

THE DISTRICT BOARD OF TRUSTEES OF
PENSACOLA JUNIOR COLLEGE, FLORIDA
1000 COLLEGE BOULEVARD
PENSACOLA, FL 32504-8998

February 28, 2006

BID NO. 17, 2005/2006

**INVITATION TO BID (ITB) ON STANDBY GENERATOR SYSTEM FOR WSRE-TV
AND
PENSACOLA JUNIOR COLLEGE**

The District Board of Trustees of Pensacola Junior College, Florida hereby extends an Invitation To Bid (ITB) on Standby Generator System for WSRE-TV and Pensacola Junior College, as specified in this bid request.

All terms and conditions included hereafter are part of this bid request. Any bid failing to comply with all of these terms and conditions may not be accepted. Rights are reserved to reject any and all bids and to waive any and all technicalities.

Directions for submitting bids include the following:

1. **All bids must be mailed or delivered to the attention of the Director of Purchasing and Auxiliary Services, and be received in the Purchasing and Auxiliary Services Office, Pensacola Junior College, Building 7, Room 737, 1000 College Boulevard, Pensacola, Florida 32504-8998, or delivered to the bid opening site, not later than 2:00 P.M., local time, Tuesday, March 21, 2006 and shall be clearly marked "SEALED ITB NO. 17, 2005/2006 – Standby Generator System for WSRE-TV and Pensacola Junior College. Due to the requirement of sealed bidding, facsimile bids will not be acceptable as valid bid responses. All bids shall be submitted on the bid form, herein included, and shall be properly signed by an authorized representative of the firm or entity submitting the bid, with delivery or completion date clearly indicated, in order to be considered. Attach all amplifying instructions and documents to this bid form. In the event that you are unable to submit a bid, written notification should be submitted to the Purchasing and Auxiliary Services Office in order for your firm's name to remain on the mailing list.**

An evaluation committee meeting, in accordance with FS 286.011(1), is scheduled to be held on **Thursday, March 23, 2006, at 9:00 A.M.** in the Barfield Administration Building No. 7, Room 737, 1000 College Boulevard, Pensacola, Florida 32504-8998. Bid tabulations and award recommendations will be posted in the Purchasing Department, Pensacola Junior College. Posting normally occurs within 10 days of bid opening date.

2. A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not submit a bid on a contract to provide any goods or services to a public entity, may not submit a bid on a contract with a public entity for the construction or repair of a public building or public work, may not submit bids on leases of real property to a public entity, may not be awarded or perform work as a contractor, supplier, subcontractor, or consultant under a contract with any public entity, and may not transact business with any public entity in excess of the threshold amount provided in F.S. 287.017, for CATEGORY TWO for a period of 36 months from the date of being placed on the convicted vendor list.
3. Any person(s) requiring reasonable accommodations, in accordance with the provisions of the American With Disabilities Act for attendance at the scheduled bid opening shall contact the Office of the Director of Purchasing and Auxiliary Services, at least seventy-two (72) hours in advance of the scheduled bid opening deadline as indicated on Page 1, herein.
4. Price, quality, specifications and time of guaranteed delivery will be the determining factors in the award of the bid.
5. All prices shall be firm until order is placed, unless otherwise specified herein or indicated by bidder.
6. **Bid prices shall be as follows: Item No. 1 - FOB 1295 West Fairfield Drive, Pensacola, FL, 32501. Item No. 2 – FOB 26567 Ernest Patterson Road, Robertsdale, AL, 36557-4331.**
7. Failure to file a protest within the time prescribed in F.S. 120.57(3), or failure to post the bond or other security as required by F.S. 287.042(2)(c) shall constitute a waiver of proceedings under Chapter 120, Florida Statutes. All protests must be delivered to the Director of Purchasing & Auxiliary Services, Pensacola Junior College, 1000 College Blvd., Pensacola, FL. 32504 within the time prescribed in Chapter 120, Florida Statutes to be considered valid.
8. Unless otherwise indicated herein, when manufacturer's names, trade names, and/or catalog numbers are listed in a specification, they are provided for information and are not intended to limit competition. The bidder may offer any brand for which he/she is an authorized representative which meets or exceeds the specification(s) for any item(s). If equivalent products are offered, the manufacturer's name and model number shall be clearly indicated on the bid form. Any item(s) offered as equivalent to that which is specified must be equivalent in quality of materials, workmanship, and effect and shall be corresponding in function and performance. Descriptive literature and/or complete specifications shall be included for any item(s) offered as approved equivalent(s). Bids lacking any written indication of intent to bid an alternate product or brand will be considered to be in complete compliance with the specifications of the bid form. Pensacola Junior College shall retain the right to determine the acceptability of any item(s) offered as equivalent to any item(s) specified.
9. In the event of an error in extending the total cost of any item, the unit price submitted will prevail.

10. **With the consent and agreement of the successful bidder(s)** purchases may be made under this ITB by other community colleges, state universities, district school boards and by other educational institutions within the state of Florida. Such purchases shall be governed by the same terms and conditions stated in the proposal solicitation as provided in State Board of Education Rule 6A14.0734(2) (c). If the period of time is not defined within the solicitation, the prices, terms and conditions shall be firm for 120 days from the date of award. Bidders shall note exceptions to the above paragraph, if any.
11. Bids may be awarded or rejected, item-by-item, in sub-group(s) or in whole, at the discretion of Pensacola Junior College.
12. Any award on the basis of this bid will be contingent upon approval by The District Board of Trustees of Pensacola Junior College, Florida, and the terms of the contract to be negotiated with the successful bidder.
13. Insurance: The successful bidder shall provide appropriate insurance as indicated hereafter:
 - (a) Valid workmen's compensation insurance as required by Chapter 440, Florida Statutes;
 - (b) General public liability insurance against bodily injury, personal injury, and property damages, in limits of not less than \$1,000,000.00 per claimant, and \$3,000,000.00 per incident or occurrence. The District Board of Trustees, Pensacola Junior College, Florida shall be named as an additional insured on the contractor's policy.
 - (c) Automotive liability insurance against bodily injury and property damage, in at least the amounts of \$1,000,000.00 per claimant, and \$2,000,000.00 per occurrence.
 - (d) Certificates evidencing that all of the previously listed insurance is in force shall be forwarded to the Purchasing and Auxiliary services office prior to any work beginning. The Certificate of General Public Liability Insurance shall list The District Board of Trustees, Pensacola Junior College, Florida, as additional insured.

We look forward to your participation in submitting a proposal for consideration. Any questions or concerns should be addressed to the Director, Purchasing and Auxiliary Services at (850) 484-1794.

Angie C. Jones
Director of Purchasing
and Auxiliary Services

ITEM	QTY./UNIT	DESCRIPTION/SPECIFICATIONS	TOTAL PRICE
1.	1 Lot	Standby Generator System as listed herein and the drawing enclosed. This system is for the transmitter site located at 1295 West Fairfield Drive, Pensacola, Florida, 32501. * _____ Brand and Model Offered	_____
2.	1 Lot	Standby Generator System as listed herein and the drawing enclosed. This system is for the transmitter site located at 26567 Ernest Patterson Road, Robertsdale, Alabama 36567-4331. Price shall include all applicable taxes. * _____ Brand and Model Offered	_____
3.	1 Lot	Less discount if awarded both locations.	(_____)
GRAND TOTAL			_____

***If bidding other than specified, as listed herein, provide full detailed specifications on the item you are bidding and submit with your bid. Failure to provide these specifications may result in the rejection of your bid.**

MATERIALS REQUIRED FOR COMPLETE SYSTEM AS LISTED ABOVE

Diesel Engine Driven Generator, Kohler Model 230REOZJB, or an approved equal.

Rated - 230kW Voltage - 277/480 Phase – 3 Wire – 4 Hertz – 60

Dec-3+ 16 Light Controller

- Remote Serial Annunciator
- Remote Emergency Stop Switch
- Run Relay
- Failure Relay
- Local Emergency Stop Button
- Pre-Alarm Senders
 - Anticipatory Low Oil Pressure
 - Anticipatory High Water Temperature
 - Low Water Temperature

Weather Housing Complete with

- Critical Silencer
- Tail Pipe and Rain Cap

Fuel System

- 425 Gallon Double Wall Subbase Fuel Tank
 - Emergency Pressure Relief
 - Inner Tank Leak Alarm
 - 2" Locking Fill Cap
 - Normal Vent Kit
 - Low Fuel Level Alarm
 - Flexible Fuel Lines

Engine and Generator Accessories

- Starting Batteries
 - Battery Rack and Cables
- Battery Charger, Equalize/Float Type with Alarms, 24V, 10 Amp
- Block Heater, 240 V
- Safeguard Breaker
- Line Circuit Breaker, 350 Amp, 3 Pole

Automatic Transfer Switch

Kohler Model KCT-AMTC-0400S, or an approved equivalent

- 400 Amp, 480 V, 3 Pole, 3 Phase, 4 Wire, NEMA-36
- Microprocessor Controller
- Real-time Clock
- Broad-range Voltage Sensing (208-600VAC) with 2% Accuracy
- Frequency Sensing with 1% Accuracy on Both Sources
- Environmentally Sealed User Interface
- Keypad with Tactile Feedback Pushbuttons
- LED Indicators
- Selectable Operating Modes
- Programmable Inputs and Outputs
- Load / No Load Exercise Function
- In-phase Monitor
- Anti-single Phasing Protection
- Load Control Inputs and Outputs
- Phase Rotation Sensing
- Time-stamped Event Log
- Gold-Flashed Engine Start Contacts
- Modbus Communication with Network and Setup Connections

