

**SECTION VII.**

**TECHNICAL  
SPECIFICATIONS**

## Technical Specifications for Electrical Equipment

Bidders must indicate whether the goods and equipment offered are “Compliant” or “Non-Compliant” to the corresponding specifications prescribed by BCDA using this form.

<b>PROCUREMENT FOR THE SUPPLY, DELIVERY, AND INSTALLATION OF ELECTRICAL EQUIPMENT FOR THE NATIONAL ACADEMY OF SPORTS (NAS) – PHASE 1 AT NEW CLARK CITY</b>					
<b>TECHNICAL SPECIFICATIONS COMPLIANCE FORM</b>					
NO.	QTY.	UNIT	SPECIFICATIONS	COMPLIANCE	
				Compliant	Non-Compliant
1	1	Unit	<p><b>500kVA/400kW Stand by Generator Set</b></p> <p>1) ENGINE-GENERATOR SET</p> <p>A. Factory-assembled and -tested, engine-generator set.</p> <p>B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.</p> <p style="padding-left: 20px;">a. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.</p> <p>C. Capacities and Characteristics:</p> <p style="padding-left: 20px;">a. Power Output Ratings: 1 unit of 500kVA (400KW), 400V, 3Phase, 60Hz Standby rated</p> <p style="padding-left: 20px;">b. Output Connections: Three-phase, four wire</p> <p style="padding-left: 20px;">c. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.</p> <p>D. Generator-Set Performance:</p> <p style="padding-left: 20px;">a. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.</p> <p style="padding-left: 20px;">b. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds</p> <p style="padding-left: 20px;">c. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load</p> <p style="padding-left: 20px;">d. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed</p> <p style="padding-left: 20px;">e. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds</p>		

- f. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent
- g. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components
- h. Start Time: Comply with NFPA 110, Type 10, system requirements.

2) ENGINE

- A. Fuel: Fuel oil, Grade DF-2
- B. Rated Engine Speed: 1800 rpm
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s)
- D. Lubrication System: The following items are mounted on engine or skid:
  - a. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow
  - b. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe
  - c. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
  - a. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
  - b. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.
- G. Governor: Adjustable isochronous, with speed sensing.
- H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
  - a. Minimum sound attenuation of 25 dB at 500 Hz.
  - b. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.
- I. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- J. Starting System: 24-V electric, with negative ground.

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|  |  |  | <ul style="list-style-type: none"> <li>a. Components: Sized so they will not be damaged during a full engine cranking cycle with ambient temperature at maximum.</li> <li>b. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.</li> <li>c. Cranking Cycle: As required by NFPA 110 for system level specified</li> <li>d. Battery: Adequate capacity within ambient temperature range to provide specified cranking cycle at least three times without recharging.</li> <li>e. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.</li> <li>f. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range. Include accessories required to support and fasten batteries in place.</li> <li>g. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating</li> <li>h. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. <ul style="list-style-type: none"> <li>i. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.</li> <li>ii. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.</li> <li>iii. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.</li> <li>iv. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.</li> <li>v. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.</li> </ul> </li> </ul> |  |  |
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vi. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

3) FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Day Tank: Freestanding, factory-fabricated fuel tank assembly, with integral, float controlled transfer pump and the following features:

- a. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.
  - i. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.
- b. Tank Capacity: As indicated in the drawings (to provide 8 hours capacity).
- c. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
- d. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
- e. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
- f. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
- g. Redundant High-Level Fuel Shutoff: Actuated by high-level alarm sensor in day tank to operate a separate motor device that disconnects day-tank pump motor. Sensor shall signal solenoid valve, located in fuel suction line between fuel storage tank and day tank, to close. Both actions shall remain in shutoff state until manually reset. Shutoff action shall initiate an alarm signal to control panel but shall not shut down engine-generator set.

4) CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

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|  |  | <p>B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.</p> <p>C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.</p> <p>D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel.</p> <p>E. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:</p> <ul style="list-style-type: none"> <li>a. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper.</li> <li>b. Switchboard Construction: Freestanding unit complying with Division 16 Section "Switchboards."</li> <li>c. Switchgear Construction: Freestanding unit complying with Division 16 Section "Switchgear."</li> <li>d. Current and Potential Transformers: Instrument accuracy class.</li> </ul> <p>F. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 2 system, and the following:</p> <ul style="list-style-type: none"> <li>a. AC voltmeter</li> <li>b. AC ammeter</li> <li>c. AC frequency meter</li> <li>d. DC voltmeter (alternator battery charging)</li> <li>e. Engine-coolant temperature gauge</li> <li>f. Engine lubricating-oil pressure gauge</li> <li>g. Running-time meter</li> <li>h. Ammeter-voltmeter, phase-selector switch (es)</li> <li>i. Generator-voltage adjusting rheostat</li> <li>j. Start-stop switch</li> <li>k. Over speed shutdown device</li> <li>l. Coolant high-temperature shutdown device</li> <li>m. Coolant low-level shutdown device</li> <li>n. Oil low-pressure shutdown device</li> <li>o. Fuel tank derangement alarm</li> <li>p. Fuel tank high-level shutdown of fuel supply alarm</li> <li>q. Generator overload</li> </ul> <p>G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other</p> |  |  |
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supporting items on engine or generator, unless otherwise indicated

- H. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel
  - a. Over crank shutdown
  - b. Coolant low-temperature alarm
  - c. Control switch not in auto position
  - d. Battery-charger malfunction alarm
  - e. Battery low-voltage alarm
- I. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset
  - a. Engine high-temperature shutdown
  - b. Lube-oil, low-pressure shutdown
  - c. Over speed shutdown
  - d. Remote emergency-stop shutdown
  - e. Engine high-temperature pre alarm
  - f. Lube-oil, low-pressure pre alarm
  - g. Fuel tank, low-fuel level
  - h. Low coolant level
- J. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated
- K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

5) GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated
  - a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous
  - b. Trip Settings: Selected to coordinate with generator thermal damage curve
  - c. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices
  - d. Mounting: Adjacent to or integrated with control and monitoring panel
- B. Generator Disconnect Switch: Molded-case type, 100 percent rated
  - a. Rating: Matched to generator output rating
  - b. Shunt Trip: Connected to trip switch when signaled by generator protector or by other protective devices

- C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:
  - a. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
  - b. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds
  - c. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set
  - d. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot

6) GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor
- C. Electrical Insulation: Class F
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity
- F. Instrument Transformers: Mounted within generator enclosure
- G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified
  - a. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band
- H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding
- J. Subtransient Reactance: 12 percent, maximum.

7) MOTORS

- A. General requirements for motors:
  - a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not

require motor to operate in service factor range above 1.0

- b. Controllers, Electrical Devices, and Wiring:  
Electrical devices and connections are specified in Division 16 Sections.

#### 8) VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
  - a. Material: Standard neoprene
  - b. Durometer values range from 30 to 70 and are measures of hardness or, indirectly, deflection. Lower durometer values indicate softer material with more deflection
  - c. Durometer Rating: 50
  - d. Number of Layers: Two
- B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint
  - a. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation
  - b. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load
  - c. Minimum Additional Travel: 50 percent of required deflection at rated load
  - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness
  - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

#### 9) FINISHES

- A. Indoor and Outdoor Enclosures and Components:  
Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

#### 10) SOURCE QUALITY CONTROL

- A. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  - a. Test components and accessories furnished with installed unit that are not identical to those on tested

