

Part 1 General

1.1 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Submittals to include:
 - .1 System configuration with single-line diagrams.
 - .2 Functional relationship of equipment including weights, dimensions, and heat dissipation.
 - .3 Descriptions of equipment to be furnished.
 - .4 Size and weight of shipping units to be handled by installing contractor.
 - .5 Detailed installation drawings including all terminal locations.

1.2 CLOSEOUT SUBMITTALS

- .1 Provide data for incorporation into operation and maintenance manual specified in Section 01 78 00 - Closeout Submittals.

- .2 Operation and Maintenance Manual to include:
 - .1 Operation and maintenance instructions concerning design elements, construction features, component functions and maintenance requirements to permit effective operations maintenance and repair.
 - .2 Technical data:
 - .1 Approved shop drawings.
 - .2 Project data.
 - .3 Technical description of components.
 - .4 Parts lists with names and addresses of suppliers.
 - .5 Functional description of the equipment with block diagrams
 - .6 Safety precautions
 - .7 Instructions and step-by-step operating procedures
 - .8 Routine maintenance guidelines, including illustrations.

1.3 SYSTEM START-UP

- .1 Provide factory authorized service personnel to supervise start-up of system, checking, adjusting and testing on site.

1.4 TRAINING

- .1 Provide one training session for City electrical maintenance personnel, at the Site.

- .2 Instruct City personnel on theory, construction, installation, operation and maintenance of the UPS installations.

Part 2 Products

2.1 UNINTERRUPTIBLE POWER SYSTEM

- .1 Provide as per Schedule 263353-1.
- .2 Manufacturer and Model: Liebert NX Series.
 - .1 Alternative manufacturers will not be accepted due to this product having been selected as the plant standard.
- .3 Conformance with CSA C22.2, No. 107.3.
- .4 CSA/ cUL approved.
- .5 Technology:
 - .1 Online, double-conversion, split-phase topology with static bypass switch.
 - .2 Frequency independent operation.
- .6 Design Requirements - UPS Module
 - .1 Voltage. Input/output voltage specifications of the UPS shall be:
 - .1 Rectifier Input: 208 volts, three-phase.
 - .2 Output: 208 volts, three-phase, 4-wire-plus-ground.
 - .2 Output Load Capacity. Specified output load capacity of the UPS shall be as shown in Schedule 263353-1 at 0.8 lagging power factor.
- .7 Design Requirements - Battery
 - .1 Battery Cells: Sealed, lead-acid, valve-regulated.
 - .2 Recharge Time: to 95% capacity within ten (10) times discharge time.
 - .3 Provide means (circuit breaker or switch) to isolate the battery from the UPS.
 - .4 Runtime:
 - .1 For units going to the SEWPCC: minimum 40 minutes at design load.
 - .2 For units going to the NEWPCC: minimum 120 minutes at design load.
- .8 Modes of Operation
 - .1 The UPS shall be designed to operate as an on-line, double-conversion, reverse-transfer system in the following modes:
 - .1 Normal - The critical AC load is continuously supplied by the UPS inverter. The rectifier/charger derives power from a utility AC source and supplies DC power to the inverter while simultaneously float-charging the reserve battery.
 - .2 Emergency - Upon failure of utility AC power, the critical AC load is supplied by the inverter, which, without any switching, obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
 - .3 Recharge - Upon restoration of utility AC power, after a utility AC power outage, the rectifier/charger shall automatically restart, walk-in, and gradually assume the inverter and battery recharge loads.