Miscellaneous Items

- Standard One (1) Year Warranty
- Three (3) Copies General Maintenance Literature
- Rated Power Factor Test
- Certified Test Report
- Load Bank Test, Two (2) Hours
- Lube Oil and Antifreeze
- Installation Supervision
- Initial Test, Startup and Training

CERTIFICATION OF DRUG-FREE WORKPLACE PROGRAM

IDENTICAL TIE BIDS - Whenever two or more bids which are equal with respect to price, quality, and service are received by the State or by any political subdivision for the procurement of commodities or contractual services, a bid received from a business that certifies that it has implemented a drug-free workplace program shall be given preference in the award process. Established procedures for processing tie bids will be followed if none of the tied vendors have a drug-free workplace program, or if all of the tied vendors have drug-free workplace programs. In order to have a drug-free workplace program a business shall:

- (1) Publish a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the workplace and specifying the actions that will be taken against employees for violations of such prohibition.
- (2) Inform employees about the dangers of drug abuse in the workplace, the business's policy of maintaining a drug-free workplace, any available drug counseling, rehabilitation, and employee assistance programs, and the penalties that may be imposed upon employees for drug abuse violations.
- (3) Give each employee engaged in providing the commodities or contractual services that are under bid a copy of the statement specified in subsection (1).
- (4) In the statement specified in subsection (1), notify the employees that, as a condition of working on the commodities or contractual services that are under bid, the employee will abide by the terms of the statement and will notify the employer of any conviction of, or plea of guilty or nolo contendere to, any violation of chapter 893 or of any controlled substance law of the United States or any state, for a violation occurring in the workplace no later than five (5) days after such conviction.
- (5) Impose a sanction on, or require the satisfactory participation in a drug abuse assistance or rehabilitation program if such is available in the employee's community, by any employee who is so convicted.
- (6) Make a good faith effort to continue to maintain a drug-free workplace through implementation of this section.

AS THE PERSON AUTHORIZED TO SIGN THE STATEMENT, I CERTIFY THAT THIS FIRM COMPLIES FULLY WITH THE ABOVE REQUIREMENTS.

SIGNATURE OF VENDOR

REPRESENTATIVE: _____

TYPED OR PRINTED NAME OF VENDOR

REPRESENTATIVE _____

BIDDING FIRM OR ENTITY NAME: _____

BID SUBMITTED BY:

FEDERAL TAX I.D. NUMBER

FIRM OR ENTITY NAME

ADDRESS

CITY, STATE & ZIP CODE

TELEPHONE NUMBER /FAX NUMBER

TYPED OR PRINTED NAME
OF REPRESENTATIVE: _____

SIGNATURE OF REPRESENTATIVE: _____

DATE: _____

SECTION 16460 - EMERGENCY ELECTRICAL GENERATOR SYSTEM FOR WSRE TRANSMITTER SITE AT 26567 ERNEST PATTERSON ROAD, ROBERTSDALE, AL 36567-4331

PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements, and Section 16050 apply.

1.02 SUBMITTALS

- A. Submit system shop drawing and catalog cuts for approval. Include complete piping shop drawings indicating all required valves and accessories.

1.03 SPECIAL INSPECTION AND MAINTENANCE.

- A. The system manufacturer shall provide complete system maintenance for one year after final acceptance.

1.04 SCOPE

- A. This specification covers requirements for providing a factory built, prototype tested, production tested, field tested, complete and operable emergency/standby electric generating system, including all devices and equipment specified herein, shown on the drawings, and/or as required for the service. Materials and equipment shall be new and current, delivered to the site completely wired, tested, and ready for installation this system shall include the following:

1. One engine generator set rated as indicated.
2. Engine-generator control console resiliently mounted on the generator set shall include complete engine start-stop control and monitoring system.
3. Starting batteries.
4. Mounted and loose accessories, control devices, and other equipment as required for a fully functional system.
5. Automatic transfer switch.
6. Above ground storage tank and fuel piping.
7. Such other components, accessories, parts, tests, documents, and services, as needed to meet the performance requirements of this specification.
8. The engine generator system shall be capable of starting, coming up to speed, and power transfer within a 10-second time period.
9. The generator set, muffler, vibration isolators, battery charger, day tank, and automatic transfer switch shall be owner furnished contractor installed. All other system components shall be contractor furnished and installed.

1.05 SINGLE MANUFACTURER

- A. This equipment, including engine-generator set shall be manufactured by a single manufacturer who has been regularly engaged in the production of engine generator sets for a minimum of ten years. The electric generating system described herein, including

these components shall be factory built, factory tested, and shipped by this single manufacturer so there is one source of supply and responsibility for warranty, parts, and service.

1.06 SAFETY STANDARD

- A. The electric generating system must meet all requirements of NFPA 110-1985 including design specifications, prototype tests, one-step full load pickup, and installation acceptance.
- B. The responsibility of performance to this specification in its entirety cannot be split up among individual suppliers of components comprising the system, but must be assumed solely by the supplier of the system. The manufacturer shall furnish schematic and wiring diagrams for the engine-generator set.
- C. All controls shall be standard of the manufacturer who is engaged in the manufacture of generators and has them available for sale on the open market. Control parts shall be identified by part numbers of this manufacturer and shall have second source listing where applicable. Control systems that are supplied by a sub-vendor or sub-contractor of the vendor and not incorporated within the documentation drawings of the generator manufacturer are NOT ACCEPTABLE, unless approved by the Architect.

1.07 TESTING

- A. The intent of this specification is to provide equipment of proven reliability and compatibility. Three separate series of tests shall be performed: Factory Prototype Model Tests, Factory Production Model Tests, and Field Tests.
- B. Factory Prototype Model Tests: The electric generator system consisting of prime mover, generator, governor, coupling and all controls must have been tested as complete unit on representative engineering prototype model as required by NFPA 110-1985. The tests being potentially damaging to the equipment tested, must not be performed on equipment to be sold, but on separate prototype models as specified by NFPA 110-1985, Paragraph 3-2.1 through 3-2.1.2 and their accomplishment certified by means of documentation of the tests accompanying submittal data. These tests shall include:
 - 1. Maximum power level (maximum kW).
 - 2. Maximum motor starting capacity (maximum KVA) and voltage dip recovery within seven (7) cycles of applied load.
 - 3. Structural soundness (Short-Circuit and Endurance Tests).
 - 4. Torsiograph Analysis: The manufacturer of the engine-generator set shall verify that the engine generator combination, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype unit. The empirical data must include spectrum analysis of the torsional transducer output within the critical speed range of the engine-generator set. Results of this analysis shall be made available to the specified on request. Calculations are based on engine and generator separately are NOT ACCEPTABLE.
 - 5. Engine-generator cooling air requirements.

6. Transient response and steady-state speed control and voltage regulation.
 7. Generator temperature rise per NEMA MG1-22.40.
 8. Harmonic analysis and voltage waveform deviation per MIL-STD-705B, Method 601.4.
 9. Three phase short circuit test for mechanical and electrical strength. With system operating at rated volts, amps, power factor, and speed, the generator terminals must be short circuited ten times on all three phases for a duration of thirty seconds. Engine generator set must build up and perform normally without manual interventions of any kind such as resetting of circuit breakers or other tripping devices when the short circuit is removed.
 10. Failure mode test for voltage regulator. The engine generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The engine-generator set must be fully operative after the test, and without evidence of damage.
 11. Endurance testing is required to detect and correct potential electrical and mechanical problems associated with typical operation.
- B. Factory Production Model Tests: Before shipment of the equipment, the engine-generator set shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Testing at unity power factor only (resistance banks only) is NOT ACCEPTABLE. Tests shall include:
1. Single step load pickup per NFPA 110-1985, Paragraph 5.13.2.6.
 2. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.
- C. Upon completion of the above test, allow the prime mover to cool for five (5) minutes. Then apply full rated load (nameplate kW) consisting of a load bank provided by the Contractor. (Building load shall not be used for testing.) Unit power factor is suitable for on-site testing, provided that rated load tests at power factory have been performed by the manufacturer prior to shipment. This full load pickup shall be in one step immediately upon reaching rated r/min.
- D. The Engineer shall have the option of witnessing these tests. A summary of these test results shall be available upon request.
- E. Field Tests After Installation:
1. The complete installation shall be initially started and checked out for operational compliance by factory trained representative of the engine-generator set manufacturer. The engine lubrication oil recommended by the manufacturer for operation under environmental conditions specified shall be provided by the engine generator set supplier.
 2. Upon completion of initial start up and system checkout, the supplier of the system shall perform a field test with the Architect notified in advance to demonstrate load carrying capability and voltage and frequency stability.

3. With the emergency load at normal operating level, a power failure is initiated by opening all switches or breakers supplying the normal power to the building or facility. Records shall be maintained throughout the tests of time-of-day, coolant temperature, cranking time until prime mover starts and runs, time required to come up to operating speed, voltage and frequency overshoot, time required to achieve steady-state condition with all switches transferred to the emergency position, voltage, frequency, current, oil pressure, ambient air temperature, kilowatts, power factor, battery charger rate at five (5) minute intervals for the first 15 minutes, and at 15 minute intervals thereafter. Provide a load bank (do not use building load) and continue the test as follows:

25% load - 2 hours
50% load - 2 hours
100 % load -4 hours

Return normal power, record the time delay on retransfer for each switch (set for 15 minutes minimum) and the time delay on prime mover cool down period and shutdown.

1.08 GUARANTEE

- A. Guarantee shall be in accordance with FHWA 23 CFR, CH.1 (4-1-90 Edition) Section 635.413 Guarantee and Warrantee clauses (as attached). Provide manufacturers standard warrantee or guarantee for all equipment.

