This master should be used by designers working on Port of Portland construction projects and by designers working for PDX tenants (“Tenants”). Usage notes highlight a few specific editing choices, however the entire section should be evaluated and edited to fit specific project needs.

SECTION 263353 – STATIC UNINTERRUPTIBLE POWER SUPPLY

1. GENERAL
	* + 1. DESCRIPTION
				1. Provide a 3-phase, on-line, solid state uninterruptible power system (UPS) for regulated 60 Hz alternating current (AC) power to a critical load.
			2. REFERENCES
				1. IBC: International Building Code
			3. DEFINITIONS
				1. UPS - Equipment operating to provide precise AC power to a load. The UPS shall include modules, a static bypass switch, maintenance bypass, controls and monitoring, and a battery system.
				2. UPS Module - A single or multiple rectifier/charger and inverter unit with associated controls, synchronizing equipment, protective devices and auxiliary equipment required to operate individually.
				3. Rectifier/Charger Unit - That portion of a UPS module containing the equipment and controls necessary to convert input AC power to regulated DC power required for input power to the inverter units and for battery charging.
				4. Inverter Unit - That portion of a UPS module containing the equipment and controls necessary to convert DC power, from the rectifier/charger or battery, to precise AC power required to supply power to a load.
				5. Static Bypass Switch - The solid-state device used to automatically switch the critical load to the bypass AC input source in the event of a UPS failure.
				6. Maintenance Bypass - A manual switch which provides the capability to continuously support the critical load from the bypass AC input source while the UPS is isolated for maintenance.
			4. OPERATION
				1. The UPS shall automatically affect continuity of electric power within specified tolerances, without interruption upon failure or deterioration of the power supply. Continuity of electric power to the load shall be maintained for a standby period with the inverters supplied by the batteries up to the specified maximum time or until restoration of the power supply.
				2. The rectifier/chargers shall be solid state and shall convert incoming AC power to DC power. The UPS shall present a nominal unity power factor and sinusoidal current demand to the source. The rectifier/ charger outputs shall be fed into solid state inverters. The inverters shall convert the DC power into AC power which shall supply the load.
				3. Upon failure of AC power, supply input power for the inverter shall automatically be supplied from the batteries with no interruption to the inverter output. At the same time, the UPS shall energize an alarm circuit and associated trouble indicators. When the AC power is restored, input power for the inverter and for recharging of battery shall automatically be supplied from the rectifier/charger outputs without interruption. If the battery is exhausted before AC power returns, the UPS shall shut down automatically with no software reload required.
				4. The output of the UPS shall be via an output breaker for distribution to a panel board.
			5. SUBMITTALS
				1. Submit the following:

Product data.

Shop drawings.

Operation and maintenance manuals, showing sufficient detail and clarity to enable Port maintenance personnel to understand and operate the UPS equipment. The manual shall describe the UPS in full including, but not limited to, the following major items:

Operating procedures.

Performance data and technical data.

General description.

UPS module description.

Communications capability.

Battery description.

Accessory description.

Maintenance procedures.

* + - 1. QUALITY ASSURANCE
				1. Manufacturer: The manufacturer shall be one regularly engaged in the manufacture of solid-state power conversion equipment for commercial and industrial use. The manufacturer shall maintain a quality control program encompassing in-process as well as final inspection and tests designed to ensure the quality, reliability, and performance required by this specification.
				2. Acceptance Tests: All equipment furnished under this specification shall be subject to the following factory tests:

Complete wire check to assure correct connections and quality of all joints.

Proper grounding check of complete system equipment.

Electrical operation of all control circuits.

Transformer tests to assure proper secondary voltage balance.

Safety check for spacing of bare bus bars, conductors, and components and for access space for maintenance.

Static and magnetic noise elimination check to avoid control circuit interference.

Operation of RS232 communication package over a remote modem connection.

* + - 1. SYSTEM DEMONSTRATIONS
				1. Provide training by the manufacturer for the Port’s personnel at an on-site location. Training shall be conducted by experienced personnel, supported by training aids. Participants shall receive individual copies of technical manuals and pertinent documentation at the time the course is conducted.
			2. WARRANTY
				1. Provide the UPS system with a comprehensive, on-site warranty expiring 5 years from the date of final acceptance. The warranty shall cover parts, labor, travel, and freight for the UPS system. Typical on-site response time shall be 4 hours (24 hours, maximum).
			3. RELIABILITY
				1. System mission reliability (including bypass) shall be in excess of 62,000 Mean Time Between Failures based upon reliability information of previous installations. Demonstrated equipment reliability shall be 3 years, minimum.
			4. MAINTAINABILITY
				1. Calculated and demonstrated Mean Time to Repair shall be 1 hour, including time to diagnose the problem and replace subassembly.
1. PRODUCTS
	* + 1. ACCEPTABLE MANUFACTURERS

Brand name exemption expires 5/17/2021.