			<p>prototype to demonstrate compatibility and reliability.</p> <ul style="list-style-type: none"> <li>b. Full load run</li> <li>c. Maximum power</li> <li>d. Voltage regulation</li> <li>e. Transient and steady-state governing</li> <li>f. Single-step load pickup</li> <li>g. Safety shutdown</li> <li>h. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative</li> <li>i. Report factory test results within 10 days of completion of test.</li> </ul> <p>11) PERMIT</p> <p>A. Secure all necessary permits from LGU</p> <p>Warranty: 2 years against factory defect</p>		
2	1	Unit	<p><b>MEDIUM VOLTAGE SWITCH GEAR</b></p> <p>1) MANUFACTURED UNITS</p> <ul style="list-style-type: none"> <li>A. Description: Factory assembled and tested, and complying with IEEE C37.20.1</li> <li>B. Ratings: Suitable for application in 3-phase, 60-Hz, solidly grounded-neutral system</li> <li>C. System Voltage: 13.8kV nominal; 15 kV maximum</li> <li>D. The brand must have at least 5 years of existence in the market.</li> </ul> <p>2) VACUUM CIRCUIT-BREAKER SWITCHGEAR</p> <ul style="list-style-type: none"> <li>A. Nominal Interrupting-Capacity Class: 750 MVA.</li> <li>B. Ratings: <ul style="list-style-type: none"> <li>a. Main-Bus Rating: 1200 A, continuous</li> </ul> </li> <li>C. Circuit Breakers: Three-pole, single-throw, electrically operated, drawout-mounting units using three individual, vacuum-sealed interrupter modules and including the following features: <ul style="list-style-type: none"> <li>a. Designed to operate at rated voltage to interrupt fault current within its rating within five cycles of trip initiation. For systems with X/R ratio of 17 or less, transient voltage during interruption shall not exceed twice the rated line-to ground voltage of the system</li> <li>b. Contact-Wear Indicator: Readily accessible to field maintenance personnel</li> <li>c. Minimum of six Type A and six Type B spare contacts</li> <li>d. Interchangeability: Circuit breakers are interchangeable with vacuum circuit breakers of same current and interrupting ratings</li> <li>e. Internal sulfur hexafluoride pressure is not to exceed 2.5 bars during normal operation</li> </ul> </li> </ul>		

- i. Current Rating of Main Circuit Breaker: 630 A
    - ii. Continuous Current Rating of Feeder Circuit Breaker: 630 A
  - f. Operating Mechanism: Electrically charged, mechanically and electrically trip-free, stored-energy operated
    - i. Closing speed of moving contacts to be independent of both control and operator
    - ii. Design mechanism to permit manual charging and slow closing of contacts for inspection or adjustment
      - (a) Control Power: 48-V dc for closing and tripping
      - (b) Control Power: 240-V ac for closing and tripping
    - iii. Provide shunt trip capability independent of overcurrent trip
- D. Test Accessories: Relay and meter test plugs
- E. Low-DC-Voltage Alarm: Switchgear shall have a monitor for dc control power voltage with a remote alarm located where indicated. Alarm shall sound if voltage falls to an adjustable value to indicate an impending battery failure. Factory set alarm value at 80 percent of full-charge voltage
- F. Grounding and Testing Device: Suitable for phasing out, testing, and grounding switch gear bus or feeder if device is installed in place of circuit breaker. Include the following:
  - a. Portable Grounding and Testing Device: Interchangeable with drawout- mounting medium-voltage circuit breakers to provide interlocked electrical access to either bus or feeder; electrically operated
  - b. System control cabinet permanently mounted near switchgear
  - c. Control-Cabinet Coupler Cable: Of adequate length to connect device inserted in any switchgear cubicle and control cabinet
  - d. Permanent Control Power Wiring: From control cabinet to power source
  - e. Protective Cover: Fabricated of heavy-duty plastic and fitted to device
  - f. Approval of Grounding and Testing Device System: Obtain approval of final system design from utility company and agency designated by Owner to handle future maintenance of medium-voltage switchgear
- G. Circuit-Breaker Test Cabinet: Separately mounted and containing push buttons for circuit-breaker closing and tripping, control relay, fuses, and secondary coupler with cable approximately 108 inches (2740 mm) long. Include a set of secondary devices for operating circuit breaker if removed from switchgear and moved near test cabinet. Include provision for storage of test and maintenance accessories in cabinet