PART 2 – PRODUCTS

2.01 ENGINE-GENERATOR SET

- A. General: This system shall include one engine-generator set as indicated. The set shall be rated as indicated on the drawings. The engine generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components, and each set shall incorporate vibration isolators of the type and quantity as specified by the set manufacturer, whether mounted internally or externally to the set. Engine generator set shall be provided with a weatherproof enclosure and a double wall sub-base diesel fuel tank. Tank capacity shall be as indicated on the drawings. Tank shall be left full of fuel after completion of all testing.
- B. Engine: Engine shall be stationary, liquid cooled, spark ignited for fuel as specified below. Engine shall be capable of driving the generator of this rating on a continuous standby basis for the duration of normal source interrupting per SAE J1349 conditions.
- C. Engine components shall include the following:

1. A DC, solenoid shift, electric starter (s) as required by manufacturer.
2. Positive displacement, mechanical full pressure lubrication oil pump, full flow, lubrication oil filters with replaceable elements, pressure relief valve, dipstick oil level indicator, and oil drain valve with hose extension.
3. An oil cooler adapter with 190 thermostat.
4. Dry element air cleaner with replaceable element.
5. Engine speed isochronous electric governing system to control generator frequency within +/-0.28% of rated frequency under steady state load conditions, and capable of parallel operation with load sharing controls.
6. Engine mounted thermostatically controlled water jacket heater to aid in quick starting. Heater shall be rated as indicated and be disconnected whenever the engine starts.
7. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and engine shutdowns:

Low coolant temperature alarm
Low lubrication oil pressure alarm
High coolant temperature alarm
Low lubrication oil pressure shutdown
High coolant temperature shutdown
Over speed shutdown
Over crank lockout

8. Provide low coolant level shutdown, which shall activate high engine temperature lamp shutdown.
 9. Engine starter battery charging alternator amperes, with solid-state voltage regulator.
- D. Engine Cooling System: Engine shall be radiator cooled by engine mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Performance of components shall be as required by set manufacturer. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall. Radiator shall be filled 50% ethylene glycol antifreeze solution.
- E. Engine Exhaust System:
1. Exhaust muffler shall be provided for the engine of size as recommended by the set manufacturer. Muffler shall be of the critical type. Contractor shall mount muffler so its weight is not supported by the engine.

2. Flexible exhaust connection shall be provided for the engine of size as recommended by the set manufacturer. Muffler shall be of the critical type. Contractor shall mount muffler so its weight is not supported by the engine.
3. The Contractor shall provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine.
4. Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.
5. Contractor shall mount and install all exhaust components as required to comply with applicable codes and regulations. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings. Make provisions as required for pipe expansion and contraction.
6. Exhaust piping shall be size as recommended by the manufacturer.

F. Generator:

1. Generator shall be single bearing, self-aligning, four-poled, synchronous type revolving field, with amortisseur windings, with direct drive centrifugal blower for proper cooling and minimum noise, with temperature compensated solid-state voltage regulator, with brushless rotating rectifier exciter system. No brushes will be allowed. Generator shall be directly connected to engine flywheel housing and driven through a flexible coupling to insure permanent alignment; gear driven generators ARE NOT ACCEPTABLE under this specification. Insulation shall meet NEMA standards for Class F and additionally shall meet the Quality Assurance requirements of paragraph 4 of the Onan or equal "PTS" certificate. The maximum temperature rise shall not exceed 100 degrees C at 40 degrees C ambient. Generator design shall prevent potentially damaging shaft currents.
2. The three-phase, broad range, reconnectible generator shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
3. Voltage regulator shall be solid-state design and shall function by controlling the exciter magnetic field between stator and rotor to provide no load to full load regulation of rated voltage with +/- 2% during steady state conditions. The engine generator set and regulator must sustain at least 90% of no load voltage for 10 seconds with 250% of rated load at near zero power factor connected to its terminals.
 - a. The voltage regulator shall be insensitive to severe load induced waveshape distorted from SCR or thyristor circuits such as those used in battery charging (UPS) and motor speed control equipment.

- b. A rheostat shall provide a minimum of +/- voltage adjustment from rated value.
4. The generator, exciter, and voltage regulator shall be designed and manufactured by the engine generator set manufacturer so that the characteristics shall be matched to the torque curve of the prime over. This design allows the prime over to use its fullest power producing capacity (without exceeding it or over compensating) at speeds lower than rated, to provide the fastest way possible system recovery from transient speed dips. A system that routinely selects a linear type (straight line) constant volts/hertz characteristic, without regard of or the engine power and torque characteristics shall be demonstrable as follows:

With engine generator set operated at rated speed, voltage and load, reduce engine speed to half rated by manually overriding the engine speed governor control. Engine generator set must recover to full speed with the rated load connected when the engine speed governor control is returned to its normal mode.

Calculations must demonstrate that the exciter and voltage regulator will permit utilization of at least 80% of maximum available prime mover torque at all engine speeds between 50% and rated speed, and with rated unity power factory load connected to its terminals.

5. Exciter shall be three phase-full wave, rectified, with heavy duty silicon diodes mounted on the common rotor shaft and sized for maximum motor starting loads. Systems using three wire solid state control elements (such as transistors or SCR's) rotating on the rotor shall NOT be acceptable.
6. Generator design shall be of the self-protecting type, as demonstrated by the prototype short-circuit test as described under "testing" herein. All other generator performance criteria shall be equal to that of the specified equipment.

G. Engine-Generator Set Control:

1. Provide a lighted, unit mounted control module that is factory built, wired, tested, and shock mounted by the generator manufacturer. Control module shall be mounted on the generator end of the set. Control wires running between GenSet and Transfer Switch shall have termination identification on both ends. Identification shall be provided for each device or function and shall be silk screen white on a black background.
2. Engine generator set control shall include the following for each unit:
 - a. Gauges and meters: oil pressure gauge, coolant temperature gauge, charge rate ammeter and running time ammeter.
 - b. Manual selector switch: RUN-STOP-REMOTE
 - c. Remote, two wire 24 volt DC controls start-stop terminals

- d. Manual reset field circuit breaker.
- e. Automatic engine shut down for the following fault conditions:

- Over crank
- Over speed
- Low lube oil pressure
- High engine temperature

- f. Indicator lamps shall be provided to signal the following functions:

RUN - indicates start disconnect

FAULT - indicates overcrank, overspeed, high coolant temperature, or low oil pressure

OVERCRANK - indicates the starter has been locked out because cranking time was excessive

OVERSPEED - indicates engine has shut down because of excessive r/min.

HIGH ENGINE TEMPERATURE - indicates engine has shut down because of critically high temperature

LOW OIL PRESSURE - indicates engine has shutdown because of critically low oil pressure

PRE HIGH ENGINE TEMPERATURE - indicates engine temperature is too high

PRE LOW OIL PRESSURE - indicates oil pressure is marginally low

LOW ENGINE TEMPERATURE - indicates engine temperature is marginally low for starting

SWITCH OFF (flashing) - indicates control switch is in the "STOP" position.

- 3. A fault reset switch shall be provided to clear fault indications and allow restarting of the engine after shut down faults. The control design shall be such that the fault indication shall remain until reset. The fault indicator memory shall not be dependent on the presence of either A-C or D-C voltage and shall retain the fault batteries. The fault reset function shall operate only when the RUN-STOP-REMOTE switch is in the STOP position.
- 4. A locking screwdriver type potentiometer shall be provided to adjust the voltage +/- 5% from rated value.

5. Manual reset exciter field circuit breaker.
6. A locking screwdriver type potentiometer (electronic governor) shall be provided to adjust the speed +/- 2% from rated value.
7. AC voltmeter, 90 degree scale, 2-1/2" (61.25 mm) flange, 2% switchboard meter.
8. AC ammeter, 90 degree scale, 2-1/2" (61.25 mm) flange, 2% switchboard meter.
9. Frequency meter 45-65 Hz., 90 degree scale, 2-1/2" (61.25mm) flange, +/- 0.6 Hz panel meter.
10. Four position AC meters phase selector switch to read line current and voltage in each phase with off position.

H. Auxiliary Equipment:

1. Starting Battery: Battery shall be supplied for the engine and shall be mounted in a battery rack within the engine-generator set skidbase.
2. Vibration Isolators: The engine generator set shall be mounted on vibration isolators both internal or external to the set skidbase.
3. Fuel Tank: Provide double wall 550 gallon diesel fuel sub-base fuel tank, leave full after completion of all testing.
4. 100% rated line circuit breaker site as indicated on the drawings.
5. Weather housing shall be as follows:
 - a. All enclosures are to be constructed from G60 galvanized high strength, low alloy steel
 - b. The enclosure shall be primed with BASF urethane and finish coated with BASF Superl System paint. Enclosures will be finished in the manufacturer's standard color.
 - c. The enclosures must allow the generator set to operate at full load in an ambient of 40°C with no additional derating of the electrical output.
 - d. The enclosures must meet all of the requirements of UL-2200.
 - e. Enclosures must be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker must meet the requirements of the National Electric Code.
 - f. Doors must be hinged with stainless steel hinges and hardware and be removable.
 - g. Doors must be equipped with lockable latches. Locks must be keyed alike.
 - h. Enclosures must be mounted to the generator set skid.
 - i. The enclosure roof must be pitched to prevent accumulation of water
 - j. A duct between the radiator and air outlet must be provided to prevent re-circulation of hot air.

- k. The complete exhaust system shall be internal to the enclosure. Enclosures with roof mounted or externally exposed silencers are not acceptable.
 - l. The silencer shall be an insulated critical silencer with a tailpipe and rain cap
6. 6-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient temperatures from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.
 7. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.
 8. Enclosure shall be rated for 140 mph.