* + - * 1. Toshiba, no substitutions.
			1. RATING

Edit “80KVA/64KW” as appropriate for the project.

* + - * 1. The UPS shall be capable of sustaining a total equipment load of 80KVA/64KW. The UPS shall be equipped with a battery system capable of supplying the load at rated voltage, for a minimum period of 5 minutes for the rated load.
			1. ELECTRICAL CHARACTERISTICS
				1. Input:

Voltage: 208V AC +10 percent, -15 percent, 3-phase.

Frequency: 60 Hz, ±5 percent.

Power Walk-In: 20 percent to 100 percent of full rated load over 10 seconds.

Power Factor: Unity to 0.95 lagging with full load at ±5 percent input voltage and normal float voltage on battery.

Input Current Limit: 125 percent of nominal capacity.

Input Current THD: Less than 10 percent total harmonic distortion.

The UPS shall be fully capable of operating from a motor generator with no interaction problems.

* + - * 1. Output:

Rating: 80KVA/64KW.

Voltage: 208Y/120 volts ac, 3-phase, 4 wire plus ground, ±3 percent manually adjustable.

Voltage Regulation for All Load Conditions: ±2 percent for balanced load, ±3 percent for 100 percent unbalanced load.

Frequency: 60 Hz, ±0.1 percent.

Harmonic Content for All Load Conditions: Maximum 5 percent RMS total, maximum 3 percent single harmonic; crest factor not to exceed 3:1.

Phase Displacement:

Balanced Loads: 120° ±2°.

100 Percent Unbalanced Load: 120° ±4°.

Voltage Unbalanced:

Balanced Load: ±1 percent from the arithmetic average of the three phases.

20 Percent Unbalanced Load: ±1 percent from the arithmetic average of the three phases.

50 Percent Unbalanced Load: ±2 percent from the arithmetic average of the three phases.

Voltage Transient Response:

50 percent step load change ±3 percent.

100 percent step load change ±5 percent.

Transient Voltage Recovery: 50 ms to within ±1 percent of output voltage.

Overload: 125 percent of its full load rating for 1.5 minutes. 150 percent of the full load rating for 10 seconds.

* + - * 1. Efficiency: Overall system efficiency AC to AC shall not be less than 87 percent at 100 percent rated load when the battery is fully charged and input AC voltage and frequency are within the limits specified.
			1. ENVIRONMENTAL CONDITIONS
				1. The UPS shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics:

Operating ambient temperature 0°C to 40°C (not including batteries).

Relative humidity 0 percent to 90 percent for all temperatures in the temperature range stated above.

Barometric Pressure: From sea level to 3,000 feet above.

Acoustical Noise Level: Less than 70 dBA at 3 feet, measured at full load.

* + - 1. EQUIPMENT
				1. Rectifier/Charger Unit:

The rectifier/charger unit shall be solid state and shall provide direct current to the inverter unit and for battery charging, be provided with an input circuit breaker, and be designed to limit the input harmonic current distortion fed back into the input AC source at full load and nominal input voltage.

Provide for input current limiting whereby the maximum input current shall be limited to 125 percent of the full input current rating. Current limit shall be adjustable from 100 percent to 125 percent.

Provide features whereby when the AC power is returned to the AC input bus after the UPS has been operating on battery power or has been de‑energized, the total initial power requirement at the input terminals will not exceed 20 percent of rated load current, and the current will gradually increase to 100 percent of full rating over a 10-second time interval.

Power semi-conductors in the rectifier/charger shall be fused with fast acting fuses, so that loss of any one power semi-conductor will not cause cascading failures.

Contain an input filter to minimize ripple current into battery. Under no conditions shall ripple current into the battery exceed 2 percent RMS. UPS module shall have the capability of having the inverter operated from the rectifier with battery disconnected.

Charging current shall be voltage regulated current limiting. In addition to supplying power for the load, the rectifier/charger shall be capable of recharging the battery to 95 percent charge within ten times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.

* + - * 1. Inverter Unit:

Be a solid state device capable of accepting the output of the rectifier/chargers or battery, and providing rated output within specified limits.

Sustain an overload across its output terminals, while supplying any load within its rating. If a short circuit is sustained, the inverter shall shut down and disconnect automatically from the critical load bus.

Contain fault sensing and a static interrupter together with output circuit breaker for removal of a faulted module from the system.

Power semi-conductors in the inverter shall be fused with fast acting fuses to prevent cascading failures. Each fuse shall be provided with a blown fuse indicator with an alarm light on the control panel.