		<p>H. Remote-Tripping Device: Wall-mounting emergency control station to open circuit breakers; located in red cast-metal box with break-glass operation</p> <p>I. The brand must have at least 5 years of existence in the market</p> <p>3) FABRICATION</p> <p>A. Indoor NEMA 2: not less than US gauge 12 (2.657mm)</p> <p>B. Finish: Manufacturer's standard gray finish over rust-inhibiting primer on phosphatizing-treated metal surfaces</p> <p>C. Bus Transition Unit: Arranged to suit bus and adjacent units</p> <p>D. Incoming-Line Unit: Arranged to suit incoming line</p> <p>E. Outgoing Feeder Units: Arranged to suit distribution feeders</p> <p>F. Auxiliary Compartments: Arranged to suit house meters, relays, controls, and auxiliary equipment; isolated from medium-voltage components</p> <p>G. Key Interlocks: Arranged to effect interlocking schemes indicated</p> <p>H. Provisions for Future Key Interlocks: Mountings and hardware required for future installation of locks, where indicated.</p> <p>4) COMPONENTS</p> <p>A. Main Bus: Copper, silver plated at connection points; full length of switchgear</p> <p style="padding-left: 20px;">a. Ground Bus: Copper, tin plated; minimum size 6 by 50mm; full length of switchgear</p> <p>B. Bus Insulation: Covered with flame-retardant insulation</p> <p>C. Instrument Transformers: Comply with IEEE C57.13</p> <p style="padding-left: 20px;">a. Potential Transformers: Secondary voltage rating of 230 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y</p> <p style="padding-left: 20px;">b. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments</p> <p>D. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three or four-wire systems, listed and labelled by an NRTL, and with the following features:</p> <p style="padding-left: 20px;">a. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V</p> <p style="padding-left: 20px;">b. Switch-selectable digital display with the following features:</p> <p style="padding-left: 40px;">i. Phase Currents, Each Phase: Plus or minus 1 percent</p> <p style="padding-left: 40px;">ii. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent</p> <p style="padding-left: 40px;">iii. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent</p> <p style="padding-left: 40px;">iv. Three-Phase Real Power: Plus or minus 2 percent</p> <p style="padding-left: 40px;">v. Three-Phase Reactive Power: Plus or minus 2 percent</p> <p style="padding-left: 40px;">vi. Power Factor: Plus or minus 2 percent</p> <p style="padding-left: 40px;">vii. Frequency: Plus or minus 0.5 percent</p>		
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- viii. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent
  - ix. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours
  - c. Mounting: Display and control unit that is flush or semiflush mounted in instrument compartment door
- E. Analog Instruments: Rectangular, 4-1/2 inches (115 mm) square, 1 percent accuracy, semiflush mounting, with antiparallax 250-degree scale and external zero adjustment, and complying with ANSI C39.1
  - a. Voltmeters: Cover an expanded scale range of normal voltage plus 10 percent
  - b. Voltmeter Selector Switch: Rotary type with off position to provide readings of phase-to-phase and phase-to-neutral voltages
  - c. Ammeters: Cover an expanded scale range of bus rating plus 10 percent
  - d. Ammeter Selector Switch: Permits current reading in each phase and keeps current-transformer secondary circuits closed in off position
  - e. Locate meter and selector switch on circuit-breaker compartment door for indicated feeder circuits only
  - f. Watt-Hour Meters: Flush- or semiflush-mounting type, 5 A, 120 V, 3 phase, 3 wire; with 3 elements, 15-minute indicating demand register, and provision for testing and adding pulse initiation
  - g. Recording Demand Meter: Usable as totalizing relay or indicating and recording maximum demand meter with 15-minute interval
    - i. Operation: Counts and records a succession of pulses entering two channels
    - ii. Housing: Drawout, back-connected case arranged for semiflush mounting
- F. Relays: Comply with IEEE C37.90, integrated digital type; with test blocks and plugs
- G. Surge Arresters: Distribution class, metal-oxide-varistor type. Comply with NEMA LA 1
  - a. Install in cable termination compartments in each phase of circuit
  - b. Coordinate rating with circuit voltage
- H. Control Power Supply: DC battery system
- I. Control Power Supply: Control power transformer supplies 120-V control circuits through secondary disconnect devices. Include the following features:
  - a. Dry-type transformers, in separate compartments for units larger than 3 kVA, including primary and secondary fuses
  - b. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker

- i. Secondary windings connected through relay(s) to control bus to affect an automatic transfer scheme
  - ii. Secondary windings connected through an internal automatic transfer switch to switchgear control power bus
  - c. Control Power Fuses: Primary and secondary fuses provide current limiting and overload protection
- J. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:
  - a. Flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
  - b. Conductors sized according to PEC for duty required.