2.02 AUTOMATIC TRANSFER SWITCH

- A. General: Automatic transfer switch shall be furnished with ampere ratings as shown on the drawing and shall consist of automatic transfer switches with control interconnected to provide complete automatic operation. Switch shall be listed by UL 1008.
- B. Accessories: The automatic transfer switches shall be provided with the following accessories:
 1. Three phase normal sensing with pick-up set at 95% and drop out set at 90% normal voltage. Both pick up and drop out shall be field adjustable to provide flexibility for brownout and other field conditions.
 2. ½ to 6 seconds field adjustable time delay on engine starting to override power dips.
 3. Emergency sensing to prevent transfer until source is adequate with voltage pick up set at 90% and frequency pick up set at 95%. Both values shall be independently field adjustable.
 4. Field adjustable 0 to 32 minutes time delay (set at 15 minutes) on retransfer to normal.
 5. Field adjustable 0 to 8 minutes unload engine run time delay after retransfer to normal.
 6. Running rime meter
 7. Pilot lights to indicate switch position
 8. Test switch to simulate a power failure under load conditions.

9. Auxiliary contact: 1 closed on normal, 1 closed on emergency.
10. NEMA 1 wall mountable cabinet.
11. Exerciser clock.
12. Time delay shall be such that engine starts comes up to full voltage and transfers to emergency within 30 seconds.

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PART 3 - EXECUTION

3.01 GENERAL

- A. The generator set and accessories shall be installed in accordance with the manufacturer's written instructions. Engine coolant and lubricating oil as recommended by the engine manufacturer shall be provided. (Provide antifreeze solution for engine coolant.)

End of Section

SECTION 16050 - BASIC MATERIALS AND METHODS FOR STANDBY GENERATOR FACILITY FOR WSRE TRANSMITTER SITE LOCATED AT 26567 ERNEST PATTERSON ROAD, ROBERTSDALE, ALABAMA 36567-4331

PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements, and Section 16050 apply.

1.02 DRAWING

- A. The drawing shows the general arrangement of all conduit, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to other requirements shown on all of the drawings. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as required to meet such conditions.

1.03 CODES AND STANDARDS

- A. All material and workmanship shall comply with all applicable codes, specifications, local ordinances, and industry standards.
- B. In case of difference between building codes, specifications, state laws and local ordinances, regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.

1.04 COORDINATION OF WORK

- A. The Contractor shall compare the electrical drawings and specifications with existing conditions and report any discrepancies between them to the Engineer and obtain from him written instructions for changes necessary in the work. Before installation, the Contractor shall make proper provision to avoid interferences in a manner approved by the Engineer. All changes required in the work of the Contractor due to his neglect shall be corrected by the Contractor at his own expense.
- B. Locations of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe, duct and electrical raceway prior to fabrication.

- C. Installation and Arrangements: The Contractor shall install all materials and equipment to allow access and clearances for equipment operation, maintenance and in compliance with code.

1.05 FEES, PERMITS AND INSPECTIONS

- A. All required fees, permits and inspections for electrical work shall be obtained and paid for by the Contractor.
 - 1. Certificate of Final Inspection: The Contractor shall, upon completion of the work under this section, furnish a certificate of final inspection to the Engineer.

1.06 CUTTING AND PATCHING

- A. The Contractor shall be responsible for all required excavation, cutting, etc., incidental to the work under that Section, and shall make all required repairs thereafter to the satisfaction of the Engineer, but in no case shall the Contractor cut into any major structural element, beam or column without the written approval of the Engineer.

1.07 AS-BUILT DRAWINGS

- A. Maintain one set of blue-line electrical prints on site marked to show as-built conditions and installations.

1.08 GUARANTEE

- A. Contractor shall leave the entire system in proper order and shall replace without additional charge all work or material which may develop defects within one year of final inspection and acceptance by the Engineer.

1.11 IDENTIFICATION

- A. Devices: Each panelboard cabinet, safety switch, individual circuit breakers in distribution panel or main distribution switchboard, time clock, motor starter, and the like shall have an identifying nameplate, such as "PANEL L", "FAN EF-1 STARTER". Nameplates: Laminated plastic with 1/4-inch high white engraved letters on black background. Fasten nameplates by 2 rustproof screws.
- B. Conductors: Label each branch circuit in every panel, box, and wireway to indicate the circuit number corresponding with the panel directory. Labels: Self-stick adhesive baked vinyl cloth wire markers. Write on type markers, lettered with indelible ink will be acceptable where stock numbers will not suffice.
- C. Directories: Each panel shall have a typewritten directory mounted on the inside of panel door (power distribution panels shall have engraved nameplates).

1.12 FIRE SAFING

- A. Provide all required fire safing in accordance with accepted UL Standards and in accordance with all applicable code requirements. Boxes in fire walls shall be arranged in accordance with UL requirements.

1.13 EQUIPMENT AND MATERIALS

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label. The equipment to be furnished shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.
- B. Delivery and Storage: Equipment and materials shall be delivered to the site and stored in original containers, suitable sheltered from the elements. All items subject to moisture or heat damage shall be properly stored in dry and/or heated spaces.
- C. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
- D. Protection: Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury. At the completion of the work, fixtures, equipment and materials shall be cleaned thoroughly and turned over to the Owner in a condition satisfactory to the Engineer. Damage or defects developing before acceptance of the work shall be made good at the Contractors expense.
- E. Dimensions: It shall be the responsibility of the Contractor to insure that items to be furnished can be properly installed within the space provided which will allow adequate space for operation and maintenance. The Contractor shall make necessary field measurements to determine actual space requirements.
- F. Manufacturer's printed instructions shall be followed completely in the delivery, storage, protection and installation of all equipment and materials. The Contractor shall promptly notify the Engineer in writing of any conflict between any requirement of the contract documents and the manufacturer's directions and shall obtain the Engineer's written instruction before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Engineer, he shall bear all costs arising in correcting the deficiencies.
- G. The Contractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the individual systems in such a manner that each system can be operated, maintained, and serviced by the Owner.
- H. Concrete Equipment Bases and Pads: Provide concrete pads and bases for equipment as indicated.
- I. Supports: The Contractor shall support plumb, rigid and true to line all work and equipment. The Contractor shall study thoroughly all general, structural, mechanical and electrical drawings, shop drawings and catalog data to determine how equipment,

fixtures, etc., are to be supported, mounted or suspended and shall provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support whether or not shown on the drawings.

- J. Owner furnished contractor installed equipment - as indicated on the drawings certain equipment will be owner furnished contractor installed. These specifications cover all material regardless of whether contractor furnished or owner furnished.

1.14 SUBMITTED DATA AND SHOP DRAWINGS

- A. Materials and equipment schedules shall be submitted as soon as practicable, but not later than thirty days after the date of award of contract, and before commencement of installation of any material or equipment.

PART 2 - PRODUCTS

2.01 CONDUIT

- A. General: 3/4" diameter minimum conforming in size to NEC requirements for the number and type of conductors installed.
 - 1. Uniform thickness, smooth circular bore, standard lengths and free of defects.
- B. Rigid Conduit: Hot dipped galvanized including threads conforming to F.S. W-C58, and ANSI Standard C80.1.
- C. Electro-Metallic Tubing: Zinc plated or sheradized, as manufactured by Triangle or Republic Steel Co.
- D. Flexible Conduit: Regular galvanized, 1/2 diameter minimum.
- E. Liquidtight Flexible Conduit: Galvanized with polyvinyl covering.
- F. Plastic conduit, Schedule 40 or 80 PVC only.
- G. Fittings: Manufactured for service required.
 - 1. Steel fittings only for electro-metallic tubing and rigid.
 - 2. Threadless couplings and connectors not permitted on rigid conduit.
 - 3. EMT: Steel compression type or all steel set screw fittings.

2.02 OUTLET JUNCTION AND PULL BOXES

- A. Outlet boxes and covers shall comply with UL Standard No. 514, cadmium or zinc coated.
- B. Boxes with volume greater than 50 square inches shall comply with UL Standard No. 50 hot dip zinc sheet steel.
- C. Minimum box size 4 inches square with plaster frame to suit outlet.

2.03 WIRE AND CABLE

- A. All conductors shall be copper with type THW, THHN or THWN insulation (size #14 thru #6 shall be THHN/THWN only). Conductors for branch circuits shall be #12 minimum with conductors through #10 solid, #8 and above stranded.
- B. All conductors shall be color coded. Wire sizes through #8 shall have factory applied colored insulation. Wires #6 and larger shall have field applied colored tape at all junction boxes and terminal locations. Color coding shall be as follows:

	L1	L2	L3	Neutral	Grd
120/208V 3t 60Hz	black	red	blue	white	green
277/480V 3t 60Hz	brown	orange	yellow	grey	green

- C. Minimum #12 AWG branch circuit conductors. Minimum #10 AWG conductors shall be used for all branch circuit runs exceeding 100 feet to first outlet.
- D. Special system conductors shall be in accordance with manufacturer's recommendations.
- E. Fixture wires shall be suitable for fixture operating temperature.

2.04 WIRE CONNECTIONS AND DEVICES

- A. Comply with F.S. W-S-610B for connections.
- B. Connectors:
 - 1. For temperatures to 105 degrees C: Ideal Wing Nut or 3M Scotchloc.
 - 2. For temperatures to 150 degrees C for use in fixtures: Ideal Wire Nut.
- C. Taped Connections:
 - 1. Scotch 33 or slip-knot grey. Fill voids with rubber tape or Scotchfill.
 - 2. Use Burndy or equivalent compression connectors for wire sizes #6 and larger.

2.05 INSTALLATION

- A. Conduit:
 - 1. Rigid Conduit:
 - (a) For exposed (exterior) use.
 - (b) Make up all joints tight with no running threads.
 - (c) Ream inside edge of cut conduit to prevent wire damage during pulling.
 - 2. Electro-Metallic tubing:
 - (a) May be used for all branch circuit system wiring in dry areas above grade within the building.
 - 3. Flexible Metal Conduit:
 - (a) Use flexible conduit for the connection of light fixtures in ceiling, electric motors and all equipment subject to vibration.

