyl chloride (PVC) shall conform to UL 651. Plastic utility duct and fittings manufactured without a UL label or listing shall be provided with a certification as follows: "The materials are suitable for use with 75 degree C (167 degrees F) wiring. No reduction of properties in excess of that specified for materials with a UL label or listing will be experienced if samples of the finished product are operated continuously under the normal conditions that produce the highest temperature in the duct."

2.8 GROUND RODS

Ground rods shall be of copper clad steel conforming to UL 467 not less than 19.1 mm in diameter by 3.1 m in length, driven full length into earth.

2.9 POLES

Metal {AM#2}_____ poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of 40.2 meters per second (90 mph) 144.7 kmh at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding

connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.9.1 Aluminum Poles

Aluminum poles and brackets for roadway and perimeter security lighting shall have a uniform satin finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

a. Shafts shall be round and of seamless construction. The wall thickness shall be at least 4.8 mm (0.188 in). Exterior surfaces shall be free of protuberances, dents, cracks, and discoloration. Material for shafts shall be 6063 aluminum alloy; after fabrication, the alloy shall have a T6 temper. Tops of shafts shall be fitted with a round or tapered cover. Bases shall be anchor bolt mounted, made of cast aluminum alloy 356-T6, and shall be machined to receive the lower end of shafts. Joints between shafts and bases shall be welded. Bases shall be provided with four holes, spaced 90 degrees apart, for anchorage.

b. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

2.9.2 Steel Poles

Steel poles shall be hot-dip galvanized in accordance with ASTM A 123/A 123M and shall not be painted. Poles shall have tapered tubular members, either round in cross-section or polygonal. Pole shafts shall be no more than three pieces. Pole markings shall be approximately 900 to 1270 mm above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are required. Include climber's safety cable. Bases shall be of the anchor bolt-mounted type. Poles shall be as indicated in the contract drawings.

2.9.3 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.10 POLE LINE HARDWARE

Zinc coated hardware shall conform to ANSI C135.1 and ANSI C135.14, and steel hardware material shall conform to ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.11 ELECTRICAL ENCLOSURES

The Contractor shall provide metallic enclosures as needed to house the

lighting equipment. Enclosures shall conform to NEMA ICS 6 and NEMA 250. Enclosures shall be provided with lockable or padlock handles. Keys for lockable enclosures shall be delivered to the Contracting Officer. The enclosures shall be as specified or as shown on the drawings.

2.11.1 Interior Enclosures

Enclosures to house lighting equipment in an interior environment shall meet the requirements of a NEMA 12 enclosure as defined in NEMA 250.

2.11.2 Exposed-to-Weather Enclosures

Enclosures to house lighting equipment in an outdoor environment shall meet the requirements of a NEMA 4 enclosure as defined in NEMA 250.

2.12 ILLUMINATION

2.12.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for general area lighting shall be in accordance with sheets 3 and 30 of Standard Detail No. 40-06-04, attached to these specifications. Fixtures illustrated on the drawings are indicative of the general type desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, and equal finish and quality will be acceptable. To minimize glare, when installed, the apron flood lighting fixtures shall have a maximum candela of 30 per 1000 lumens at 0 degrees horizontal and 85 degrees vertical. For approval of apron floodlighting fixtures other than those indicated in the drawings the contractor must submit floodlighting calculations and lux plot (point by point method) demonstrating the design meets the following criteria; loading areas shall receive at least 21.52 lux in the horizontal plane and all other apron areas shall receive at least 10.76 lux. The ratio of maximum illumination to minimum illumination shall not exceed 5 to 1.

2.12.2 Roadway Lighting

Luminaires, ballasts, lamps, and control devices required for roadway lighting shall be

2.12.3 Apron Lighting

Luminaires, ballasts, lamps, control devices and accessories required for Apron Flood Lighting shall be as detailed in the contract drawings.

2.13 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

2.13.1 High Pressure Sodium

Lamps shall conform to [ANSI C78.1350] [or ANSI C78.1351] [or ANSI C78.1352] [or ANSI C78.1355]. Ballasts shall conform to ANSI C82.4, or UL 1029. High pressure sodium lamps shall be clear.

2.13.2 Metal-Halide

Lamps shall be made by a manufacturer with not less than 5 years experience in making metal-halide lamps. Metal-halide lamps shall conform to ANSI C78.1375 or ANSI C78.1376. Ballasts shall conform to ANSI C82.4 or UL 1029.