5) CONTROL BATTERY SYSTEM

- A. System Requirements: Battery shall have number of cells and ampere-hour capacity based on an initial specific gravity of 1.210 at 25 deg C with electrolyte at normal level and minimum ambient temperature of 13 deg C. Cycle battery before shipment to guarantee rated capacity on installation. Arrange battery to operate ungrounded
- B. Battery: Lead-calcium type in sealed, clear plastic or glass containers, complete with electrolyte, fully charged and arranged for shipment with electrolyte in cells. Limit weight of each container to not more than 70 lb (32 kg) and cells per container to not more than 3. System batteries shall be suitable for service at an ambient temperature ranging from minus 18 to 25 deg C. Limit variation of current output to 0.8 percent for each degree below 25 deg C down to minus 8 deg C
- C. Rack: Two-step rack with electrical connections between battery cells and between rows of cells; include two flexible connectors with bolted-type terminals for output leads. Rate battery rack, cell supports, and anchorage for seismic requirements
- D. Accessories:
  - a. Set of socket wrenches and other tools required for battery maintenance
  - b. Wall-mounting, non-metallic storage rack fitted to store above items
  - c. Set of cell numerals
- E. Charger: Static-type silicon rectifier equipped with automatic regulation and provision for manual and automatic adjustment of charging rate. Unit shall automatically maintain output voltage within 0.5 percent from no load to rated charger output current, with ac input-voltage variation of plus or minus 10 percent and input frequency variation of plus or minus 3 Hz. Other features of charger include the following:
  - a. DC ammeter
  - b. DC Voltmeter: Maximum error of 5 percent at full-charge voltage; operates with toggle switch to select between battery and charger voltages

- c. Ground Indication: Two appropriately labelled lights to indicate circuit ground, connected in series between negative and positive terminals, with midpoint junction connected to ground by normally open push-button contact
- d. Capacity: Sufficient to supply steady load, float-charge battery between 2.20 and 2.25 V per cell and equalizing charge at 2.33 V per cell
- e. Charging-Rate Switch: Manually operated switch provides for transferring to higher charging rate. Charger operates automatically after switch operation until manually reset
- f. AC power supply is 120 V, 60 Hz, subject to plus or minus 10 percent variation in voltage and plus or minus 3-Hz variation in frequency. After loss of ac power supply for any interval, charger automatically resumes charging battery. Charger regulates rate of charge to prevent damage due to overload and to prevent fuses or circuit breakers from opening
- g. Protective Feature: Current-limiting device or circuit, which limits output current to rating of charger but does not disconnect charger from either battery or ac supply; to protect charger from damage due to overload, including short circuit on output terminals
- h. Electrical Filtering: Reduces charger's audible noise to less than 26 dB

6) IDENTIFICATION

- A. Materials: Refer to Division 16 Section "Electrical Identification." Identify units, devices, controls, and wiring
- B. Mimic Bus: Continuous mimic bus applied to front of switchgear, arranged in single line diagram format, using symbols and lettered designations consistent with approved final mimic-bus diagram
  - a. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections
  - b. Medium: Painted graphics, as approved
  - c. Color: Contrasting with factory-finish background;

7) SOURCE QUALITY CONTROL

- A. Before shipment of equipment, perform the following tests and prepare test reports:
  - a. Production tests on circuit breakers according to ANSI C37.09
  - b. Production tests on completed switchgear assembly according to IEEE C37.20.2
- B. Assemble switchgear and equipment in manufacturer's plant and perform the following:
  - a. Functional tests of all relays, instruments, meters, and control devices by application of secondary three-phase voltage to voltage circuits and injection of current in current transformer secondary circuits

