SECTION 26 34 37

UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. System requirements.

B. Rectifier/chargers.

C. Inverter.

D. Static transfer switch.

E. Maintenance transfer switch.

F. Hard transfer.

G. Batteries.

H. Controls.

I. Metering.

J. Indicators.

1.02 MEASUREMENT AND PAYMENT

A. General: Uninterruptible power supply systems, as specified herein, will not be measured separately for payment but will be paid for as part of the Contract lump-sum price for the related electrical or electronic systems work as indicated in the Bid Schedule of the Bid Form.

1.03 SUBMITTALS

A. General: Refer to Section 01 33 00 - Submittal Procedures, and Section 01 33 23 - Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Submit product information and catalog cuts of UPS equipment components and devices.

PART 2 - PRODUCTS

2.01 SYSTEM REQUIREMENTS

A. General: Uninterruptible Power Supply Systems (UPS) shall consist of the UPS cabinet, dc batteries, racks, regulating transformer, and interface accessories.

B. Mode of Operation.

1. Train Control and Communication Circuits. The UPS for train control and communication circuits shall be an on-line type and make before break operation during load transfer. Mode of operation shall be as follows:

   a. Normal. The inverter shall supply ac power continuously to the essential loads through the static transfer switch. The inverter output shall be synchronized with the alternate ac power source. The rectifier/charger shall convert the normal ac input power to dc power for the inverter and for float charging the dc battery.

   b. Loss of Normal Input Power. The dc battery shall supply dc power to the inverter so that there is no interruption of ac power to the essential loads whenever the normal ac input power source of the UPS deviates from specifications or fails. The battery shall continue to supply power to the inverter at rated full load for the specified hours of emergency operation at each TCR.

   c. Return Of Normal Power. The rectifier/charger shall start and assume essential loads when the normal ac power is restored. The rectifier/charger shall then simultaneously supply the inverter with dc power and charge the dc. This shall be an automatic function and shall not cause any disturbance to the essential loads.

   d. Transfer to Alternate Source. On an inverter shutdown or degradation of the inverter output, the transfer switch shall automatically transfer the essential loads from the inverter output to the alternate ac power source without interruption of power. If the alternate power source is not within normal voltage limits, then such a transfer shall be inhibited.

   e. Retransfer To Normal Operation. The static transfer switch shall be capable of manual operation to retransfer the loads to the inverter, after the inverter has been returned to normal operation and stabilized for a period of time. Retransfer shall not occur if the two ac sources are not synchronized.

   f. Preferred Source Discontinuity. If there is loss of continuity on the inverter side of the static transfer switch, then loads shall automatically transferred to the alternate source and automatic retransfer to UPS shall be inhibited. Retransfer of loads to the inverter shall be possible only after a manual reset.

   g. Operation Without Batteries. If the battery is taken out of service for any reason, the UPS shall continue to function with all the performance criteria except for the battery operation.

2. Lighting and Power Circuits: The UPS for lighting and power circuits shall be an off-line type and break before make operation during load transfer.

C. Power Rating

1. Power calculations for each UPS shall be prepared and submitted for District approval. The UPS shall be sized in accordance with the District-approved power calculations to support the connected load. The UPS shall be capable of supplying power to loads with power factor of 0.8 lagging to 0.8 leading. The input line voltage, load voltage and input bypass line voltage shall be as indicated on the Contract Drawings. Product information for the UPS shall be submitted to the District for approval.

2. The UPS battery shall have capacity to support the load at each location. A battery voltage of no less than 1.75 volts per cell shall be maintained for the specified hours of emergency operation.