2.14 LAMPS, INCANDESCENT

Incandescent lamps shall conform to UL 1571 and shall be rated for 12O volt operation unless otherwise specified.

2.15 LAMPS, FLUORESCENT

Fluorescent lamps shall have standard cool-white color characteristics and shall not require starter switches. The lamps shall be of the rapid-start type.

2.16 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.17 LIGHTING CONTROL EQUIPMENT

2.17.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 5.4 to 53.8 lux. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

2.17.2 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.17.3 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for 480 volts, 3 phase, 60 Hz. Coil voltage shall be 120 volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

2.18 LUMINAIRES, FLOODLIGHTING

2.18.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1572. Incandescent lighting fixtures shall conform to UL 1571.

2.18.2 Fluorescent

Fluorescent lamps shall conform to ANSI C78.1.

2.19 FIXTURES

Standard fixtures shall be as detailed on Standard Detail No. 40-06-04, Sheet Nos. 3 and 30 which accompany and form a part of this specification. Other fixtures shall be as indicated on the drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

2.19.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.19.2 In-Line Fuse

An in-line fuse shall be provided for each fixture, and shall consist of a fuse and a UL approved waterproof fuse holder rated as indicated, with insulated boots. Fuse rating shall be as indicated.

2.20 {AM#2} AIR TERMINALS

{AM#2} Terminals shall be installed on the 36.6m floodlight poles. They shall be installed in accordance with UL 96 and NFPA 780. The tip of the air terminals shall be a minimum of 0.6 m above the tallest pole feature. Air terminals shall be rigidly connected to, and electrically bonded to the pole.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the

design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government. The Contractor shall not take any corrective action without written permission from the Government.

3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.3 PREVENTION OF CORROSION

3.3.1 Aluminum

Aluminum shall not be used in contact with earth or concrete, and where connected to dissimilar metal, shall be protected by approved fittings and treatment.

3.3.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 254 micrometers (0.010 inch) thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 CABLE INSTALLATION

Cable and all parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors shall be stranded. Each circuit shall be identified by means of fiber or nonferrous metal tags, or approved equal, in each handhole and junction box, and at each terminal.

3.4.1 Splices

Splices below grade shall be made with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Splices above grade shall be made with sealed insulated pressure

connectors and shall provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, jackets shall be cut back to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.4.2 Installation in Duct Lines

Ground and neutral conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and size of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short radius manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) for ducts of less than 80 mm (3 inches) in diameter, and 900 mm (36 inches) for duct 80 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m (25 feet) shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and shall match factory tapers. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70 . Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad and airfield crossings, tops of concrete encasements shall not be less than the cover requirements listed in NFPA 70. At railroad and airfield crossings, duct lines shall be encased with concrete and reinforced as indicated to withstand specified surface landings. Tops of concrete encasement shall not be less than 1.5 m below tops of rails or airfield paving unless otherwise indicated. Where ducts are jacked under existing pavement, rigid steel conduit shall be installed. To protect the corrosion-resistant

conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 15 m in length, the predrilling method or the jack-and-sleeve method shall be used. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not more than 1.2 m on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete, and joints shall be staggered at least 150 mm vertically.

3.5.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendation for the particular type of duct and coupling selected and as approved.

3.5.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4 turn to set the joint tightly.

3.5.5 Concrete

Concrete work shall be as specified in Section 03307 CONCRETE FOR MINOR STRUCTURES. Concrete shall be plain, 17 MPa at 28 days, except that reinforced concrete shall be 21 MPa at 28 days. Duct line encasement shall be of monolithic construction. Where a connection is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

3.5.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other duct locations that are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.6 HANDHOLES

The exact locations shall be determined after carefully considering the locations of other utilities, grading, and paving. Exact locations shall be approved before construction is started.

3.6.1 Construction

Handholes shall be constructed as indicated on drawings, including appurtenances. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic construction. Concrete

shall be 21 MPa at 28 days. Precast concrete handholes having the same strength and inside dimensions as cast-in-place concrete handholes may be used. In paved areas, the top of entrance covers shall be flush with the finished surface of the paving. In unpaved areas, the top of entrance covers shall be approximately 15 mm above the finished grade. Where finished grades are in cut areas, unmortared brick shall be installed between the top of handhole and entrance frame to temporarily elevate the entrance cover to existing grade level. Where duct lines enter walls, the sections of duct may be cast in the concrete or may enter the wall through a suitable opening. The openings around entering duct lines shall be caulked tight with lead wool or other approved material.

