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Technical Specification

230 V AC INVERTERS FOR PROCESS COMPUTER SYSTEMS POWER SUPPLY

KRŠKO NUCLEAR POWER PLANT

SP–E3057

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1. SCOPE

1.1. Scope of Work

This specification provides the technical requirements for the design, manufacturing, testing, packing, documentation, and supply of three (3) Uninterruptible Power Supply (UPS) assemblies per MOD 1352-PC-L. The UPSs shall be non-safety related, augmented quality (AQ), EMC and seismic category 1 qualified.

1.1.1. Uninterruptible Power Supply - UPS (3 units)

Each assembly shall be of a modular type and have module redundancy (N+1). Each assembly shall contain a rectifier, inverter, electronic static switch, manual/maintenance bypass switch, blocking diode, instrumentation and alarms, as specified herein. The uninterruptible power supply assembly shall henceforth be referred to as UPS.

The UPS shall be 15 kVA (preliminary), redundancy is not included, with output voltage of 230 VAC (Ph+N), 50Hz. The size of the individual module should be standardized.

Each UPS will be powered from a primary 3 phase 400 V AC source and an alternate (secondary) 230 V AC source to the static switch (1 Ph+N). The backup source is a 220 V DC battery, powering the UPS over the blocking diode (attachment 2).

It shall be bolted and anchored to the concrete floor.

Access to the interior of the cabinet shall be through the front door, mounted on the cabinet front side. All controls (breakers and switches) located on the front of the cabinet shall not be accessible without opening the door, this does not apply to the graphic display.

1.2. Equipment, Material and Service to be furnished by the Contractor

The equipment, material and devices shall include, but not necessarily be limited to the following:

1.2.1. UPS

[1] Three (3) complete, fully assembled and operational UPSs within the scope of this of this specification.

[2] Pedestal (if needed), anchoring bolts, nuts, links.

[3] Cable lugs, and other installation hardware shall be supplied in sufficient quantities, in order to assemble equipment on site.

[4] Set of mutually agreed spare parts, such as startup kit and spare operational kit with part numbers and unit pricing. This should be included in proposal as an option.

[5] Packing and shipping to NEK site.

[6] All documentation required by this Technical specification.

[7] Information shall be provided to allow the NEK to establish an effective maintenance program. As a minimum, this information shall include itemized supplier and manufacturer part numbers, recommended spare parts list, maintenance procedures, troubleshooting and component replacement schedules to achieve qualified life of 20 years.

[8] All special tools required for maintaining the UPS. This should be included on proposal as an option.

[9] Necessary software and full access passwords required for maintenance of UPS (download data and upload software and setting of Printed Circuit Boards (PCB's) in case of module replacement or changing of set-points or alarm settings).

[10] Detail training for maintenance personnel at manufactures facility on the offered UPS model (highest level) for 3 attendees. This should be included on proposal as an option.

[11] Start-up and site acceptance test procedures.

[12] EMC qualification.

[13] Seismic qualification with calculations and mounting details with the selected bolts.

[14] Supply of the documentation required herein.

[15] Prototype UPS[1], as applicable.

Supplier is fully responsible for proper sizing, design, performance, materials selection, quality assurance, testing, packing, shipping and full technical support during design finalization, production, installation, and commissioning.

Any deviation from the Specification or repair of equipment, even when accepted in writing by the NEK, shall not relieve the Vendor from its responsibility for proper equipment design, manufacturing, or performance.

The final equipment selection shall be approved by NEK prior to supplier procurement.

2. DEFINITIONS AND ABBREVIATIONS

2.1. Definitions

CoC Certificate of Compliance
DC Direct Current
E&DC Engineering and Design Change

[1] In case that seismic or EMC qualification will be performed on the prototype.

EBS Electronic Bypass Switch
EMC Electromagnetic Compatibility
ESD Engineering Service Division
FAT Factory Acceptance Test
IGBT Insulated Gate Bipolar Transistor
MBS Manual Bypass Switch
MCC Motor Control Center
MCCB Molded Case Circuit Breaker
N/A Not Applicable
NCR Non-Conformance Report
NEK Nuklearna elektrarna Krško (Nuclear Power Plant Krško)
NRC Nuclear Regulatory Commission
OBE Operating Basis Earthquake
OEM Original Equipment Manufacturer
PCB Printed Circuit Board
PDR Problem Deficiency Report
PIS Process Information System
SIS Switchboard wire, 90°C, 600V with XLPE isolation
SPDT Single Pole-Double Throw
SPWAR System Performance/Warranty Action Request
SSE Safe Shutdown Earthquake
TBD To Be Determined
UPS Uninterruptible power supply

3. CODES STANDARDS AND REGULATORY REQUIREMENTS

All equipment to be furnished under this Specification shall conform to portions of the following codes as applicable for non 1E class seismic category 1 inverters.

3.1. UPS

[1] IEEE – Institute of Electrical and Electronic Engineers:

a) IEEE 344-2013 IEEE Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations (RG 1.100-2020)

b) IEEE 519-2022 IEEE Standard for Harmonic Control in Electric Power Systems

c) IEEE 1050-2004 IEEE Guide for I&C Equipment Grounding in Generating Stations

[2] NEMA –National Electrical Manufacturers Association

a) NEMA AB 4-2023, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications

[3] IEC – International Electrotechnical Commission

a) IEC 62040-1 Uninterruptible power systems (UPS) - Part 2: Safety requirements

b) IEC 62040-2 Uninterruptible power systems (UPS) - Part 2: Electromagnetic compatibility (EMC) requirements

c) IEC 62040-3 Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements

d) IEC 61000 Electromagnetic Compatibility (EMC), Part 3 Limits and Part 4 Testing and Measurement Techniques

e) IEC 60950-1 Information technology equipment – Safety – Part 1: General requirements

f) IEC 60068-2-57 Environmental testing - Part 2-57: Tests - Test Ff: Vibration - Time-history and sine-beat method

g) IEC 60068-3-3 Environmental testing - Part 3-3: Supporting documentation and guidance - Seismic test methods for equipment

h) IEC 60980-344 International Standard - Nuclear facilities - Equipment important to safety - Seismic qualification

[4] EPRI

a) EPRI-TR102323 Rev. 5, Guidelines for Electromagnetic Interference Testing of Power Plant Equipment

[5] U.S.NRC – United States Regulatory commission

a) RG-1.180, rev. 2 NRC Guidelines for Evaluating EMI & RFI in Safety-Related I&C Systems

b) RG-1.89, rev. 2 Environmental qualification of certain electric equipment important to safety for nuclear power plants, as applicable for post-accident monitoring system.

[6] MIL-STD 461 Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference".

Any conflict between the above requirements and those specified herein shall be reported to the NEK (via the Purchaser) for interpretation. Contractor shall be responsible for compliance with all applicable codes and regulations. The NEK will accept only material and equipment, which meets the criteria of this Technical Specification and the referenced codes and standards.

4. SUPPLEMENTAL DATA

Items listed below are hereby made a part of this Specification. Where a conflict exists between supplemental data and this Specification, this Specification shall take precedence.