- .4 Bypass - If the UPS must be taken out of service for maintenance or repair, or should the inverter overload capacity be exceeded, the static transfer switch shall perform a reverse transfer of the load from the inverter to the bypass source with no interruption in power to the critical AC load.
- .9 Performance Requirements
 - .1 AC Input to UPS
 - .1 Voltage Configuration for Standard Units: three-phase, 3-wire plus ground.
 - .2 Voltage Range: +10%, -20% of nominal.
 - .3 Frequency: Nominal frequency $\pm 5\%$.
 - .4 Power Factor: Up to 0.99 lagging at nominal input voltage and full rated UPS output load.
 - .5 Inrush Current: 800% of full load current maximum.
 - .6 Current Limit: 125% of nominal AC input current maximum.
 - .7 Input Current Walk-In: 20 seconds to full rated input current maximum. Field selectable 5 through 20 seconds.
 - .8 Current Distortion: 4% reflected THD maximum at full load.
 - .9 Surge Protection: Sustains input surges without damage per criteria listed in IEC 1000-4-5.
 - .2 AC Output, UPS Inverter
 - .1 Voltage Configuration: three-phase, 4-wire plus ground
 - .2 Voltage Regulation:
 - .1 $\pm 1\%$ three-phase RMS average for a balanced three-phase load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.
 - .2 $\pm 2\%$ three-phase RMS average for a 100% unbalanced load for the combined variation effects of input voltage, connected load, battery voltage, ambient temperature, and load power factor.
 - .3 Frequency: Nominal frequency $\pm 0.1\%$.
 - .4 Frequency Slew Rate: 1.0 Hertz per second maximum. Field selectable from 0.1 to 1.0 Hz per second.
 - .5 Phase Displacement:
 - .1 ± 0.5 degree for balanced load,
 - .2 ± 1.0 degrees for 100% unbalanced load.
 - .6 Bypass Line Sync Range:
 - .1 0.5 Hertz,
 - .2 Field selectable ± 0.5 to 5.0 Hz.
 - .7 Voltage Distortion:
 - .1 1% total harmonic distortion (THD) for linear loads.
 - .2 $< 4\%$ THD for 100% nonlinear loads (3:1 crest factor) without kVA/kW derating.
 - .8 Load Power Factor Range: 0.7 lagging to 0.95 leading without derating.
 - .9 Output Power Rating: Rated kVA at 0.8 lagging power factor.

- .10 Overload Capability:
 - .1 125% for ten minutes (without bypass source).
 - .2 150% for one minute (without bypass source).
- .11 Inverter Output Voltage Adjustment: $\pm 5\%$ manual adjustment.
- .12 Voltage Transient Response:
 - .1 100% load step $\pm 4.0\%$.
 - .2 Loss or return of AC input power $\pm 1.0\%$.
 - .3 Manual transfer of 100% load $\pm 3.0\%$.
- .13 Transient Recovery Time: to within 1% of output voltage within one cycle.
- .14 Voltage Unbalance: 100% unbalanced load $\pm 1\%$.
- .10 Environmental Conditions
 - .1 The UPS shall be able to withstand the following environmental conditions without damage or degradation of operating characteristics:
 - .1 Operating Ambient Temperature
 - .1 UPS Module: 0°C to 40°C .
 - .2 Battery: $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$.
 - .2 Storage/Transport Ambient Temperature
 - .1 UPS Module: -20°C to 70°C .
 - .2 Battery: 20°C to 33°C .
 - .3 Relative Humidity
 - .1 0 to 95%, non-condensing.
 - .4 Altitude
 - .1 Operating: to 1000 meters above Mean Sea Level. Derated for higher altitude applications.
- .11 Audible Noise
 - .1 Noise generated by the UPS under any condition of normal operation shall not exceed 54 dBA measured 1 meter from surface of the UPS.
- .12 The UPS shall have provision for battery status monitoring, which shall include automatic battery tests on a scheduled basis, and be able to report on battery life remaining (estimate), total number of discharges, total time in discharge. The power to the load of the unit shall be completely protected from unanticipated battery failure during these tests.
- .13 The UPS shall have controls mounted in panel front.
- .14 Factory Testing:
 - .1 Before shipment, the manufacturer shall fully and completely test the system to assure compliance with the specification.
- .15 Relay Card
 - .1 Provide status contacts for:
 - .1 UPS Fault
 - .2 Summary Alarm

- .3 Low battery
- .4 On Battery / ON UPS status
- .5 On Bypass Status

2.2 MAINTENANCE BYPASS CABINET

- .1 Provide as per Schedule 263353-1.
- .2 Transformers in accordance with CAN/CSA-C22.2 No. 47
- .3 Include:
 - .1 Input and output breakers.
 - .2 Internal 600:120/208 V input transformer.
 - .3 Make-before-break switch with UPS, Line, Service, and Off Positions.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate UPS and Maintenance Bypass Cabinets as indicated on the drawings.
- .2 Support and anchor the UPS as per manufacturer's instructions.
- .3 Connect and configure UPS and Maintenance Bypass Cabinets as per manufacturer's Installation Manual.
 - .1 Wire input, output, and ground bus bars.
 - .2 Connect control cables.
 - .3 Connect ac mains to main input terminal.
 - .4 Connect UPS output to load.
 - .5 Connection of internal batteries to be performed ONLY by factory authorized service personnel.
- .4 Start-up UPS and make preliminary tests to ensure satisfactory performance. Do not power UPS without factory authorized service personnel present.