			<ul style="list-style-type: none"> <li>b. Functional test of all control and trip circuits. Connect test devices into circuits to simulate operation of controlled remote equipment such as circuit breaker trip coils, close coils, and auxiliary contacts. Test proper operation of relay targets</li> <li>C. Prepare equipment for shipment <ul style="list-style-type: none"> <li>a. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration</li> <li>b. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage</li> </ul> </li> </ul> <p>8) FACTORY FINISHES</p> <ul style="list-style-type: none"> <li>A. Finish: Manufacturer's standard color finish applied to equipment before shipping</li> </ul> <p>Warranty: 1 year against factory defect</p>		
3	1	Unit	<p><b>500kVA PAD MOUNTED TRANSFORMER</b></p> <ul style="list-style-type: none"> <li>A. Liquid-filled Secondary Distribution Transformers: ANSI C57.12.00; 3-phase, self-cooled transformer, dead front construction, loop feed; frequency, 60 Hz</li> <li>B. Capacity: 500kVA, 3Ø, 13.8kV primary voltage-400Y/230Volts secondary, 60 Hz</li> <li>C. Primary Voltage: Primary voltage shall be wye connected. Provide two each 2.5% percent full capacity above normal and full capacity below normal primary taps, with externally-operated tap change</li> <li>D. Secondary Voltage: 400 volts</li> <li>E. Impedance: 5.75 %± ANSI tolerance</li> <li>F. Sound Level: 58 db ave</li> <li>G. BIL: 150 kV</li> <li>H. Cooling and Temperature Rise: ANSI C57.12.00; Class OA. 65°C</li> <li>I. Liquid: Contain less-flammable biodegradable fluid with no detectable level of PCB, less than 1PPM at the time of manufacture</li> <li>J. Accessories: ANSI C57.12.00 standard accessories and magnetic dial-type liquid level gauge, dial-type thermometer with alarm contact, stainless steel diagrammatic nameplate on side of unit, 1-inch upper filter press and filling plug, 1-inch drain valve with sampling device, vacuum-pressure gauge, pressure relief valve, six (6) 200A HV bushing wells, six (6) load break inserts (Dead front), three (3) 27 kV elbow arrester 35 kV interface, three (3) fused Bayonet no isolation link and three (3) oil immersed partial range current limiting fuse, 4 position T-blade switch, elbow connectors for XLPE</li> <li>K. Windings: Copper</li> <li>L. Primary Terminations: Air-filled compartment. Bushings shall be porcelain or cast resin epoxy side mounted on opposite side of transformer from secondary bushings</li> <li>M. Secondary Terminations: or bussed to switchgear as indicated on the one-line diagrams. Bushings shall be</li> </ul>		

		<p>porcelain or cast resin epoxy side mounted on opposite side of transformer from primary bushings</p> <p>N. Other Accessories: Secondary current transformers to IEEE C57.13</p> <p>O. Finish: Tank cleaned in phosphatized solution, coated with rust-inhibiting primer, followed with baked enamel finish. Finish shall have a minimum dry film thickness of 3 mils. Color shall be ANSI 70, light gray</p> <p>P. Factory Tests and Reports: Provide certified test reports to the Contractor on each unit for the following:</p> <ul style="list-style-type: none"> <li>a. Winding resistance test report</li> <li>b. Ratio, polarity, and phase measurements Test Report</li> <li>c. No-load, full-load loss tests</li> <li>d. Exciting current, impedance, X/R ratio</li> <li>e. Applied and induced potential tests. All tests per IEEE C57.12.90</li> <li>f. Core loss and Copper loss Test (at least 3 different loading/efficiency)</li> <li>g. Sound Level Test Report</li> <li>h. Factory-Installed Nameplates: Temporary tape labels</li> <li>i. Field-Installed Nameplates: Laminated plastic with engraved letters on each unit</li> </ul> <p>Warranty: 1 year against factory defect</p>		
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**Bidder's Authorized Representative:**

\_\_\_\_\_  
Signature over Printed Name

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Principal Bidder / Supplier