- (b) Make connections to equipment having motors with flexible metal conduit; where exposed to weather or moisture, use liquid tight flexible metal conduit, unless otherwise shown.
4. PVC Conduit: PVC conduit may be used for runs in slabs or for exterior underground installation.
 5. MC Cable. MC Cable may not be used.
 6. In slabs on grade having wire mesh reinforcing and no steel bars, install below the vapor barrier.
 7. Use conduit of sizes indicated and required by NEC for number and sizes of conductors indicated. Minimum size shall be 1/2" for branch circuits. Minimum size for communications or fire alarm circuits (unless specifically indicated otherwise) shall be 3/4".
 8. Neatly paint threaded conduit connections with sealant before connecting. Cut conduit with hacksaw and ream smooth to remove burrs. Cutting by any method which alters the cross section of conduit in any way will not be permitted. Keep conduit bends free from dents, kinks and bruises. Protective coating shall be undisturbed. Radii of the bends shall not be less than those stated in current edition of the NEC. Do not use more than four 90 degree bends between outlets or boxes. Avoid trapping of conduit.
 9. Conduit shall be electrically continuous from service equipment to outlets and cabinets. Secure to boxes of sheetmetal construction with one locknut outside and one inside box with reinforced bakelite bushing, O.Z. Gedney Type "A" through 2" and Type "B" for 2-1/2" and larger.
 10. See that each length of conduit has the manufacturer's name, initials, or trademark and the Underwriters' Laboratories Inspection Label thereon.
 11. Where connections are made to motors, not near walls or columns, install a vertical conduit, minimum size 3/4", attached to floor by a floor flange; bring wiring out of this conduit by means of condulets and flexible conduit, and extend to motor junction boxes.
 12. Provide hangers made of durable materials, suitable for the application involved.
 13. Do not use perforated iron for supporting conduit.
 14. Do not support conduit from ceiling system support wires.
 15. Base required strength of supporting equipment and size and type of anchors on the combined weight of conduit, hanger and cables.
 16. Support conduits at intervals not to exceed code requirements.
 17. Use capped bushings to prevent dirt, concrete, moisture, or other foreign matter from entering conduits during construction. Paper, wood or other plugs are unacceptable.
 18. Remove any water from conduit and ducts to avoid freeze damage. Blow out or swab conduit and ducts before pulling wire.
 19. Run exposed conduits parallel with or at right angles to building lines. Where more than one conduit is following a given path, install with uniform distances between each other and with concentric bends, offsets and saddles.
 20. Fasten single runs of conduit installed exposed on walls and ceilings with cadmium-plated malleable iron or pressed steel one hole straps, machine screws, and lead anchors. Suspend single runs of conduit larger than 1-1/2" by 3/8" steel rod and malleable iron hinge hangers. Use 1/4" steel rods for smaller conduit.
 21. Cut necessary openings in concrete, masonry, brick walls, concrete, wood construction, etc., from both sides to affect a neat workmanlike job.
 22. Have competent personnel on job during placing of concrete and masonry wall construction to insure proper installation of electrical conduit.

23. Use standard electrical unions for connection conduit where standard couplings cannot be used. Use of running threads will not be permitted.
24. Conduit passing through concrete shall be sealed with concrete grout. Conduit passing through rated walls shall be sealed with concrete grout or drywall cement.
25. Conduit passing through concrete shall be sealed with concrete grout. Conduit passing through rated walls shall be sealed with concrete grout or drywall cement.
26. Where conduit passes through building expansion joints, provide O.Z. Gedney Type "AX", or equal, expansion fittings.
27. Pull a 200 pound test line into conduits left empty.
28. All conduits passing from building to building and conduit sleeves installed below the computer floor shall be interior sealed around cables (including cables installed by others) using suitable cable sealing material.

B. Cable Installation

1. Do not pull conductors into conduits until work which may cause cable damage is completed. Use only approved cable lubricants.
2. Tag all conductors and identify major conduits in or at wireways, panels, pull boxes, motor controllers, cabinets and similar items to assist in future circuit tracing.
3. Provide barriers where required by Code.
4. Independently support pull boxes on the building structure.
5. Do not depend on the conduit system for support.
6. Connection to all fixtures in areas with removable ceiling panels shall be from outlet boxes located above the ceiling with flexible conduit connection to the fixtures. Symbols on drawings and mounting heights as indicated on drawings and in specifications are approximate only. The exact locations and mounting heights must be determined on the job and is shall be the Contractors responsibility to coordinate with all trades and the architectural drawings, to secure the correct installation, i.e., over counters, in or above backsplashes, in block walls and other specific construction features. Back-to-back outlets will not be allowed. Minimum separation between boxes shall be 2 inches.

C. Grounding

1. Ground electrical system in accordance with Article 250, National Electrical Code and local authorities having jurisdiction and the following requirements. Bond to building steel, cold water mains and driven ground rods.
2. All feeders and branch circuit raceways shall contain an insulated green wires.
3. Attach panel ground bars to panel cans and isolate neutral bars.
4. Grounding bushings where required shall be bonded to the panel board ground bus with an insulated conductor sized in accordance with the NEC table for equipment grounding conductors.
5. Provide ground wire sized as per NEC in all PVC conduit.

2.06 TESTS

- A. General: The Contractor shall show by demonstration in service that all circuits and devices are in operating conditions. Tests shall be such that each item of control equipment will function not less than five times.
- B. Test on 600 Volt Wiring: Test all 600 volt wiring to verify that no short circuits or accidental grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance.
- C. Grounding System Test: Test the grounding system to assure continuity and that resistance to ground is not excessive.

PART 3 - EXECUTION - Not Applicable To This Section

End of Section

SECTION 16460 - EMERGENCY ELECTRICAL GENERATOR SYSTEM FOR WSRE TRANSMITTER SITE LOCATED AT 1295 WEST FAIRFIELD DRIVE, PENSACOLA, FLORIDA 32504-8998

PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements, and Section 16050 apply.

1.02 SUBMITTALS

- A. Submit system shop drawing and catalog cuts for approval. Include complete piping shop drawings indicating all required valves and accessories.

1.03 SPECIAL INSPECTION AND MAINTENANCE.

- A. The system manufacturer shall provide complete system maintenance for one year after final acceptance.

1.04 SCOPE

- A. This specification covers requirements for providing a factory built, prototype tested, production tested, field tested, complete and operable emergency/standby electric generating system, including all devices and equipment specified herein, shown on the drawings, and/or as required for the service. Materials and equipment shall be new and current, delivered to the site completely wired, tested, and ready for installation this system shall include the following:

1. One engine generator set rated as indicated.
2. Engine-generator control console resiliently mounted on the generator set shall include complete engine start-stop control and monitoring system.
3. Starting batteries.
4. Mounted and loose accessories, control devices, and other equipment as required for a fully functional system.
5. Automatic transfer switch.
6. Above ground storage tank and fuel piping.
7. Such other components, accessories, parts, tests, documents, and services, as needed to meet the performance requirements of this specification.
9. The engine generator system shall be capable of starting, coming up to speed, and power transfer within a 10-second time period.
9. The generator set, muffler, vibration isolators, battery charger, day tank, and automatic transfer switch shall be owner furnished contractor installed. All other system components shall be contractor furnished and installed.

1.05 SINGLE MANUFACTURER

- A. This equipment, including engine-generator set shall be manufactured by a single manufacturer who has been regularly engaged in the production of engine generator sets for a minimum of ten years. The electric generating system described herein, including these components shall be factory built, factory tested, and shipped by this single manufacturer so there is one source of supply and responsibility for warranty, parts, and service.

1.06 SAFETY STANDARD

- A. The electric generating system must meet all requirements of NFPA 110-1985 including design specifications, prototype tests, one-step full load pickup, and installation acceptance.
- B. The responsibility of performance to this specification in its entirety cannot be split up among individual suppliers of components comprising the system, but must be assumed solely by the supplier of the system. The manufacturer shall furnish schematic and wiring diagrams for the engine-generator set.
- D. All controls shall be standard of the manufacturer who is engaged in the manufacture of generators and has them available for sale on the open market. Control parts shall be identified by part numbers of this manufacturer and shall have second source listing where applicable. Control systems that are supplied by a sub-vendor or sub-contractor of the vendor and not incorporated within the documentation drawings of the generator manufacturer are NOT ACCEPTABLE, unless approved by the Architect.

1.07 TESTING

- A. The intent of this specification is to provide equipment of proven reliability and compatibility. Three separate series of tests shall be performed: Factory Prototype Model Tests, Factory Production Model Tests, and Field Tests.
- C. Factory Prototype Model Tests: The electric generator system consisting of prime mover, generator, governor, coupling and all controls must have been tested as complete unit on representative engineering prototype model as required by NFPA 110-1985. The tests being potentially damaging to the equipment tested, must not be performed on equipment to be sold, but on separate prototype models as specified by NFPA 110-1985, Paragraph 3-2.1 through 3-2.1.2 and their accomplishment certified by means of documentation of the tests accompanying submittal data. These tests shall include:
 - 1. Maximum power level (maximum kW).
 - 2. Maximum motor starting capacity (maximum KVA) and voltage dip recovery within seven (7) cycles of applied load.
 - 3. Structural soundness (Short-Circuit and Endurance Tests).
 - 4. Torsiograph Analysis: The manufacturer of the engine-generator set shall verify that the engine generator combination, as configured, is free from harmful torsional stresses. The analysis shall include correlation of

empirical data from tests on a representative prototype unit. The empirical data must include spectrum analysis of the torsional transducer output within the critical speed range of the engine-generator set. Results of this analysis shall be made available to the specified on request. Calculations are based on engine and generator separately are NOT ACCEPTABLE.