The following NEK documents are part of this Technical Specification:

[1] QS 610, Rev. 2, "Generic Quality Assurance Program Requirements"

[2] SP-S702, rev. 11 "Seismic Analysis, Testing and Documentation"

[3] ESP-2.113, rev. 7 "MECL Equipment Numbering System"

[4] ESP-2.631, "EMC program in design modification process"

5. DOCUMENT SUBMITTAL

The Contractor shall submit complete documentation for equipment, as specified in item 25.0.

All documents (including drawings, graphs, specifications, etc.) submitted shall be in the form of hard copies and searchable electronic media. Acceptable document format sizes shall be A2 or smaller. A3 and A4 should be used whenever possible.

Preferred format for electronic correspondence is Adobe Acrobat Reader (pdf). Other acceptable formats shall be:

- Word Processing: Microsoft WORD (doc, docx),
- Spreadsheet: Microsoft EXCEL (xls, xlsx),
- Computer Aided Drafting: AutoCAD (dwg).

All documents in electronic media shall be provided in original format, as well as directly converted to searchable pdf format (not scanned, if possible).

5.1. Information Required with the Proposal

The Supplier shall submit complete data for the equipment offered along with his proposal, including:

[1] List of deviations/exceptions to this specification.

The Supplier shall certify and sign that the Proposal is fully in compliance with this specification, except when specially outlined in the list of deviations or exceptions.

All exceptions shall be included in the above-mentioned list, as well as their justification, with the reference to the corresponding section of the

specification. Exceptions not included in the "List of Exceptions" shall not have contractual validity.

Supplier shall establish a matric which will show that all Technical specification items from 5.1 are referenced in the Proposal.

All requirements listed in this specification which are not according to Supplier's standard practice, shall be clearly stated. Solutions shall be suggested.

[2] Supplier's Quality Assurance (QA) and Quality Control (QC) Program for this project.

[3] Preliminary dimension drawings, showing side views, Layout drawing showing location and position of all components and anchoring details.

[4] Internal schematic diagrams, single line diagrams and representative connection detail drawings of the equipment.

[5] General list of components, indicating manufacturer, type and characteristics of each.

[6] General qualification plan, including the proposed methods.

This plan shall include the proposed methods, justifications and capability for performing the necessary seismic qualification in accordance with Specification SP-S702 "Seismic Analysis, Testing and Documentation", rev. 11 and the floor response spectra – Attachment 4 hereto.

The plan should also include the proposed methods, justifications and capability for performing the necessary electromagnetic compatibility for qualification in accordance with paragraph 11.3 EMC qualification.

[7] Installation, Commissioning, Technical, Operational and Maintenance manuals.

[8] Identification of Components with prices and its replacement schedules to achieve qualified life of 20 years.

[9] UPS technical data sheet fulfilled - Attachment 1.

[10] Detailed production and delivery schedule.

[11] List of documents to be submitted.

[12] List of accessories, spare parts (such as startup kit and operational kit) and special tools, if needed.

[13] Level of training and its contents for maintenance of the UPS.

[14] Name of accredited laboratory to perform EMC tests and EMC standards used (refer to chapter 11.3)

[15] Name of accredited laboratory to perform Seismic tests and seismic standards used (refer to chapter 11.4)

[16] a list and brief description of all tests, codes, and acceptance criteria.

Equipment shall be designed in such a way that all necessary maintenance is possible from the front side of the positioned equipment or it shall be shown by the drawing how the equipment shall be positioned that maintenance will be possible.

5.2. Documentation Required after Contract Award

5.2.1. UPS

	Content of documents	Fulfill (F) Approval(A[2]) Certified (C) Record (R)	Maximum delivery period after contract award
	Detailed Quality Plan with approved R (record), W (witness) and H (hold) points	F/A	3 weeks
	List of all documents	F/A	4 weeks
	Equipment/parts catalogues/Datasheets	R	4 weeks
	Certified datasheets	A/C	4 weeks
	Certified drawings of the general arrangement and dimensions, including: a) Physical Outline drawing, showing weight, cable openings details, minimum clearances at the front, top, rear and sides, b) Layout drawing, showing location and position of all components, c) Connection and mounting details, d) Interconnection diagrams, e) Mounting details, f) Shipping dimensions and weights, g) Structural drawing (weights, center of gravity, dimensions of the frame, etc.).	F/A/C	8 weeks
	Complete, itemized Bill of Material: a) BOM of main components with unique identification number specified on associated drawings.	A	12 weeks

[2] Fabrication prior to approval of drawings marked "A" shall be at the Supplier's own risk.

	b) BOM detailed to the smallest parts level, indicating the OEM descriptions, part numbers and. Shown shall be also PCB software versions. The design/qualified life and maintenance replacement interval to achieve qualified life of 20 years shall be specified for each item. BOM shall be submitted in the form of a spreadsheet		
	One-line diagram	A	8 weeks
	Internal schematic, wiring diagrams and interconnection diagrams.	A	8 weeks
	Rating plates and list of all nameplates shall be submitted to the NEK for comments and approval before installation.	F/A	12 weeks
	Test procedures and protocols.	F/A	12 weeks
	Final test protocols (before FAT).	F/A/R	4 weeks before FAT
	Instructions manuals (storage, installation, test & commissioning, maintenance and operation), including: a) Instructions for handling and storage prior to being put into service. b) Installation instructions and spreadsheets with torque requirements for all electrical and mechanical bolted connections. c) Activities which will allow use of parts during the complete design/qualified life of parts. d) Detailed maintenance program, including troubleshooting. e) In Storage Maintenance (ISM) Instructions. f) Spare parts list. g) List of spare parts, which must be periodically replaced in order to meet qualified life criteria, in accordance with section 11 herein. The design/qualified life and maintenance replacement interval of each item shall be specified.	A/R	16 weeks

	List of all alarms with setpoints and adjustments shall be sent to the NEK for comments and approval. List shall be a part of Manual.	F/A	4 weeks before FAT
	EMC qualification documentation package in accordance with reference standards. It shall comprise the qualification plan, description of items to be tested, detail test procedures and acceptance criteria.	F/A	4 weeks prior to qualification tests
	Seismic qualification documentation package in accordance with referenced standards. It shall comprise the qualification plan, description of items to be tested, detailed test procedures and acceptance criteria.	A/R	4 weeks prior to qualification tests
	Details of anchoring, showing static and dynamic support reaction forces with mounting details and calculations with the selected bolts (Type Hilti HST3 or similar) that can withstand the required forces.	A/C	4 weeks prior to Seismic qualification tests
	Final Seismic qualification documentation package.	A/R	One week after FAT
	Final EMC qualification documentation package.	A/R	One week after FAT
	Final test protocols (before FAT).	F/A	4 weeks before FAT
	Final test protocols and reports (after FAT).	A/R	One week after FAT
	All equipment data required for plant Master Equipment Component List.	A/R	One week after FAT is finished
	Final SAT protocols.	A/R	One week after FAT

6. DESIGN REQUIREMENTS AND DESIGN INPUTS

6.1. UPS

6.1.1. General

Three (3) seismically qualified non-class 1E Uninterruptible Power Supply (UPS) assemblies shall be designed to provide uninterruptible AC power for the connected power busses. Estimated size shall be 15 kVA, output voltage 230V, 50Hz, power factor 0.8.