3.2 TESTING

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.
- .2 Testing configuration shall not interfere with the supply of power to the load ultimately supplied by the UPS.
- .3 Provide a complete UPS testing report.
- .4 Test equipment:

- .1 Instruments used during testing are to have been calibrated within one year prior to the test date.
- .2 Load bank for testing, adjustable to 110 % of system rated output power.
 - .1 Load bank to be CSA approved or equivalent.
- .5 Provide:
 - .1 Competent field personnel to perform test, adjustments and instruction on UPS equipment.
- .6 Perform a visual inspection and identify deficiencies. Inspection to include:
 - .1 Materials, workmanship, and assembly conform with design requirements.
 - .2 Parts are new and free of defects.
 - .3 Accessories are present.
 - .4 Inspect equipment for signs of damage.
 - .5 Verify installation per drawings.
 - .6 Inspect cabinets for foreign objects.
 - .7 Verify neutral and ground conductors are properly sized and configured.
 - .8 Battery and components are not damaged.
 - .9 Battery cells are of identical construction.
 - .10 Inspect battery for proper polarity.
 - .11 Confirm polarity of connections to inverter are correct.
 - .12 Verify all printed circuit boards are configured properly.
- .7 Mechanical Inspection
 - .1 Check all control wiring connections for tightness.
 - .2 Check all power wiring connections for tightness.
 - .3 Check all terminal screws, nuts, and/or spade lugs for tightness.
- .8 Electrical Inspection
 - .1 Check all fuses for continuity.
 - .2 Confirm input voltage and phase rotation is correct.
 - .3 Verify control transformer connections are correct for voltages being used.
 - .4 Assure connection and voltage of the battery string(s).
- .9 Demonstrate System Operation:
 - .1 System start-up and shut down.
 - .2 System switchover to and from internal and external bypass.
 - .3 Adjustable settings.
- .10 UPS Measurement Test:
 - .1 Test and record all UPS internal measurements against calibrated test instruments for 50% and 100% output load. The tests shall include:
 - .1 Output voltage, current, frequency, and power.
 - .2 Battery voltage and current.
 - .3 Input voltage, current, and power.

- .4 Bypass voltage and frequency.
- .11 Steady Load Test:
 - .1 Switch system onto ac mains, start UPS and connect load bank at UPS rated load.
 - .2 Operate system at full rated load for one (1) hour.
 - .3 Record data, utilizing UPS display, at start of test and every 10 minutes thereafter, including:
 - .1 Output voltage phase to phase, phase to neutral.
 - .2 Output current each phase.
 - .3 Output frequency.
 - .4 Output kW.
 - .5 Battery voltage and current
- .12 Battery Testing:
 - .1 Charge battery to ensure cells are fully charged. When voltage reaches steady value at end of charge, record:
 - .1 Ambient temperature.
 - .2 Temperature of each cell.
 - .3 Voltage of each cell.
 - .4 Voltage of overall battery string.
 - .5 Charger output voltage and current.
 - .6 AC ripple current and voltage imposed on the battery.
 - .7 Internal ohmic values of each cell and battery.
 - .8 Measure intercell connection resistances for all cells.
- .13 Battery Load Test
 - .1 Charge battery to ensure cells are fully charged.
 - .2 Connect the load bank to the UPS output, configured for the UPS rated output power.
 - .3 Record data, utilizing UPS display, at start of test and every 5 minutes thereafter, including:
 - .1 Output voltage phase to phase, phase to neutral.
 - .2 Output current each phase.
 - .3 Output frequency.
 - .4 Output kW.
 - .5 Battery voltage and current
 - .4 Upon the Battery Low Alarm, record:
 - .1 The test time expired.
 - .2 Battery voltage and current.
 - .5 Allow the UPS to automatically shutdown on low battery. Record the time of automatic shutdown.
- .14 DCS Alarms
 - .1 With the assistance of City of Winnipeg personnel, test the UPS alarms transmitted to the DCS system.