5. Engine-generator cooling air requirements.
 6. Transient response and steady-state speed control and voltage regulation.
 7. Generator temperature rise per NEMA MG1-22.40.
 8. Harmonic analysis and voltage waveform deviation per MIL-STD-705B, Method 601.4.
 9. Three phase short circuit test for mechanical and electrical strength. With system operating at rated volts, amps, power factor, and speed, the generator terminals must be short circuited ten times on all three phases for a duration of thirty seconds. Engine generator set must build up and perform normally without manual interventions of any kind such as resetting of circuit breakers or other tripping devices when the short circuit is removed.
 10. Failure mode test for voltage regulator. The engine generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The engine-generator set must be fully operative after the test, and without evidence of damage.
 11. Endurance testing is required to detect and correct potential electrical and mechanical problems associated with typical operation.
- B. Factory Production Model Tests: Before shipment of the equipment, the engine-generator set shall be tested under rated load and power factor for performance and proper functioning of control and interfacing circuits. Testing at unity power factory only (resistance banks only) is NOT ACCEPTABLE. Tests shall include:
1. Single step load pickup per NFPA 110-1985, Paragraph 5.13.2.6.
 2. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.
- C. Upon completion of the above test, allow the prime mover to cool for five (5) minutes. Then apply full rated load (nameplate kW) consisting of a load bank provided by the Contractor. (Building load shall not be used for testing.) Unit power factor is suitable for on-site testing, provided that rated load tests at power factory have been performed by the manufacturer prior to shipment. This full load pickup shall be in one step immediately upon reaching rated r/min.
- D. The Engineer shall have the option of witnessing these tests. A summary of these test results shall be available upon request.
- E. Field Tests After Installation:
1. The complete installation shall be initially started and checked out for operational compliance by factory trained representative of the engine-

generator set manufacturer. The engine lubrication oil recommended by the manufacturer for operation under environmental conditions specified shall be provided by the engine generator set supplier.

2. Upon completion of initial start up and system checkout, the supplier of the system shall perform a field test with the Architect notified in advance to demonstrate load carrying capability and voltage and frequency stability.
3. With the emergency load at normal operating level, a power failure is initiated by opening all switches or breakers supplying the normal power to the building or facility. Records shall be maintained throughout the tests of time-of-day, coolant temperature, cranking time until prime mover starts and runs, time required to come up to operating speed, voltage and frequency overshoot, time required to achieve steady-state condition with all switches transferred to the emergency position, voltage, frequency, current, oil pressure, ambient air temperature, kilowatts, power factor, battery charger rate at five (5) minute intervals for the first 15 minutes, and at 15 minute intervals thereafter. Provide a load bank (do not use building load) and continue the test as follows:

25% load - 2 hours
50% load - 2 hours
100 % load -4 hours

Return normal power, record the time delay on retransfer for each switch (set for 15 minutes minimum) and the time delay on prime mover cool down period and shutdown.

1.08 GUARANTEE

- A. Guarantee shall be in accordance with FHWA 23 CFR, CH.1 (4-1-90 Edition) Section 635.413 Guarantee and Warrantee clauses (as attached). Provide manufacturers standard warrantee or guarantee for all equipment.

PART 2 – PRODUCTS

2.01 ENGINE-GENERATOR SET

- A. General: This system shall include one engine-generator set as indicated. The set shall be rated as indicated on the drawings. The engine generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components, and each set shall incorporate vibration isolators of the type and quantity as specified by the set manufacturer, whether mounted internally or externally to the set. Engine generator set

shall be provided with a weatherproof enclosure and a double wall sub-base diesel fuel tank. Tank capacity shall be as indicated on the drawings. Tank shall be left full of fuel after completion of all testing.

- B. Engine: Engine shall be stationary, liquid cooled, spark ignited for fuel as specified below. Engine shall be capable of driving the generator of this rating on a continuous standby basis for the duration of normal source interrupting per SAE J1349 conditions.
- C. Engine components shall include the following:
1. A DC, solenoid shift, electric starter (s) as required by manufacturer.
 2. Positive displacement, mechanical full pressure lubrication oil pump, full flow, lubrication oil filters with replaceable elements, pressure relief valve, dipstick oil level indicator, and oil drain valve with hose extension.
 3. An oil cooler adapter with 190 thermostat.
 4. Dry element air cleaner with replaceable element.
 5. Engine speed isochronous electric governing system to control generator frequency within +/-0.28% of rated frequency under steady state load conditions, and capable of parallel operation with load sharing controls.
 6. Engine mounted thermostatically controlled water jacket heater to aid in quick starting. Heater shall be rated as indicated and be disconnected whenever the engine starts.
 7. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and engine shutdowns:
 - Low coolant temperature alarm
 - Low lubrication oil pressure alarm
 - High coolant temperature alarm
 - Low lubrication oil pressure shutdown
 - High coolant temperature shutdown
 - Over speed shutdown
 - Over crank lockout
 8. Provide low coolant level shutdown, which shall activate high engine temperature lamp shutdown.
 9. Engine starter battery charging alternator amperes, with solid-state voltage regulator.
- D. Engine Cooling System: Engine shall be radiator cooled by engine mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Performance of components shall be as required by set manufacturer. Radiators

shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall. Radiator shall be filled 50% ethylene glycol antifreeze solution.

E. Engine Exhaust System:

1. Exhaust muffler shall be provided for the engine of size as recommended by the set manufacturer. Muffler shall be of the critical type. Contractor shall mount muffler so its weight is not supported by the engine.
2. Flexible exhaust connection shall be provided for the engine of size as recommended by the set manufacturer. Muffler shall be of the critical type. Contractor shall mount muffler so its weight is not supported by the engine.
3. The Contractor shall provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine.
4. Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.
5. Contractor shall mount and install all exhaust components as required to comply with applicable codes and regulations. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings. Make provisions as required for pipe expansion and contraction.
6. Exhaust piping shall be size as recommended by the manufacturer.

F. Generator:

1. Generator shall be single bearing, self-aligning, four-poled, synchronous type revolving field, with amortisseur windings, with direct drive centrifugal blower for proper cooling and minimum noise, with temperature compensated solid-state voltage regulator, with brushless rotating rectifier exciter system. No brushes will be allowed. Generator shall be directly connected to engine flywheel housing and driven through a flexible coupling to insure permanent alignment; gear driven generators ARE NOT ACCEPTABLE under this specification. Insulation shall meet NEMA standards for Class F and additionally shall meet the Quality Assurance requirements of paragraph 4 of the Onan or equal "PTS" certificate. The maximum temperature rise shall not exceed 100 degrees C at 40 degrees C ambient. Generator design shall prevent potentially damaging shaft currents.
2. The three-phase, broad range, reconnectible generator shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.

3. Voltage regulator shall be solid-state design and shall function by controlling the exciter magnetic field between stator and rotor to provide no load to full load regulation of rated voltage with $\pm 2\%$ during steady state conditions. The engine generator set and regulator must sustain at least 90% of no load voltage for 10 seconds with 250% of rated load at near zero power factor connected to its terminals.
 - a. The voltage regulator shall be insensitive to severe load induced waveshape distorted from SCR or thyristor circuits such as those used in battery charging (UPS) and motor speed control equipment.
 - b. A rheostat shall provide a minimum of \pm voltage adjustment from rated value.
4. The generator, exciter, and voltage regulator shall be designed and manufactured by the engine generator set manufacturer so that the characteristics shall be matched to the torque curve of the prime over. This design allows the prime over to use its fullest power producing capacity (without exceeding it or over compensating) at speeds lower than rated, to provide the fastest way possible system recovery from transient speed dips. A system that routinely selects a linear type (straight line) constant volts/hertz characteristic, without regard of or the engine power and torque characteristics shall be demonstrable as follows:

With engine generator set operated at rated speed, voltage and load, reduce engine speed to half rated by manually overriding the engine speed governor control. Engine generator set must recover to full speed with the rated load connected when the engine speed governor control is returned to its normal mode.

Calculations must demonstrate that the exciter and voltage regulator will permit utilization of at least 80% of maximum available prime mover torque at all engine speeds between 50% and rated speed, and with rated unity power factory load connected to its terminals.
5. Exciter shall be three phase-full wave, rectified, with heavy duty silicon diodes mounted on the common rotor shaft and sized for maximum motor starting loads. Systems using three wire solid state control elements (such as transistors or SCR's) rotating on the rotor shall NOT be acceptable.
6. Generator design shall be of the self-protecting type, as demonstrated by the prototype short-circuit test as described under "testing" herein. All other generator performance criteria shall be equal to that of the specified equipment.

G. Engine-Generator Set Control:

1. Provide a lighted, unit mounted control module that is factory built, wired, tested, and shock mounted by the generator manufacturer. Control module shall be mounted on the generator end of the set. Control wires running between GenSet and Transfer Switch shall have termination identification on both ends. Identification shall be provided for each device or function and shall be silk screen white on a black background.
2. Engine generator set control shall include the following for each unit:
 - a. Gauges and meters: oil pressure gauge, coolant temperature gauge, charge rate ammeter and running time ammeter.
 - b. Manual selector switch: RUN-STOP-REMOTE
 - c. Remote, two wire 24 volt DC controls start-stop terminals
 - d. Manual reset field circuit breaker.
 - e. Automatic engine shut down for the following fault conditions:
 - Over crank
 - Over speed
 - Low lube oil pressure
 - High engine temperature
 - f. Indicator lamps shall be provided to signal the following functions:
 - RUN - indicates start disconnect
 - FAULT - indicates overcrank, overspeed, high coolant temperature, or low oil pressure
 - OVERCRANK - indicates the starter has been locked out because cranking time was excessive
 - OVERSPEED - indicates engine has shut down because of excessive r/min.
 - HIGH ENGINE TEMPERATURE - indicates engine has shut down because of critically high temperature
 - LOW OIL PRESSURE - indicates engine has shutdown because of critically low oil pressure
 - PRE HIGH ENGINE TEMPERATURE - indicates engine temperature is too high

PRE LOW OIL PRESSURE - indicates oil pressure is marginally low

LOW ENGINE TEMPERATURE - indicates engine temperature is marginally low for starting

SWITCH OFF (flashing) - indicates control switch is in the "STOP" position.