D. Electrical Characteristics:

1.	Input Voltage Range	+10%, -15%
2.	Input Frequency Range	+5%
3.	Power Walk-in	20% to 100% of rated load over 15 seconds
4.	In rush current	8 times normal full load current
5.	Power Factor	0.8 lagging to 0.8 leading at full load
6.	Current Limit	125% full load maximum
7.	Protection	Per NEC requirements
8.	Voltage Transient	Per IEEE 587 requirements. Protection up to 4000V Peak and up to 150% line voltage for 15 seconds

E. Output Rating:

1.	Voltage Rating	as indicated
2.	Voltage Regulation	± 2%
3.	Voltage Adjustment	± 5%
4.	Frequency	60Hz, ± 0.1%
	a) Free running regulation	0.5%
	b) Free running stability	± 0.15% in 24 hr; ± 1% in 6 months

5. Voltage Transients:

a.	20% Load step	± 5%
b.	30% Load step	± 5%
c.	50% Load step	± 8%
d.	Return of AC Power	± 2%
a.	Manual transfer of load to UPS or bypass line	± 5%

	b. Automatic transfer of load	± 8%
6.	Voltage transient recovery time to within 2% within 50 msec.	
7.	Load power factor	0.8 lagging to 0.8 leading
8.	Harmonic contents	5% RMS maximum; 3% any single harmonic
9.	Overloads	125% for 10 minutes; 115% for 1 hour
10.	Static transfer	1000% full load for 1 switch loading cycle; 200% full load for 5 minutes
11.	Hours of operation	8 hrs @ full load

F. Audible Noise. Noise generated by the UPS under any condition of normal operation shall not exceed the allowable sound pressure level of 65 dBA measured at 6 feet 6 inches from the nearest surface of the cabinet

2.02 EQUIPMENT REQUIREMENTS

A. General: The UPS shall be designed for operation in a non-air conditioned room environment with temperature extremes of 32 degrees F and 120 degrees F. The UPS cabinet shall be of modular construction for ease of maintenance, minimum repair time, and quick return to service.

1. Modules shall be standardized such that replacement modules shall fit in the same slot without any need for modifications.

2. Replaceable parts shall be located such that they are easily accessible without the need to remove other unaffected parts.

B. Rectifier/Charger:

1. The rectifier/charger shall include an input circuit disconnect, an isolation transformer, surge suppressor, and a solid-state rectifier with circuitry to provide constant voltage and constant current regulation.

2. The input shall be equipped with a non-automatic disconnect and the output shall be fused and current limited to protect the rectifier wiring, connections to the inverter input and against damage to the battery.

3. The input transformer to the rectifier/charger shall be isolation type with copper windings. The transformer shall have the following characteristics:

   a. The windings shall have extra reactance to minimize noise feedback to the input power lines from the rectifier/charger;

b. The transformer core shall be designed to limit the sub cycle magnetizing inrush currents to four times the maximum peak current input during battery recharge;

c. Input transformer shall not have any active components; and,

d. The rectifier/charger shall be furnished with output filtering to limit ripple currents into the battery.

C. Inverter:

1. The inverter shall consist of dc filter capacitors, dc surge protection, a solid- state inverter, an output isolation transformer, an output filter, and circuitry to provide precise voltage regulation and current limiting.

2. Overcurrent Protection.

a. The inverter input shall be protected by fast acting fusing to prevent damage to its solid-state power devices.

b. The inverter output shall be both protected and current limited.

3. Filter Capacitors. The dc input of the inverter shall have banks of filter capacitors. The loss of one bank shall not disrupt output voltage or continued full load operation.

4. Protection.

a. The inverter input shall have dc surge protection to assure operation in the event there are surges or spikes on the inverter input.

b. The output circuitry shall limit the current by decreasing the voltage, when the load current exceeds overload limit.

c. The inverter shall provide a low-voltage initial start up and ramp up to full voltage in less than 5 seconds.

d. The circuitry shall automatically synchronize and phase lock the inverter output to the alternate power source as long as the source is within 60 +0.5 Hz. If the alternate source is not within these limits, then the inverter shall lock to an internal oscillator.

e. The inverter shall automatically turn off at the dc voltage low level of 1.75 volts per cell.

f. Test points and LED's shall be provided to facilitate adjustments, diagnostics and identify circuit integrity.

g. It shall be possible to test logic circuitry without operating the power circuits.

D. Static Transfer Switch. A static transfer switch shall be provided for automatic/manual transfer of loads from the inverter to the alternate power source. The transfer switch shall be

controlled by means of a pair of silicon-controlled rectifiers (SCR). The operation of the transfer switch shall be as follows:

1. Inverter Failure. If the inverter output voltage is below the normal undervoltage, the static transfer switch shall transfer the loads to the alternate source of power, at the same time turning off the inverter. The transfer shall be inhibited, if the alternate power source is not within specifications.