The primary power source shall be the 400 VAC (3 Ph, 50 Hz) through the UPS rectifier. The backup source shall be the 220 V DC (2 wires, ungrounded). In case of UPS failure, there is an alternate 230 V single phase AC power supply (Ph+N, 50 Hz) connection to the integrated UPS static transfer switch.

The UPSs shall be assembled from number of necessary modules with additional redundancy module (N+1).

Each module shall have its own rectifier, one phase inverter, electronic bypass, and redundant regulation/control unit in case of primary regulation failure.

The UPS assemblies will replace existing obsolete inverters.

All UPS operating mode transfers shall be without any interruption on the load side at full load (interruption time < 0 ms).

Each UPS shall have an integrated maintenance bypass switch.

UPSs shall be bolted and anchored to the concrete floor.

6.1.2. Modules

[1] UPS shall be assembled from number of necessary modules with one (1) additional redundancy module (N+1).

[2] Modules shall have function of self-configuration in case of replacement.

[3] Maximum size of one module shall not exceed 3,0 kVA and minimum size of the module shall not be less than 1,5 kVA.

[4] Each module shall consist of:

Three-phase rectifier (AC to DC) with IGBT,

One-phase inverter (DC-AC) with IGBT,

Front indicator to indicate operation status of modules and size of load,

Electronic Bypass Switch (EBS) inside of module or common EBS in a separate module, redundant regulation/control unit.

[5] In case of one module failure, faulted module shall be automatically isolated from the operation and redundant module shall take the load. Connected loads shall not sense disturbance in power flow. Faulted module shall be alarmed.

[6] Hot swappable and hot pluggable modularity that can replace an entire UPS module during operation in less than 5 min.

[7] Module is equipped with soft start.

[8] Fans are equipped with alarms and run time meter. The fan is field replaceable.

[9] No single points of failure through:

a) Redundant critical circuits in each module

b) Multi-master operation

c) Decentralized parallel architecture

[10] Efficiency

a) AC to DC >93%

b) DC to AC >93%

[11] Sleep mode

All modules in sleep mode shall remain fully ready to instantaneously provide maximum power to the load but will not be wasting energy by unnecessarily switching power. This means that the system is capable of automatically and intelligently delivering of the highest availability and the lowest TCO (Total Cost of Ownership).

[12] Modules shall be installed at the highest possible height inside of the cabinet.

6.1.3. System operation

See Attachment 2 (Simplified UPS diagram).

[1] Normal operation:

During normal operation each UPS (rectifier part) is connected to the normal source of input power 400 V AC, 3 phase, 50 Hz, non-Class 1E.

The backup source for the inverter part of the UPS is the 220 V DC ungrounded non-Class 1E system supply.

The 230 V AC, 50 Hz, single phase output of the inverter is connected to one side of the integral static transfer switch. An independent, alternate supply of 230 VAC, 50 Hz, single phase, is provided for connection to the other side of the static transfer switch. The inverter output is the preferred source and shall be synchronized to the alternate supply providing that the alternate supply is within the specified frequency range. The output of the static transfer switch is connected to the 230 VAC, 50 Hz power distribution panel. See Attachment 2 — Simplified UPS diagram.

[2] Overload operation

In case of overload outside the overload capacity, UPS shall transfer to bypass if modules are equipped with this function, otherwise it shall stay in operation and initiate an alarm. If the UPS detects a short circuit condition at the AC output level it shall transfer to bypass.

[3] Loss of Normal AC Input Power or rectifier failure:

In this case, the 220 V DC battery is the backup supply. No interruption in the inverter output shall occur during the switching from the normal 400 V AC supply to the backup 220 V DC supply.

[4] Return of Normal AC Power Supply:

Upon restoration of the primary 400 V AC power supplies, this supply shall resume operation as the normal source of supply (auto transfer back to primary source). No interruption in the inverter output shall occur during the switching from the backup 220 V DC supply to the normal 400 V AC supply.

[5] Transfer to the Alternate supply:

If the static transfer switch senses either an overload, an inverter failure signal or degradation of the inverter output, then it shall automatically transfer the load from the inverter output to the regulated alternate supply without an interruption of power. If the regulated alternate supply is outside of the specified voltage and frequency limits, then the transfer shall be inhibited.

Transfer to alternate supply shall also occur in the event of simultaneous loss of both the DC source and the normal 400V AC source. After restoration of any source, the UPS shall automatically transfer load from the alternate supply to the inverter.

[6] Retransfer to inverter from Alternate supply:

The static transfer switch shall be capable of automatically retransferring the load back to the inverter after the inverter has returned to normal output parameters and stabilized for a period of time. The time delay shall be adjustable by the purchaser. No interruption in the UPS output shall occur during the retransfer from the alternate source to the inverter. Retransfer shall not occur, if the inverter is not within the specified voltage and frequency limits or if the overload still exists.

Retransfer shall also be able by initiation of a manual pushbutton Inverter to load.

[7] Ground fault condition:

The power supply system shall be designed to operate without malfunction or degradation in performance in the event of a complete ground fault condition, such as a positive-to-ground fault. Furthermore, the system shall be capable of withstanding the immediate initiation of an opposite polarity ground fault (i.e. negative-to-ground), immediately following the clearance of the initial fault, without interruption, damage, or functional failure. The same requirement shall apply in the reverse sequence (negative-to-ground followed by positive-to-ground). The system shall maintain all safety, control, and monitoring functionalities throughout these fault transition

[8] Maintenance operation

An integral manual maintenance bypass switch connecting the UPS output directly to the bypass source shall be provided. The manual bypass switch shall be of the make-before-break" configuration to ensure continuity of AC power during switching.

6.1.4. Communications

UPS shall have an external ethernet connection to access operating parameters and statuses of the device, history log, etc. An USB or RJ45 port shall be installed on the UPS at the front side for laptop and for USB memory stick connection.

The UPS is a critical digital asset and for cyber security reasons the connection shall be protected with password and it shall be installed inside of the cabinet with a locked door.

6.1.5. User Panel

The UPS shall have a color graphic touch screen display greater than 10 inches (with good resolution and visibility) providing a mimic diagram, showing energy flow, UPS operational data, statuses of various assemblies, and alarms. All inputs and outputs breakers and statuses shall be seen on this display.

Breakers shall be operated with handles inside the panel, behind the front door.

Graphic display shall be seen without opening of the front door.

UPS shall be operated via a graphic touch screen display, and associated MCCBs.

6.1.6. The following electrical quantities shall be shown on the user graphic touch screen display.

Electrical quantities shall be of 1 % accuracy and shall include:

a) AC rectifier input voltage and current, PF & Power (kVA, kW),
b) Rectifier output current and voltage,
c) UPS output voltage, current, frequency, PF & Power (kVA, kW),
d) UPS modules temperatures,
e) Loading of modules in percentage,
f) DC input voltmeter
g) DC input amperemeter.

Instrumentation failure shall have no effect on the UPS operation. Measuring circuits shall be separated from control or any other circuits required for proper UPS operation.

6.1.7. History LOG

All possible alarms and states shall be recorded to History Log and shall have the possibility to store at least 500 events.

6.1.8. Size of the UPS cabinet (Footprint)

Max dimensions [mm]: 1422W x 813D x 2000H.

6.1.9. Painting of UPS cabinet

RAL 7035 (Light Grey) or similar.