* + - * 1. UPS Module Battery Circuit Breaker: The UPS module shall have a battery circuit breaker. When open, there shall be no battery voltage present in the UPS module enclosure. The UPS module shall automatically be disconnected from the battery by opening the circuit breaker when the discharge limit of volts per cell for the type of battery provided is reached, or when signaled by other control functions.
				2. Static Bypass System: Provide equipment to allow uninterrupted transfer of the critical load from the output of the UPS system to utility power, as well as from utility power to UPS output. This transfer shall be performed by an automatic synchronous transfer circuit from UPS to utility power in the event of an incipient UPS malfunction as follows:

AC output undervoltage (sustained).

AC output overvoltage (sustained).

AC output overcurrent (sustained).

Rectifier or inverter overtemperature.

Rectifier or inverter failure.

Manual selection of bypass.

Provide controls and instrumentation to permit manually initiated transfer of load from utility to UPS output.

* + - * 1. The static transfer switch shall meet the following requirements:

Inverter Failure Transfer: 0.10 Hz maximum.

Inverter Overload Transfer: 0.25 Hz maximum.

Asynchronous Transfer: 0.25 Hz maximum.

Retransfer Delay: 5-30 seconds, auto mode.

Transfer Point: ±10 percent of nominal inverter voltage.

Retransfer Point: ±5 percent of nominal inverter voltage.

Transfer Inhibit Point: ±20 percent of nominal inverter voltage.

* + - * 1. The static switch shall be designed to furnish two operating modes for retransfer functions:

Auto Mode: Allows the static switch to automatically retransfer the load to the inverter after a timed interval of normal operation.

Inhibit Mode: Inhibit the static switch from transferring the load to the inverter until the switch is placed in the auto position.

* + - * 1. Protection: The UPS module shall have built-in self-protection against overvoltage power line surges, undervoltages, overcurrent, sudden changes in output load, and short circuits at the output terminals. Each UPS module shall have built-in protection against permanent damage to itself and the connected load for all predictable types of failures within itself, and the connected load for all predictable types of failures within the UPS. Use fast-acting current limiting devices to protect against failure of solid state devices. Internal failures in a UPS module shall cause the module to trip off-line with minimum damage to the module and to provide maximum information to maintenance personnel regarding the reason for tripping.
				2. Emergency Power Off (EPO): The UPS shall have built-in terminals which trip open the UPS and battery circuit breakers from remote device.
				3. Maintenance Bypass System: The maintenance bypass system shall be capable of transferring full load output to normal power source without any power or phase interruption to load. The system shall include separate step down isolation transformer with matching phase rotation at UPS unit when in bypass and a make-before-break manual transfer switch feeding power panel.
			1. CONTROL AND MONITORING
				1. Module Control Panel: The UPS module shall have a digital display instrumentation and alarms control panel. Provide the following display.

Instrumentation:

Input voltage and current for each phase.

DC battery charge/discharge current.

DC battery voltage.

Inverter output voltage and current for each phase.

Alarms: An audible alarm shall sound with any of the following alarms:

Overload.

Overload shut down.

Equipment overtemperature.

Ambient overtemperature.

Fuse failure.

Blower failure.

Battery breaker open.

Battery discharging.

Low battery.

DC overvoltage.

DC ground fault.

Input power failed.

Control power failed.

Emergency OFF.

* + - * 1. System Mimic: A system mimic diagram with lights shall give the status indication of AC input breaker, battery breaker, and AC output breaker.
				2. RS232 communications interface.
				3. IBM AS/400 interface.
				4. Event history log.
			1. STORAGE BATTERIES
				1. Furnish sealed lead acid (maintenance free) batteries for the UPS, with sufficient ampere hour rating to maintain UPS output at a capacity, and for a duration as specified herein. It shall be of heavy-duty industrial type design for auxiliary power service.
				2. Battery cells shall be lead calcium type, with sealed cell containers of impact resistance plastic.
				3. Battery shall operate at 2.25 volts per cell on float charging. At the end of discharge, the cell voltage shall not be less than 1.65 volts per cell. The fully charged cells shall have a specific gravity of 1.250 at 77ºF.
				4. Mount to resist seismic forces as specified in the IBC for the ground motion accelerations corresponding to the project location.
1. EXECUTION
	* + 1. INSTALLATION
				1. Receive, inspect and install cells of battery, UPS Module and make all wiring connections. Inspect installation and check UPS for any damage due to transportation, handling and installation and any defects corrected. Start up system and test by reconducting as much of factory test as possible in field environment. Correct any problems encountered. Train Port personnel that normally will be operating the system.
			2. FIELD ACCEPTANCE TEST ON SITE
				1. Following successful start-up of the UPS system, Port personnel will assume control of the system and will proceed to perform test by reconducting as much of the factory test in accordance with this specification as is possible in the field environment. Any problems encountered during this test will be brought to the attention of the Contractor for his correction. Keep at least one of the manufacturer’s field engineers, knowledgeable in the UPS system, on site until the field test is successfully completed.

END OF SECTION 263353