3. A fault reset switch shall be provided to clear fault indications and allow restarting of the engine after shut down faults. The control design shall be such that the fault indication shall remain until reset. The fault indicator memory shall not be dependent on the presence of either A-C or D-C voltage and shall retain the fault batteries. The fault reset function shall operate only when the RUN-STOP-REMOTE switch is in the STOP position.
4. A locking screwdriver type potentiometer shall be provided to adjust the voltage +/- 5% from rated value.
5. Manual reset exciter field circuit breaker.
6. A locking screwdriver type potentiometer (electronic governor) shall be provided to adjust the speed +/- 2% from rated value.
7. AC voltmeter, 90 degree scale, 2-1/2" (61.25 mm) flange, 2% switchboard meter.
8. AC ammeter, 90 degree scale, 2-1/2" (61.25 mm) flange, 2% switchboard meter.
9. Frequency meter 45-65 Hz., 90 degree scale, 2-1/2" (61.25mm) flange, +/- 0.6 Hz panel meter.
10. Four position AC meters phase selector switch to read line current and voltage in each phase with off position.

H. Auxiliary Equipment:

1. Starting Battery: Battery shall be supplied for the engine and shall be mounted in a battery rack within the engine-generator set skidbase.
2. Vibration Isolators: The engine generator set shall be mounted on vibration isolators both internal or external to the set skid base.
3. Fuel Tank: Provide double wall 550 gallon diesel fuel sub-base fuel tank, leave full after completion of all testing.

4. 100% rated line circuit breaker site as indicated on the drawings.
5. Weather housing shall be as follows:
 - a. All enclosures are to be constructed from G60 galvanized high strength, low alloy steel
 - b. The enclosure shall be primed with BASF urethane and finish coated with BASF Superl System paint. Enclosures will be finished in the manufacturer's standard color.
 - c. The enclosures must allow the generator set to operate at full load in an ambient of 40°C with no additional derating of the electrical output.
 - d. The enclosures must meet all of the requirements of UL-2200.
 - e. Enclosures must be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker must meet the requirements of the National Electric Code.
 - f. Doors must be hinged with stainless steel hinges and hardware and be removable.
 - g. Doors must be equipped with lockable latches. Locks must be keyed alike.
 - h. Enclosures must be mounted to the generator set skid.
 - i. The enclosure roof must be pitched to prevent accumulation of water
 - j. A duct between the radiator and air outlet must be provided to prevent re-circulation of hot air.
 - k. The complete exhaust system shall be internal to the enclosure. Enclosures with roof mounted or externally exposed silencers are not acceptable.
 - l. The silencer shall be an insulated critical silencer with a tailpipe and rain cap
6. 6-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient temperatures from -40°C to +60°C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.
9. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection.
10. Enclosure shall be rated for 140mph.

2.02 AUTOMATIC TRANSFER SWITCH

- A. General: Automatic transfer switch shall be furnished with ampere ratings as shown on the drawing and shall consist of automatic transfer switches with control modules interconnected to provide complete automatic operation. Switch shall be listed by UL 1008.

- B. Accessories: The automatic transfer switches shall be provided with the following accessories:
1. Three phase normal sensing with pick-up set at 95% and drop out set at 90% normal voltage. Both pick up and drop out shall be field adjustable to provide flexibility for brownout and other field conditions.
 2. ½ to 6 seconds field adjustable time delay on engine starting to override power dips.
 3. Emergency sensing to prevent transfer until source is adequate with voltage pick up set at 90% and frequency pick up set at 95%. Both values shall be independently field adjustable.
 4. Field adjustable 0 to 32 minutes time delay (set at 15 minutes) on retransfer to normal.
 5. Field adjustable 0 to 8 minutes unload engine run time delay after retransfer to normal.
 6. Running rime meter
 7. Pilot lights to indicate switch position
 8. Test switch to simulate a power failure under load conditions.
 9. Auxiliary contact: 1 closed on normal, 1 closed on emergency.
 10. NEMA 1 wall mountable cabinet.
 11. Exerciser clock.
 12. Time delay shall be such that engine starts comes up to full voltage and transfers to emergency within 30 seconds.

PART 3 - EXECUTION

3.01 GENERAL

- A. The generator set and accessories shall be installed in accordance with the manufacturer's written instructions. Engine coolant and lubricating oil as recommended by the engine manufacturer shall be provided. (Provide antifreeze solution for engine coolant.)

END OF SECTION

SECTION 16050 - BASIC MATERIALS AND METHODS FOR STANDBY GENERATOR FACILITY FOR WSRE TRANSMITTER SITE LOCATED AT 1295 WEST FAIRFIELD DRIVE, PENSACOLA, FLORIDA 32501

PART 1 - GENERAL

1.01 CONDITIONS AND REQUIREMENTS

- A. The General Conditions, Supplementary Conditions and Division 1, General Requirements, and Section 16050 apply.

1.02 DRAWING

- A. The drawing shows the general arrangement of all conduit, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to other requirements shown on all of the drawings. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as required to meet such conditions.

1.03 CODES AND STANDARDS

- A. All material and workmanship shall comply with all applicable codes, specifications, local ordinances, and industry standards.
- B. In case of difference between building codes, specifications, state laws and local ordinances, regulations and the Contract Documents, the most stringent shall govern. The Contractor shall promptly notify the Engineer in writing of any such difference.
- C. Non-Compliance: Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards and utility company regulations, he shall bear all costs arising in correcting the deficiencies.

1.04 COORDINATION OF WORK

- A. The Contractor shall compare the electrical drawings and specifications with existing conditions and report any discrepancies between them to the Engineer and obtain from him written instructions for changes necessary in the work. Before installation, the Contractor shall make proper provision to avoid interferences in a manner approved by the Engineer. All changes required in the work of the Contractor due to his neglect shall be corrected by the Contractor at his own expense.
- B. Locations of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each pipe, duct and electrical raceway prior to fabrication.

- C. Installation and Arrangements: The Contractor shall install all materials and equipment to allow access and clearances for equipment operation, maintenance and in compliance with code.

1.05 FEES, PERMITS AND INSPECTIONS

- A. All required fees, permits and inspections for electrical work shall be obtained and paid for by the Contractor.
 - 1. Certificate of Final Inspection: The Contractor shall, upon completion of the work under this section, furnish a certificate of final inspection to the Engineer.

1.06 CUTTING AND PATCHING

- A. The Contractor shall be responsible for all required excavation, cutting, etc., incidental to the work under that Section, and shall make all required repairs thereafter to the satisfaction of the Engineer, but in no case shall the Contractor cut into any major structural element, beam or column without the written approval of the Engineer.

1.07 AS-BUILT DRAWINGS

- A. Maintain one set of blueline electrical prints on site marked to show as-built conditions and installations.

1.08 GUARANTEE

- A. Contractor shall leave the entire system in proper order and shall replace without additional charge all work or material which may develop defects within one year of final inspection and acceptance by the Engineer.

1.11 IDENTIFICATION

- A. Devices: Each panel board cabinet, safety switch, individual circuit breakers in distribution panel or main distribution switchboard, time clock, motor starter, and the like shall have an identifying nameplate, such as "PANEL L", "FAN EF-1 STARTER". Nameplates: Laminated plastic with 1/4-inch high white engraved letters on black background. Fasten nameplates by 2 rustproof screws.
- B. Conductors: Label each branch circuit in every panel, box, and wireway to indicate the circuit number corresponding with the panel directory. Labels: Self-stick adhesive baked vinyl cloth wire markers. Write on type markers, lettered with indelible ink will be acceptable where stock numbers will not suffice.
- C. Directories: Each panel shall have a typewritten directory mounted on the inside of panel door (power distribution panels shall have engraved nameplates).

1.12 FIRE SAFING

- A. Provide all required fire safing in accordance with accepted UL Standards and in accordance with all applicable code requirements. Boxes in fire walls shall be arranged in accordance with UL requirements.

1.13 EQUIPMENT AND MATERIALS

- A. All materials shall be new and shall bear the manufacturer's name, trade name and the UL label. The equipment to be furnished shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design.
- B. Delivery and Storage: Equipment and materials shall be delivered to the site and stored in original containers, suitable sheltered from the elements. All items subject to moisture or heat damage shall be properly stored in dry and/or heated spaces.
- C. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
- D. Protection: Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury. At the completion of the work, fixtures, equipment and materials shall be cleaned thoroughly and turned over to the Owner in a condition satisfactory to the Engineer. Damage or defects developing before acceptance of the work shall be made good at the Contractors expense.
- E. Dimensions: It shall be the responsibility of the Contractor to insure that items to be furnished can be properly installed within the space provided which will allow adequate space for operation and maintenance. The Contractor shall make necessary field measurements to determine actual space requirements.
- F. Manufacturer's printed instructions shall be followed completely in the delivery, storage, protection and installation of all equipment and materials. The Contractor shall promptly notify the Engineer in writing of any conflict between any requirement of the contract documents and the manufacturer's directions and shall obtain the Engineer's written instruction before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Engineer, he shall bear all costs arising in correcting the deficiencies.
- G. The Contractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the individual systems in such a manner that each system can be operated, maintained, and serviced by the Owner.
- H. Concrete Equipment Bases and Pads: Provide concrete pads and bases for equipment as indicated.