6.1.10. Mounting

The UPS cabinet shall be bolted and anchored to the concrete floor.

A metallic structure for proper levelling of the UPS shall be quoted as an option. In this case, this structure will be anchored to the floor with expansion bolts and provisions shall be made for fastening the UPS to the metallic structure or base (bolted).

The cabinet shall be mounted on channels with a 3 inch lifting base open at the front and back to provide an entrance area for air movement through the enclosure and to facilitate moving with a fork lift.

The Supplier is responsible for defining the anchoring points and details (including size of bolts, as applicable), taking into account the weight of the equipment and the dynamic loads. If possible, the existing bolts or holes could be used for anchoring. The Supplier shall calculate and show on the drawings the static and dynamic support reaction forces.

Mounting details and calculations with the selected bolts (Type Hilti HST3 or similar), shall be delivered to NEK as specified under item 25.0.

6.1.11. Cooling

Adequate passive cabinet venting shall be provided to ensure proper operation of all equipment within the ambient condition by natural circulation.

In the case that forced cooling is needed, redundant fans and a local and remote alarm (in case of failure of any fan) shall be provided. Redundancy of fans (N+1, N+2, etc) shall be submitted for NEK approval. Fan blades shall be from nonconductive material. Blades shall be also protected with grid above and below.

A suitable mesh shall be installed at the bottom side of the UPS cabinet to prevent entry of pests.

FME (Foreign Material Exclusion) from the top side of the UPS through cooling holes shall also be ensured. An additional metal plate shall be fitted above the fans which are mounted on the top of the UPS (if any).

Environmental conditions are specified under item 11.

6.1.12. UPS Equipment Protection

a) The UPS shall be equipped with adequate protection against external short circuits, open circuits, overload and transient surge voltage conditions. Integral circuit breaker protection shall be provided for the 400 V AC supply, 220 V DC supply and 230 V AC inverter output and alternate source AC input. These circuit breakers and MCCBs (Attachment 2) shall be selected taking into account the input short-circuit level.

b) Blocking diodes shall be located in the battery DC input in the blocking direction of the UPS to prevent voltage feedback from the UPS rectifier to the battery.

c) Fuses shall be installed on all voltage metering devices & protection circuits.

6.1.13. Alarms

The following conditions shall be provided for **remote alarming** as a minimum to the process data acquisition system (PIS):

1. Static switch transfer,
2. Battery supplying load,
3. Bypass source failure,
4. Fan Failure,
5. Low DCV or battery breaker open,
6. AC output overload,
7. Inverter hi or low voltage,
8. Inverter failure,

9. Bypass source failure,
10. Battery supplying load,
11. Static switch transfer,
12. AC output overload,
13. Fan Failure,

For each of above alarms, contacts shall be provided for remote indication of those alarms. These NC/NO-COM contacts (form C, SPDT, 24VDC/1A) will be used to provide information about the inverter status to the process data acquisition system (PIS).

Contractor shall provide information to the Purchaser, if any other alarms are available for remote alarming as a part of the proposal. The alarms should be selectable by the user through software.

Triggering of any of those above PIS alarms on any of the UPSs, shall trigger a common alarm on the annunciator system in the main control room. All three UPSs have a common alarm window on the annunciator system, which shall be wired to the alarm terminal blocks as digital NC/NO-COM contacts (two contacts). The signal to the annunciator system operates at 125 V DC, 10 mA.

All alarm set points shall be adjustable with normal maintenance activity. All alarm and status set-point adjustable ranges shall be sent to the Purchaser in spreadsheets to review, fulfill and approve.

6.1.14. Setpoints and alarms

List of all alarms, statuses, set-points and adjustments shall be sent to the NEK for review, comments and approval.

6.1.15. Terminal lugs and cable connection:

Provisions shall be made for power and alarm cable entrance from the top side of the UPS (Cables shall be fixed at the input of the UPS).

All External wiring shall be connected to terminals (power cable shall not be connected directly to MCCB). Burndy Type YA lugs or equal will be used by NEK for cable connections. Size of the terminals shall be determined during the sizing of the UPS.

Additional MCCB and output terminals shall be provided for testing purposes of the UPS. Terminal blocks shall be mounted in position that the safety distance to live parts is large enough. It must also be easily accessible from the front side of the UPS. There must be a gap between L, N & GND terminals (with endings in between).

Ring-tongue type wire terminal lugs with insulated ferrules shall be used for control, alarm and secondary wiring. Spade, slotted spade, and hook terminal are not acceptable.

6.1.16. Terminals

All inputs and outputs terminal blocks shall be of a heavy duty design.

6.1.17. Wiring:

Control, instrumentation and alarm wiring shall be a minimum of 14 AWG (2.08 mm^2) stranded copper conductors, 600 V, 90 °C flame retarding insulation.

Power conductors shall be 600 V rated and adequately sized for the maximum ampere capacity required. The 400 V AC power supply wire size is 6 AWG, the 230 V AC has a wire size of 2 AWG and the wire size for the 220 V DC supply is 2 AWG.

Any insulation used shall be free of halogens and made from non-combustible materials. Across-hinge conductors shall be extra flexible.

The Supplier's wiring shall not have more than two wires connected to any terminal block. Terminals provided for terminating the external wiring shall be arranged for one wire to each terminal point.

Ring-tongue type wire terminal lugs with insulated ferrules shall be used for control, alarm and secondary wiring. Spade, slotted spade, and hook terminal are not acceptable.

6.1.18. Molded case circuit breakers:

On all power inputs and outputs MCCB shall be installed. 400 V AC input breaker shall be 3 pole, 230 V AC inverter output breaker, 230 V AC alternate input breakers and 220 V DC input breaker shall be two poles.

Molded case circuit breaker shall be thermal magnetic with adequate interrupting ratings for AC and DC side.

Circuit breakers shall have screw-compression (ring) type lugs compatible with the breaker rating. Box terminals are an option.

Manipulation with all breakers (AC, DC and Manual bypass switch) shall be from the front side of the cabinet and shall not be accessible without opening the door, this does not apply to the graphic display.

Breakers shall be operated by a toggle type handle and shall have a quick-make, quick-brake, over-center switching mechanism that is mechanically trip-free from the handle in order to prevent the contact from being held closed against short circuits. Tripping due to short circuits shall be clearly indicated by the handle automatically assuming a position midway between the manual "ON" and "OFF" positions. "ON" and "OFF" shall be clearly marked.

A maintenance Bypass Switch (make-before-break) shall be supplied for transferring between Normal operation & Alternate source operation (Maintenance Operation).

A push-to-trip button on the front of the circuit breaker shall be provided to exercise the trip mechanism during maintenance activities.

6.1.19. Grounding

Devices and equipment within the cabinet shall have their conductive non-current-carrying parts effectively grounded through the metallic structure. A cable lug shall be supplied for the NEK's connection of 4 AWG (22 mm^2) copper ground wire. Grounding cable entrance shall be provided on the top side of the cabinet. Any additional requirements for proper grounding shall be described by the contractor.

6.1.20. Nameplates

UPS shall have on the front panel for each mounted item its own nameplate, which shall uniquely identify item. Nameplates shall be of laminated construction with white letters on black background. Letters shall be capital with minimum height 0,65 cm. Nameplates shall be mounted on non-removable parts.