2. Retransfer To Inverter. The static transfer switch shall be capable of automatically retransferring the load back to the inverter after the inverter has returned to normal operating conditions.

3. Inverter side discontinuity. If one or more of the SCRs on the inverter side of the static transfer system should develop a discontinuity causing loss of output or half-cycle operation, then the load shall automatically be transferred to the alternate source. Retransfer shall only be possible by a manual transfer under this case.

4. Overload. If an overload is detected, the static transfer switch shall operate as described in 1 or 2 above.

5. Over-current Protection. Fuses shall be placed in the inverter input of the static transfer switch of both sources.

6. Surge Protection. The static transfer switch shall have surge protection on the alternate source side.

7. Transfer Conditions. The static transfer switch shall transfer from inverter to the alternate power source for the following conditions:

    a. Inverter under-voltage: 90% of normal

    b. Inverter over-voltage: 110% of normal

    c. Inverter overload: 125% of rated load

    d. Loss of continuity in inverter side SCR

    e. Blown fuse in the inverter

    f. Manual initiation

8. Transfer Inhibit. The static transfer switch shall inhibit transfer if the alternate power source voltage is less than 80% of nominal value.

9. Transfer Sensing Time. Maximum transfer sensing time for loss of inverter time shall be 1/4 of a power cycle.

10. Transfer Switching Time. Maximum transfer time to switch from inverter to the alternate power source shall be 100 microseconds.

E. Maintenance Transfer Switch: A manually operated bypass switching arrangement shall be provided to permit transferring the essential loads to the alternate power source, without interruption of power and at the same time to electrically isolate the static transfer switch and inverter from the alternate power source.

F. Hard transfer: UPS transfer of power feed from primary to bypass lines through the maintenance bypass switch shall be possible only when the following conditions occur simultaneously:

1. Non-synchronization between inverter and backup power

2. Static switch disabled

3. Inverter disabled

G. Batteries: Batteries, battery racks, and accessories shall be in accordance with the requirements specified in Section 26 33 01 - DC Battery System.

H. Controls. The UPS system shall be furnished with the following controls on or inside the UPS module cabinet.

1. Rectifier/Charger

   a. Input non-automatic disconnect

   b. DC float voltage adjustment

   c. DC boost (equalize) voltage adjustment

   d. Boost (equalize) voltage timer adjustment

   e. Boost (equalize) voltage initiation

   f. Boost (equalize) voltage timer reset

2. Inverter

   a. Inverter start

   b. Inverter stop

   c. DC under-voltage shutoff adjustment

   d. Output AC voltage adjustment

3. Static transfer switch

   a. Transfer switch test

   b. Transfer switch setting adjustments

c. Maintenance transfer switch

I. Metering. The following parameters shall be individually metered with a digital read out and with an accuracy of 2% or better:

1. DC voltage; Rectifier/charger

2. Direct current: Rectifier/charger

3. AC voltage

4. Alternating current

   a. Inverter

   b. Alternate power source

   c. Load

5. Frequency

   a. Inverter

   b. Alternate power source

   c. Load

J. Indicators. The following status and alarm functions shall be monitored (or annunciated) by either LED's or message display on the front of the UPS module cabinet:

1. Status Indications

   a. Synchronization

   b. Static transfer switch (in inverter position)

2. Alarms, in the form of flashing displays, shall be provided for the abnormal conditions specified below. Auxiliary contacts shall be provided for each abnormal condition as well as a summary alarm contact for connection to the Supervisory Control and Data Acquisition System. Alarm contacts shall latch until reset.

   a. Low battery voltage

   b. Over-temperature in the battery enclosure area

   c. DC over-voltage

   d. DC ground

   e. Synchronization disconnect

f. Alternate power source failure

g. Static transfer switch position (in the alternate power source position)

h. Fan failure

i. Maintenance transfer switch position - ON

j. Battery carrying the load only

END OF SECTION 26 34 37