3.3 FAILURE OF INSPECTION AND TESTING

- .1 Any deficiencies discovered during testing, where the UPS or associated components do not meet the specification shall be addressed as follows:
 - .1 If the problem can be resolved:
 - .1 Modify adjust, or replace components as required
 - .2 Retest all tests that were deficient, as well as any other tests that could be affected by the modifications made.
 - .3 All costs to be borne by the Contractor or the manufacturer.
 - .2 If the problem can not be resolved:
 - .1 If in the opinion of the Contract Administrator, the deficiency is relatively minor from a functional operation perspective, the price of the UPS unit may be adjusted by the percentage of the deficiency.
 - .1 Example, if the UPS having a specified runtime of 14 minutes only has a tested runtime of 12 minutes, only 86% of the UPS price would be paid.
 - .2 No additional price will be paid for UPS units having tests that exceed the UPS specifications.
 - .2 If in the opinion of the Contract Administrator, the deficiency is significant, the UPS unit will not be accepted. The Contractor is responsible for removing the UPS unit from the premises, and no payment will be made.

3.4 DEMONSTRATION AND TRAINING

- .1 Provide demonstration by factory trained representative in use and maintenance of UPS system.
 - .1 Allocate a minimum of two hours for training.

Schedule 263353-1 : UPS Device List

Qty	Description	Model
UPS-M1 / MTS-M1 Administration Building Computer Room		
1	Three-phase UPS, 15 kVA Runtime at 3.5 kW: 68 minutes	Liebert NX (FX internal battery)
1	Maintenance Bypass Cabinet, c/w 600:120/208 V transformer	Liebert NX Type D
1	SNMP/HTTP Network Interface Card	
1	Alarm Interface Card	
UPS-G1 / MTS-G1 Grit Electrical Room		
1	Three-phase UPS, 15 kVA Runtime at 3.0 kW: 77 minutes	Liebert NX (FX internal battery)
1	Maintenance Bypass Cabinet, c/w 600:120/208 V transformer	Liebert NX Type D

Qty	Description	Model
1	SNMP/HTTP Network Interface Card	
1	Alarm Interface Card	
UPS-S1 / MTS-S1 Secondary Clarifiers Electrical Room		
1	Three-phase UPS, 15 kVA Runtime at 3.9 kW: 96 minutes	Liebert NX (HX internal battery)
1	Maintenance Bypass Cabinet, c/w 600:120/208 V transformer	Liebert NX Type D
1	SNMP/HTTP Network Interface Card	
1	Alarm Interface Card	
NEWPCC UPS-D1 (SUPPLY AND DELIVERY ONLY – NO INSTALLATION)		
1	Three-phase UPS, 15 kVA	Liebert NX (FX internal battery)
1	External Battery Cabinet Runtime at 3.42 kW: 150 minutes	Liebert (FX external battery)
1	SNMP/HTTP Network Interface Card	
1	Alarm Interface Card	
NEWPCC UPS-G1 (SUPPLY AND DELIVERY ONLY – NO INSTALLATION)		
1	Three-phase UPS, 15 kVA,	Liebert NX (FX internal battery)
1	External Battery Cabinet Runtime at 3.78 kW: 138 minutes	Liebert (FX external battery)
1	Maintenance Bypass Cabinet, c/w 600:120/208 V transformer	Liebert NX Type D
1	SNMP/HTTP Network Interface Card	
1	Alarm Interface Card	
NEWPCC UPS-S1 (SUPPLY AND DELIVERY ONLY – NO INSTALLATION)		
1	Three-phase UPS, 15 kVA,	Liebert NX (HX internal battery)
1	External Battery Cabinet Runtime at 5.76 kW: 165 minutes	Liebert (MX external battery)
1	SNMP/HTTP Network Interface Card	
1	Alarm Interface Card	
NEWPCC UPS-W1 (SUPPLY AND DELIVERY ONLY – NO INSTALLATION)		
1	Three-phase UPS, 20 kVA	Liebert NX (HX internal battery)
1	External Battery Cabinet Runtime at 7.02 kW: 133 minutes	Liebert (MX external battery)
1	Maintenance Bypass Cabinet, c/w 600:120/208 V transformer	Liebert NX Type D

Qty	Description	Model
1	SNMP/HTTP Network Interface Card	
1	Alarm Interface Card	

END OF SECTION