Busses, terminal blocks and other internal devices shall be identified with printed or stenciled nameplates.

A legend list for all nameplates with sizes shall be submitted to the NEK for comments and approval before installation.

NEK designations for the UPS shall be CH201INV, CH202INV and CH203INV (see paragraph 14.). Nameplate shall be placed on front side at middle top location.

6.1.21. Insulation against unintentional contacts

All reachable current paths shall be isolated against unintentional contacts (buses, terminals...).

Between different breakers, terminals/connections shall have appropriate distances.

7. PERFORMANCE REQUIREMENTS

7.1. UPS

7.1.1. Inputs Characteristics

AC Input Voltage	400 V, ± 10% (3P)
AC Frequency (grid)	50 Hz ± 3 Hz
AC Power Factor:	0.8 lagging at nominal input voltage.
AC fault Current	22 kA, RMS symmetrical amperes
AC UPS Magnetising Inrush Current:	Less than 400% of rated current.
Rated AC alternate supply:	230 VAC, 50 Hz
Total distortion THDi (100 % load)	≤ 3 %
DC Voltage:	220 VDC nominal, 187— 232 VDC range; floating – ungrounded.
DC Fault Current:	10 kA

7.1.2. AC Output Characteristics

Output voltage:	230 V, 50 Hz, single phase, two wires, (1P + N)
Expected loading of the UPS	15 kVA, @ PF=0.8 + redundancy (N+1)

Voltage Regulation:	230 VAC, ±2% from 0 to 100% of rated power output at 0,8 PF lagging to 1.0 PF and all specified variations of input voltage and frequency
Size of one module	>1,5 kVA < 3 kVA
Output frequency regulation:	50 Hz, ±0.5 Hz
AC output voltage stability	±1% from 10 % to 100 % load
Output Voltage Transients:	20% Load Step: ±2% 50% Load Step: ±4%
Crest factor	≥ 3:1 at full load
Voltage Transient Recovery Time:	Worst-case transient response for 50% load step shall not exceed ±4 % for the first half cycle with recovery to the regulation band of 12% within 50 milliseconds.
Phase unbalance	100%
Overload With Full Voltage:	120%, continuous 150%, of full load rating for 30 seconds Current limit at 175 - 200% of rating
Harmonic Distortion:	Total harmonic distortion (THD) with non-linear load ≤ 5 % RMS For any single harmonic with non-linear load ≤ 3 %
Efficiency:	> 90 % @ full load
Audible noise shall be less than 72 dB in all UPS operational modes, when measured at 1,5 m from the nearest surface of the cabinet.	

8. MATERIAL REQUIREMENTS

The Contractor shall be responsible for all materials and their procurement specifications. All current carrying parts shall be copper made. Control, instrumentation and alarm wiring shall be a minimum of 14 AWG 7-strand copper conductors, 600V 90°C flame retarding insulation. Where wire is subjected to flexing on hinged panels 14 AWG 41-strand extra flexible, copper conductors with 600V, 90°C flame-retardant insulation shall be used. Any insulation used shall be free from halogens (chloride, etc.) and made from non-combustible materials. SIS or equivalent type wire shall be used.

Materials used shall be suitable for environmental qualification as specified under item 11.0.

Isolating materials shall have dielectric strength to withstand 2 kV over-voltage.

Enclosures shall consist of rigid welded or bolted steel frames with a minimum 12GA (2,5 mm^2) framework. Door panels shall be a minimum of 14GA (2 mm^2) commercial steel and side panels shall be a minimum of 18GA (1,2 mm^2). Enclosure shall be completely metal enclosed, with smooth and level sheets, free from flaws and provided with suitable braces to withstand all stresses incidental to shipping, installation and operation without permanent deformation or other damage. Conductive seal shall be installed between the enclosure and removable enclosure panels. Removable covers shall be attached with machine screws.

The enclosure shall be mounted on channels with a 3 inch lifting base open at the front and back to facilitate moving with a fork lift and to provide an entrance area for air movement through the enclosure.

Optional: One or more hinged doors shall be provided in the front with door locks on each. Hinged panels shall be provided with at least a 2 point latching system for holding the panels securely.

Except where otherwise stated herein, construction materials shall meet the manufacturer's standards which have proven satisfactory in the past and meet applicable code requirements.

9. FABRICATION AND ASSEMBLY

During manufacturing and assembling the Foreign Material Exclusions procedure shall be considered.

Only new (not used) components/materials traceable and certified to meet the design requirements shall be utilized in production. Internal wiring shall follow accepted industry practice and shall be neatly bounded and marked on both ends.

9.1. UPS

UPS shall be assembled so it shall sustain environmental conditions according to item 11.0. and fulfill technical details specified herein.

UPS will be bolted and anchored to the concrete floor. The Supplier shall calculate and show on the drawings the static and dynamic support reaction forces and determine the type of expansion bolts in accordance with paragraph 11.4.

Additionally, the Supplier is responsible for defining the anchoring points and details (including size of bolts).

10. INSPECTION AND TESTS

Certified data shall be submitted by the Supplier to show the characteristics of the UPS, Charger, Batteries, Cabinets/Racks, Panels and associated

material supplied, to show that the material is in compliance with the specified test values. Testing, inspection, and acceptance criteria shall conform to applicable codes and standards.

The Contractor shall be responsible for conducting all inspection and tests including recording of results and maintaining records thereof.

All testing, inspection, and acceptance criteria shall conform to the applicable codes and standards as specified under section 3.0. When no code or standard applies, the acceptance criteria shall be the Contractor's standard and have proven suitability for the service. The Contractor shall submit a list and brief description of all tests, codes, and acceptance criteria as part of the Proposal.

All testing and inspection procedures shall be submitted to the NEK for review, fulfill and approval. NEK shall also be informed about time schedule of all tests and beginning of assembly.

Contractor shall supply overall inspection plan that will include all activities (design, fabrication, assembly and delivery).

NEK intents to witness:

a) The beginning of the UPS assembling,

b) Seismic tests,

c) UPS pre-EMC testing,

d) Final UPS assembly with all software setups and factory acceptance tests.

Acceptance shall be based on testing and inspection of the complete assembly and approval of the documented construction, testing and inspection procedures. Assembly, which fails to meet the acceptance criteria for any test or inspection, shall be reported to NEK as nonconformance as specified under item 16.0.

NEK reserve the right to visit the Contractor plant at any time to witness routine factory tests and such other test of control as may be required to provide the correctness of wiring and operation. The Contractor shall give the NEK representative at least twenty (20) days prior notice of all tests, and other checkpoints in the manufacturing program specifically requested by the NEK.

10.1. UPS

NEK representative shall be allowed to measure or witnessing of measuring all necessary voltage and current signals on the equipment specified in this specification during FAT. In case that NEK will use its own measuring system, manufacturer shall ensure current clamps if needed.

10.1.1. Testing before and during assembling of UPS

[1] MCCB - (ref.: 3.1[2]a:

a) Insulation Resistance Test (AB-4, § 6.3)

b) Individual Pole Resistance Test (Millivolts Drop) (AB-4, § 6.4)

c) Inverse Time Over Current Trip Test (AB-4, §.6.5)

d) Instantaneous Over Current Trip Test (AB-4, § 6.6)

[2] All bolted connections shall be checked for proper torqueing torque per moment tables.