- I. Supports: The Contractor shall support plumb, rigid and true to line all work and equipment. The Contractor shall study thoroughly all general, structural, mechanical and electrical drawings, shop drawings and catalog data to determine how equipment, fixtures, etc., are to be supported, mounted or suspended and shall provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support whether or not shown on the drawings.
- J. Owner furnished contractor installed equipment - as indicated on the drawings certain equipment will be owner furnished contractor installed. These specifications cover all material regardless of whether contractor furnished or owner furnished.

1.14 SUBMITTED DATA AND SHOP DRAWINGS

- A. Materials and equipment schedules shall be submitted as soon as practicable, but not later than thirty days after the date of award of contract, and before commencement of installation of any material or equipment.

PART 2 - PRODUCTS

2.01 CONDUIT

- A. General: 3/4" diameter minimum conforming in size to NEC requirements for the number and type of conductors installed.
 - 1. Uniform thickness, smooth circular bore, standard lengths and free of defects.
- B. Rigid Conduit: Hot dipped galvanized including threads conforming to F.S. W-C58, and ANSI Standard C80.1.
- C. Electro-Metallic Tubing: Zinc plated or sheradized, as manufactured by Triangle or Republic Steel Co.
- D. Flexible Conduit: Regular galvanized, 1/2 diameter minimum.
- E. Liquid tight Flexible Conduit: Galvanized with polyvinyl covering.
- F. Plastic conduit, Schedule 40 or 80 PVC only.
- G. Fittings: Manufactured for service required.
 - 1. Steel fittings only for electro-metallic tubing and rigid.
 - 2. Threadless couplings and connectors not permitted on rigid conduit.
 - 3. EMT: Steel compression type or all steel set screw fittings.

2.02 OUTLET JUNCTION AND PULL BOXES

- A. Outlet boxes and covers shall comply with UL Standard No. 514, cadmium or zinc coated.

- B. Boxes with volume greater than 50 square inches shall comply with UL Standard No. 50 hot dip zinc sheet steel.
- C. Minimum box size 4 inches square with plaster frame to suit outlet.

2.03 WIRE AND CABLE

- A. All conductors shall be copper with type THW, THHN or THWN insulation (size #14 thru #6 shall be THHN/THWN only). Conductors for branch circuits shall be #12 minimum with conductors through #10 solid, #8 and above stranded.
- B. All conductors shall be color coded. Wire sizes through #8 shall have factory applied colored insulation. Wires #6 and larger shall have field applied colored tape at all junction boxes and terminal locations. Color coding shall be as follows:

	L1	L2	L3	Neutral	Grd
120/208V 3 ϕ 60Hz	black	red	blue	white	green
277/480V 3 ϕ 60Hz	brown	orange	yellow	grey	green

- C. Minimum #12 AWG branch circuit conductors. Minimum #10 AWG conductors shall be used for all branch circuit runs exceeding 100 feet to first outlet.
- D. Special system conductors shall be in accordance with manufacturer's recommendations.
- E. Fixture wires shall be suitable for fixture operating temperature.

2.04 WIRE CONNECTIONS AND DEVICES

- A. Comply with F.S. W-S-610B for connections.
- B. Connectors:
 1. For temperatures to 105 degrees C: Ideal Wing Nut or 3M Scotchloc.
 2. For temperatures to 150 degrees C for use in fixtures: Ideal Wire Nut.
- C. Taped Connections:
 1. Scotch 33 or slip-knot grey. Fill voids with rubber tape or Scotchfill.
 2. Use Burndy or equivalent compression connectors for wire sizes #6 and larger.

2.05 INSTALLATION

- A. Conduit:

1. Rigid Conduit:
 - (a) For exposed (exterior) use.
- (b) Make up all joints tight with no running threads.
 - (c) Ream inside edge of cut conduit to prevent wire damage during pulling.
2. Electro-Metallic tubing:
 - (a) May be used for all branch circuit system wiring in dry areas above grade within the building.
3. Flexible Metal Conduit:
 - (a) Use flexible conduit for the connection of light fixtures in ceiling, electric motors and all equipment subject to vibration.
 - (b) Make connections to equipment having motors with flexible metal conduit; where exposed to weather or moisture, use liquid tight flexible metal conduit, unless otherwise shown.
4. PVC Conduit: PVC conduit may be used for runs in slabs or for exterior underground installation.
5. MC Cable. MC Cable may not be used.
6. In slabs on grade having wire mesh reinforcing and no steel bars, install below the vapor barrier.
7. Use conduit of sizes indicated and required by NEC for number and sizes of conductors indicated. Minimum size shall be 1/2" for branch circuits. Minimum size for communications or fire alarm circuits (unless specifically indicated otherwise) shall be 3/4".
8. Neatly paint threaded conduit connections with sealant before connecting. Cut conduit with hacksaw and ream smooth to remove burrs. Cutting by any method which alters the cross section of conduit in any way will not be permitted. Keep conduit bends free from dents, kinks and bruises. Protective coating shall be undisturbed. Radii of the bends shall not be less than those stated in current edition of the NEC. Do not use more than four 90 degree bends between outlets or boxes. Avoid trapping of conduit.
9. Conduit shall be electrically continuous from service equipment to outlets and cabinets. Secure to boxes of sheetmetal construction with one locknut outside and one inside box with reinforced bakelite bushing, O.Z. Gedney Type "A" through 2" and Type "B" for 2-1/2" and larger.
10. See that each length of conduit has the manufacturer's name, initials, or trademark and the Underwriters' Laboratories Inspection Label thereon.
11. Where connections are made to motors, not near walls or columns, install a vertical conduit, minimum size 3/4", attached to floor by a floor flange; bring wiring out of this conduit by means of condulets and flexible conduit, and extend to motor junction boxes.
12. Provide hangers made of durable materials, suitable for the application involved.
13. Do not use perforated iron for supporting conduit.
14. Do not support conduit from ceiling system support wires.
15. Base required strength of supporting equipment and size and type of anchors on the combined weight of conduit, hanger and cables.
16. Support conduits at intervals not to exceed code requirements.
17. Use capped bushings to prevent dirt, concrete, moisture, or other foreign matter from entering conduits during construction. Paper, wood or other plugs are unacceptable.

18. Remove any water from conduit and ducts to avoid freeze damage. Blow out or swab conduit and ducts before pulling wire.
19. Run exposed conduits parallel with or at right angles to building lines. Where more than one conduit is following a given path, install with uniform distances between each other and with concentric bends, offsets and saddles.
20. Fasten single runs of conduit installed exposed on walls and ceilings with cadmium-plated malleable iron or pressed steel one hole straps, machine screws, and lead anchors. Suspend single runs of conduit larger than 1-1/2" by 3/8" steel rod and malleable iron hinge hangers. Use 1/4" steel rods for smaller conduit.
21. Cut necessary openings in concrete, masonry, brick walls, concrete, wood construction, etc., from both sides to affect a neat workmanlike job.
22. Have competent personnel on job during placing of concrete and masonry wall construction to insure proper installation of electrical conduit.
23. Use standard electrical unions for connection conduit where standard couplings cannot be used. Use of running threads will not be permitted.
24. Conduit passing through concrete shall be sealed with concrete grout. Conduit passing through rated walls shall be sealed with concrete grout or drywall cement.
25. Conduit passing through concrete shall be sealed with concrete grout. Conduit passing through rated walls shall be sealed with concrete grout or drywall cement.
26. Where conduit passes through building expansion joints, provide O.Z. Gedney Type "AX", or equal, expansion fittings.
27. Pull a 200 pound test line into conduits left empty.
28. All conduits passing from building to building and conduit sleeves installed below the computer floor shall be interior sealed around cables (including cables installed by others) using suitable cable sealing material.

B. Cable Installation

1. Do not pull conductors into conduits until work which may cause cable damage is completed. Use only approved cable lubricants.
2. Tag all conductors and identify major conduits in or at wireways, panels, pull boxes, motor controllers, cabinets and similar items to assist in future circuit tracing.
3. Provide barriers where required by Code.
4. Independently support pull boxes on the building structure.
5. Do not depend on the conduit system for support.
6. Connection to all fixtures in areas with removable ceiling panels shall be from outlet boxes located above the ceiling with flexible conduit connection to the fixtures. Symbols on drawings and mounting heights as indicated on drawings and in specifications are approximate only. The exact locations and mounting heights must be determined on the job and is shall be the Contractors responsibility to coordinate with all trades and the architectural drawings, to secure the correct installation, i.e., over counters, in or above backsplashes, in block walls and other specific construction features. Back-to-back outlets will not be allowed. Minimum separation between boxes shall be 2 inches.

C. Grounding

1. Ground electrical system in accordance with Article 250, National Electrical Code and local authorities having jurisdiction and the following requirements. Bond to building steel, cold water mains and driven ground rods.
2. All feeders and branch circuit raceways shall contain an insulated green wires.
3. Attach panel ground bars to panel cans and isolate neutral bars.
4. Grounding bushings where required shall be bonded to the panel board ground bus with an insulated conductor sized in accordance with the NEC table for equipment grounding conductors.
5. Provide ground wire sized as per NEC in all PVC conduit.

2.06 TESTS

- A. General: The Contractor shall show by demonstration in service that all circuits and devices are in operating conditions. Tests shall be such that each item of control equipment will function not less than five times.
- B. Test on 600 Volt Wiring: Test all 600 volt wiring to verify that no short circuits or accidental grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance.
- C. Grounding System Test: Test the grounding system to assure continuity and that resistance to ground is not excessive.

PART 3 - EXECUTION - Not Applicable To This Section

END OF SECTION