3.6.2 Appurtenances

The following appurtenances shall be provided for each handhole.

3.6.3 Cable Pulling-In Irons

A cable pulling-in iron shall be installed in the wall opposite each duct line entrance.

3.6.4 Ground Rods

In each handhole, at a convenient point close to the wall, a ground rod conforming to paragraph GROUNDING shall be driven into the earth before the floor is poured; approximately 100 mm of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor; a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall.

3.7 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of 9.1 m (30 feet) 36.6 m (120 feet). Luminaire mounting height may be increased by the height of the transformer base where required. Electrical cabling shall be provided to the light pole as specified in Section 2.3. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Light poles shall not be installed outside the site or inside the perimeter zone. Security system light poles shall be installed inside the secure area. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

3.7.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. Pole brackets for floodlights shall have the number of tenons indicated. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

3.7.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03307 CONCRETE FOR MINOR STRUCTURES. Concrete shall be 21 MPa at 28 days. Anchor bolts shall be designed and supplied by the pole manufacturer.

3.7.3 Aluminumand Steel Pole Installation

Poles shall be mounted on cast-in-place foundations. Conduit elbows shall be provided for cable entrances into pole interiors.

3.7.3.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03307 CONCRETE FOR MINOR STRUCTURES. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufactures standard, and not less than necessary to meet the pole wind loading and other specified design requirements.

3.8 LIGHTING

3.8.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.8.2 Fixture Installation

Standard fixtures shall be installed as detailed on Standard Detail No. 04-06-04, Sheet Nos. 3 and 30, which accompany and form a part of this specification. Special fixtures shall be as indicated on drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light-distribution and brightness characteristics, and equal finish and quality will be acceptable as approved.

3.8.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

3.8.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

3.9 LIGHTING CONTROL SYSTEM

3.9.1 Photo-Control

Lighting luminaires shall be individually controlled by photo-control elements mounted on the heads of the luminaires.

3.9.2 Manual and Safety Switches

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.9.3 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed. Magnetic contactors shall be electrically operated and mechanically held.

3.10 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following. Grounding conductors shall be soft-drawn, stranded copper. Ground rods shall be driven into the earth so that after the installation is complete, the top of the ground rod will be approximately 300 mm below finished grade, except in handholes. Butt grounds shall not be used.

3.10.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes shall be up to three, 3.1 m long rods spaced a minimum of 3.1 m apart 19.1 mm in diameter, driven perpendicular to grade . In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.10.2 Items to be Grounded

Ground conductors, metallic conduits, junction boxes, and noncurrent-carrying metallic parts of equipment shall be grounded. Connections above grade shall be made with solderless connectors, and those below grade shall be made by a fusion-welding process.

3.10.3 Lighting Pole

One ground rod shall be provided at each pole. Bases of metal or concrete lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire.

3.10.4 Handhole

In each handhole, at a convenient point close to the wall, a ground rod shall be driven into the earth before the floor is poured, and approximately 100 mm of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor, and a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall. Connection to ground rods shall be by means of bolted-clamp terminals or by an approved fusion-welding process. Ground wires shall be neatly and firmly attached to handhole walls, and the amount of exposed bare wire shall be held to a minimum.

3.11 TESTS

3.11.1 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power. The following criteria shall be met for overhead lighting of the apron; all areas designated loading areas shall be illuminated to a minimum of 21.52 lux in the horizontal plane, and all other apron areas shall be lit to a minimum of 10.76 lux in the horizontal plane. The ratio of maximum illumination to minimum illumination shall not exceed 5. For lighting purposes taxiways are not considered part of the apron. IESNA survey procedures for outdoor measurements shall be followed. Lamps shall be operated for at least one hour to ensure normal stable operating conditions before measurements are made. Areas to be measure shall be divided into sections equal to 5% of their total area and measurements made at the center of each of these sections.

3.11.2 Ground Resistance Measurements

The resistance to ground shall be measured by the fall-of-potential method described in IEEE Std 81.

The Contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "as-built" drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the lighting system. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the as-built drawings, a representative of the Government will review the

as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and shall complete the work as required.

-- End of Section --