10.1.2. Testing before the FAT

[1] Detail Visual inspection,

[2] Review of installed of all wire and cable marks,

[3] Review of installed component marks,

[4] All bolted connections shall be checked with adequate torques,

[5] All performance and design requirements under paragraph 6.0 & 7.0 shall be checked,

[6] Rectifier, DC/DC converter, Inverter @ full load test @ 4 h duration shall be performed,

[7] Factory standard tests,

[8] Testing per IEC-62040%.

Manufacturer shall submit the Type-Test reports and reports of reviews and tests specified above to NEK for review and approval after manufacture, but prior to Final FAT Testing.

10.1.3. Final FAT Testing

After manufacture and satisfactory type test reports, the equipment shall be inspected by NEK. Following tests shall be witnessed at the time of inspection:

[1] Detail visual inspection,

[2] Insulation and dielectric test,

[3] Cable and interconnection check,

[4] Bolted connections torque check,

[5] Functional tests of all operational modes at light load and full load at following conditions:

a) AC Mains Failure,

b) AC Mains Return,

c) Bypass failure,

d) Bypass failure Return,

e) DC input failure,

f) DC input Return,

g) Bypass Failure and DC input failure simultaneously,

h) AC Mains Failure and DC input failure simultaneously,

i) AC Mains Failure and DC input failure Return

j) All AC failures All sources Return,

k) Automatic Shutdown of the UPS to prevent excessive discharging of the battery. After the return of any of AC sources, UPS shall start automatically supplying AC loads.

[6] Overload tests

[7] Proper Bypass operation,

[8] Boost function test (if installed),

[9] Input Frequency Tolerance test from Zero to Full Load & PF=1.0,

[10] Inrush Current measurement (AC & DC) @ startup @ Full Load & PF=1.0

[11] Output Voltage Transients (AC & DC side) @ PF=1.0 & PF=0.8:

a) 50% Load Step from 100% to 50% of load: ± 1%,

b) 50% Load Step from 50% to 0% of load: ± 1%,

c) 100% Load Step from 100% to 0% of load: ± 1.5%,

d) 100% Load Step from 0% to 100% of load: ± 1.5%,

e) 50% Load Step from 0% to 50% of load: ± 1%.

[12] Measurement of following characteristics from zero to full load @ PF=1.0 & 0.8, [from - 30%*Urated to +20%*Urated] and [from Hi battery voltage to LO battery voltage, AC sources during this test shall be OFF]:

a) Input voltages measurement,

b) Input current measurement,

c) Input Power Factor measurement,

d) Input Current Harmonics measurement,

e) AC Output current measurement,

f) AC Output voltage measurement (±1%),

g) AC Output PF measurement,

h) DC output Current measurement,

i) DC output Voltage measurement,

j) Efficiency test (AC/DC, DC/AC, AC/AC),

[13] Three Phase Input Voltage transient

Input voltage transient from rated voltage 400 VAC to 480 VAC in ½ s, immediately reduced to 280 VAC in 1s and raised to rated voltage (400 VAC) in ½ s. Transient shall be performed at full and ½ output load.

[14] Overload Testing (all design limits),

[15] Crest Factor Testing,

[16] Battery is in fault. Check the appropriate UPS response.

[17] Checking of alarms,

[18] Checking of initiating of all alarms on graphic display and history log,

[19] Checking of initiating of all alarms on remote signaling contact,

[20] Checking of remote shutdown,

[21] Checking of system set-points

[22] Rectifier, Inverter & DC/DC converter full load test at 24 h duration shall be performed @ Max environmental design temperature, see Paragraph 11.2.

a) All components shall be loaded,

b) Critical temperatures shall be measured during the test (connections, cabinet internal temperature, fan air outlet temperature, critical components, ambient/room temperature, etc.),

c) Voltages and currents shall be measured (inputs and outputs).

[23] Functional test of the event of a complete ground fault condition with a positive-to-ground fault and immediate initiation of an opposite polarity ground fault (negative-to-ground). The same functional test shall also be performed in the reverse sequence (negative-to-ground followed by positive-to-ground fault.

10.1.4. Testing of the UPS before and after EMC testing

Performed shall be all activities specified in paragraph 10.1.3. After the EMC testing some paragraphs can be excluded on the basis of the consent of the customer.

10.2. Problem Deficiency report (PDR) & System Performance/Warranty Action Request (SPWAR)

[1] The PDR applies to problems / deviations of a technical nature during the duration of the project. Both parties can initiate PDR to address problems/deficiencies, technical problems or deviations to the other party.

[2] The SPWAR is used for all problems from the end of FAT testing to the expiration of the warranty period.

[3] PDR Priority:

PDR & SPWAR Priority	Required response time	Sender	Receiver at Contractor	Communication (all to be applied)	AIL priority
A	< 2 days	NEK		Email with high priority Phone-call (reaching one of the receivers personally) Formal letter (sent or handed over)	High
B	< 5 working days			Email with high priority Phone-call (reaching one of the receivers personally) Formal letter (sent or handed over)	High
C	< 2 wks			Email with normal priority Formal letter (sent or handed over)	Normal
D	< 4 wks			Email with normal priority Formal letter (sent or handed over)	Low

11. ITEM QUALIFICATION

11.1. General

The function of the UPS is to provide one phase 230V AC, 50 Hz uninterruptible power for the NEK's electronic control systems and thus assure stable operation without transients that could lead to potentially dangerous accidents.

11.2. Environmental Qualification

UPSs will be installed indoor. The expected environmental conditions are as follows:

- Ambient temperature: 16°C to 40°C,
- Maximum relative humidity: 95 % (without condensate),
- The altitude does not exceed 500 m.

11.3. EMC qualification

The system shall be designed and tested to ensure that all analog, digital, or hybrid (i.e., combined analog and digital) electronic equipment supplied is compatible with the electromagnetic environment of the location where the equipment will be installed. In this specific case, this includes consideration of conducted emissions. All susceptibility tests can be omitted , because the new equipment is not classified as safety-related. Applicable standards for conducted emissions are:

a) Regulatory Guide 1.180, rev. 2 - NRC Guidelines for Evaluating EMI & RFI in Safety-Related I&C Systems,

b) EPRI TR-102323, rev. 5, "Guidelines for Electromagnetic Interference Testing of Power Plant Equipment",
c) MIL-STD 461, "Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference",
d) IEC Standard European Norm (EN) 61000, Electromagnetic Compatibility (EMC), Part 3 "Limits" and Part 4 "Testing and Measurement Techniques",
e) IEEE Std. 1050-2004, "IEEE Guide for I&C Equipment Grounding in Generating Stations".

The testing sequence will generally consist of:

- Receipt and inspection
- Baseline functional test
- EMI/RFI tests
- Post-EMI/RFI functional test

Modifications to standard equipment designs (shielding, filtering, and grounding) that are necessary to achieve acceptable testing results must be documented. The equipment must be installed in the same modified configuration and be reflected in the testing documentation.

The emissions tests listed in the table in this Specification shall be performed in accordance with the standards indicated. For testing applicability, consult EPRI-102323 or RG-1.180. A technical rationale should be provided for each omitted test.

A documented technical basis shall be provided when certification to a commercial testing standard not listed in the table above is used to satisfy any of the testing requirements of this specification.

Testing limits and frequencies shall be based on NRC Reg. Guide 1.180, Rev. 2, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related I&C Systems", or EPRI TR-102323, Rev. 5, "Guidelines for Electromagnetic Interference Testing of Power Plant Equipment".

The NRC states that any of the alternate testing programs may be selected. However, regardless of the emissions testing program selected, it is intended that each be applied in its entirety, without selective application of individual methods (i.e. no mixing and matching of test methods) for emission testing.

Name of the accredited laboratory to perform EMC tests and EMC shall be named before the testing performance.

11.3.1. List of endorsed EMC emission tests

EMISSIONS TESTS		MIL-STD-461	IEC
Conducted emissions	Low freq.	CE101	None
	High freq.	CE102 (450 kHz – 2 MHz)	IEC EN61000-6-4 (CISPR 11 Class A)
Radiated emissions	Low freq.	RE101	None
	High freq.	RE102	IEC EN61000-6-4 (CISPR 11 Class A)

11.3.2. Responsibilities

[1] EMI Test Procedure (EMITP):

NEK:

- shall define external wiring details, connection methods and conduits that will be connected to the device/system.

CONTRACTOR:

- generally responsible for preparation of EMITP in accordance with the guidelines given in EPRI TR-102323, rev.5
- shall determine the list of EMC tests to be performed. It shall be prepared and sent to NEK for approval, as a standalone document or latest as a part of EMITP

CONTRACTOR/ NEK/:

- shall define acceptance criteria (according to IEC Performance criterion A to C or equipment-specific) for the device/system, including all the input, output, storage and display parameters for the device/system that are required for proper performance.
- It shall be based on knowledge of the function of the equipment and the acceptability of deviations from specified performance.
- may use operating experience to waive non-mandatory tests. The waiver is to be written from any of two sides and approved by NEK.
- may propose alternate tests to be performed. The proposal is to be written from any of two sides and approved by NEK.

All test procedures (EMITP) shall be submitted to NEK for approval with sufficient time prior to the test for comment resolution, not less than 4 weeks prior to the test.

[2] Testing:

CONTRACTOR:

- responsible for performance of the EMC tests in accordance with the approved EMITP
- shall provide materials for all modifications required to the device/system to comply with the acceptance criteria.

[3] EMI Test Report (EMITR)

CONTRACTOR:

- responsible for preparation of EMI Test Report (EMITR) in accordance with the guidelines given in EPRI TR-102323, rev.5

11.4. Seismic qualification

[1] The NUREG 0696 Functional Criteria for Emergency Response Facilities states that SPDS need not to be class 1E or meet the single-failure criterion, but it shall be sufficiently durable to function during and after earthquakes (paragraph 5.6 Design Criteria of NUREG 0696). The function of the SPDS is to aid the operator in the interpretation of transients and accidents. This function shall be provided during and following all events expected to occur during the life of the plant, including earthquakes.

[2] Seismic qualification of the UPSs shall be performed in accordance with the requirements of IEEE 344 (refer to chapter 3.1[1]a) and specification SP-S702 (refer to chapter 4.0[2]). The acceptance criteria are defined in the same way as for the 1E class equipment; nevertheless, the UPSs are not safety-related equipment. Qualification shall be justified by tests. The floor response spectra for the Intermediate Building, elevation 115, room 040, where the UPS will be installed, are presented in Attachment 4.

[3] The cabinets shall be anchored to a reinforced concrete foundation with a specified compressive strength of 300 kg/cm² (≈29.4 MPa). In the anchorage design process, it should be considered that there are already six existing bolts or holes per cabinet which could preferably be used for anchoring, otherwise concrete scanning shall be performed to ensure that the anchoring design of the equipment avoids interference with reinforcement bars during anchor bolt installation. The exact positions and dimensions of the holes/bolts are in attachment 3.

[4] It shall be stated clearly in the Proposal the qualified life of the UPS and the providers experience in the qualification of UPS assemblies in similar conditions. The Bid shall also clearly state the qualification method proposed, qualification schedule and justifications and capability for performing the necessary seismic qualification. This information will be important for the technical evaluation.

11.5. Design life

11.5.1. UPS

UPS shall have a design life of at least 20 years, with routine parts replacement, as identified by the Supplier.

A list of all components that cannot meet the above requirement shall be provided with the offer. A complete service plan, for any such component shall be provided, including replacement parts, shelf life of such spare parts, frequency of change-out, etc.

11.5.2. Cabinet/rack, panel and accessories

Cabinet/rack, panel and accessories shall have a design life at least 30 years.

12. CLEANING

The Foreign Material Exclusion (FME) program shall be followed and enforced through production, assembling and packing shop activities.

All parts shall be shipped free from dirt, corrosion, and unwanted grease.

13. CORROSION PROTECTION / COATING

Corrosion and oxidation protection shall be applied on all surfaces per manufacturer's internal painting procedures.

Painting of the cabinets shall be finished with RAL 7035 (Light Grey) if not already specified under Paragraph 6.1. The final exterior surface shall be bonded, smooth, and free of bubbles, ripples or other flaws. Steel parts shall be thoroughly cleaned to remove dirt, scale and grease, fully in compliance with Supplier's painting procedures, prior to painting. This shall be followed immediately by an application of a priming coat of rust-resistant paint and the necessary finish coats. Steel surfaces shall have a minimum of two coats of finish. Paint shall be suitable for the operating temperatures of the equipment. Paint coating shall be free of sags, runs and incomplete coverage.

14. MARKING AND IDENTIFICATION

Identification labels shall be provided for all components to uniquely identify each item.

All devices (terminal blocks, fuses, circuit breakers, etc) and wiring shall be properly identified and marked according to designations on the wiring diagrams. Cables and wires shall be marked on both ends.

All devices mounted inside of the UPSs shall be clearly permanently identified either by identification plates or by printed or stenciled inscriptions.

Devices located or accessible on the front plate shall also be clearly identified and marked with temporary identifier tag.

All nameplates and any other identifications shall be approved by NEK prior to application. Appropriate drawings or sketches shall be provided for approval.

The Supplier shall establish and maintain a system for the identification of materials, parts and components according to NEK instructions. If the Supplier offers its own identification system, it shall be approved by NEK. These measures shall ensure that the lot number, serial number or other appropriate means, either on the item or on records, maintain identification of items traceable to the item throughout fabrication, testing, shipment and use of them.

These identification and control measures shall be designed to prevent the use of incorrect or defective materials, parts and components as well as to provide a permanent record to assist in the future evaluation of in-service degradation of parts.

Identification marks for equipment herein are the following:

- UPS#1: CH201INV
- UPS#2: CH202INV
- UPS#3:CH203INV

15. PACKAGING, HANDLING AND STORAGE

Packing or crating shall ensure the satisfactory transportation, handling, and delivery of the equipment at its destination in undamaged condition.

Deliveries shall be packed in wooden transportation crates or better type of packaging.

ShockWatch and TipNTell indicators (ULINE or equivalent) shall be installed on the equipment housing and each shipping crate in all three axes prior shipment. Clear receiving inspection acceptance criteria shall be identified by the Contractor before shipment

The Supplier shall inform NEK of any special storage, handling, controls and preventive maintenance requirements, as necessary to adequately maintain and preserve the item before installation. The Supplier shall inform sufficiently in advance of shipping for necessary preparation.

16. NONCONFORMING MATERIALS

Any deviations or design changes, not fully in accordance with the technical or quality assurance requirements of the procurement documents, and which the Supplier desires to accept, shall be reviewed by Purchaser and approved by NEK. Any such deviation request shall be made in writing prior to disposition by means of the Deviation/Change Request Form submitted to NEK for approval prior to continuing work.

Non-conformance with specification requirements and applicable codes and standards invoked by this specification will not be accepted until approved by NEK.

Those non-conformances which cannot be brought within specification requirements by rework or replacement shall be reported to NEK and put on hold until approval. When such a condition exists, the Supplier shall initiate a non-conformance report (NCR) using the Supplier's standard non-conformance document, which identifies the non-conformance, Supplier's proposed disposition and NEK disposition approval.

The Supplier shall:

a) Tag and segregate the non-conformance item to prevent any further processing which may result in a change of the non-conformance as identified

b) Make the NCR available to the responsible NEK inspector for review to ensure the non-conformance is completely identified and accurately stated

c) Transmit the NCR with non-conformance disposition to NEK in an expeditious manner. The Supplier shall provide technical justification for the recommended dispositions.

The requirements of the specification are binding; no exceptions are acceptable without the prior consent of NEK.

The NCR shall provide the method by which the Supplier shall obtain a documented response and approval from NEK when non-conformances are identified. The use of NCRs will pertain to the work at the Supplier and/or Sub-Supplier's.

Once the item is identified with an NCR, the NCR shall remain assigned to that item permanently and NEK shall be advised of the originating NCR.

17. RECORDS

17.1. Record system

A record system shall be established and maintained by the contractor to provide documentary evidence of the quality of items and activities affecting quality. Quality assurance records shall include results of reviews, inspections, test, audits, monitoring of work performance and material analysis. Records shall at minimum identify Contractor's name, order number, inspection and data recorder, data inspection that was performed, type of observation, procedures used, results, acceptability and action taken with deficiencies noted. Record of inspection shall also include identity of drawings and procedures utilized along with the revision level.

All quality verification records, procedures and qualifications shall be identifiable to the item or activity involved. All listed records shall be sent to NEK.

17.2. Fabrication records

Additionally, to the requirements for manufacturing data, the Contractor shall prepare and provide all fabrication records related to NEK equipment.

18. OTHER REQUIREMENTS

Any additional requirements and/or exceptions imposed beyond this specification requirements during biding, negotiating and contracting process shall be identified as change to this specification and brought to the attention of the NEK ESD – Design and Modification Superintendent for resolution concurrence and/or approval.

19. RIGHT OF ACCESS

Access shall be granted to NEK representative(s) to all Supplier's and/or Sub-contractor's premises where design, fabrication and assembly of equipment specified in this Specification will take place in order to survey production, assembling, testing, and QA Program implementation i.e. review of generated QA related documentation. Such premises shall include, but not be limited to: shops, working areas, and engineering offices.

Such survey shall take place at any time upon NEK request, periodically according to the PQP or on the task basis during the course of work.

NEK representatives shall have the right to request Supplier to stop the work, if major contractual deviations are discovered during the manufacturing, purchasing, control, or any other process/production activities.

NEK QA surveys shall not relieve the Supplier's and/or his Sub-contractors from responsibility to perform all inspections and tests required.

During inspections and witnessing FAT the buyer is allowed to use his measuring equipment if he wants.

20. QA PROGRAM REQUIREMENTS

20.1. SUPPLIER's QA Program

The SUPPLIER shall maintain Quality Assurance (QA) program which comply with ISO 9001 or comparable standard and confirms with relevant NEK QA requirements from Quality Specifications QS-610 Generic Quality

Assurance Program Specification, revision 2. The relevant requirements are indicated in Attachment A of the Quality Specifications QS-610.

The Supplier's bid shall be accompanied by the QA Manual of the latest revision, if not previously submitted to NEK. The relevance and effectiveness of the Supplier's QA Program shall be reviewed and approved by NEK prior to the contract award. The same shall apply to any subsequent changes proposed by the Supplier during the implementation of the purchase order.

NEK reserves the right to verify the Supplier's control activities by using the following methods:

[1] Documentation review (Report).

[2] QC procedures review (audits).

[3] QC activities witnessing (Witness), testing (Test), and obligatory presence (Hold)

20.2. SUPPLIER's responsibility for Subcontractors

The SUPPLIER shall ensure that its subcontractors meet quality, technical requirements and schedules of this Specification.

The Specification requirements shall apply to sub suppliers for works and services not performed by the SUPPLIER.

The SUPPLIER shall be fully responsible for all actions of his subcontractors in relation to the PURCHASER.

20.3. Certificate of Compliance

The SUPPLIER and its subcontractors shall provide a Certificate of Compliance stating that all provided equipment and services meet requirements of this Specification, related purchase order& EC Declaration of Conformity.

20.4. Manufacturing and Inspection Plans

The SUPPLIER shall provide the Manufacturing and Inspection Plans with record (R), witness (W), hold (H) and approval (A) points to the PURCHASER for review and approval prior to start of manufacturing.

The Manufacturing and Inspection Plans shall cover at least all relevant inspection requirements and shall outline the manufacturing and production sequence and specific inspections that are required to be performed.

The SUPPLIER shall update the Manufacturing and Inspection Plan and submit copies thereof to the PURCHASER when changes are approved by the PURCHASER.

21. SPECIAL HANDLING

The Supplier shall specify special handling requirements during transportation and storage.

A detailed special handling procedure shall be provided to NEK in such case.

The Supplier shall also specify any special requirements necessary to maintain equipment warranties.

22. SHELF LIFE

Minimum operational life for all items specified herein shall be 20 years. The SUPPLIER shall not ship any item that has less than 90% of remaining shelf life at time of shipment.

The SUPPLIER shall provide shelf life data as follows:

a) Expiration date,

b) Cure date or manufacturing date, and

c) Material composition.

If the above requirements are not met the item will be shipped back to the SUPPLIER at the SUPPLIER's expenses.

23. 10CRF21 REPORTING (For US supplied equipment only)

N/A

24. COMMERCIAL GRADE DEDICATION

N/A

25. SUPPLIER DOCUMENTATION REQUIREMENTS

Documents shall be submitted as requested in sections 5.0 and 33.0 herein.

Vendor shall submit the final revision of all documentation in electronic and printed form.

Documentation shall be delivered as follows:

[1] Documents requested in section 5.1 shall be submitted with the proposal

[2] Documents requested in section 5.2 shall be submitted after contract award

[3] Documents requested in section 10.0 (Inspections and Tests) shall be submitted upon FAT completion.

[4] Qualification reports as requested in 11. shall be submitted in before FAT.

[5] Details of anchoring with mounting details and calculations with the selected bolts (Type Hilti HST3 or similar) that can withstand the required forces as requested in section 11.4.

[6] Complete quality assurance package as requested in 20.0 shall be submitted upon shipment (factory release)

[7] Certificate of Compliance;

A Certificate of Conformance/Compliance shall be submitted by the Supplier stating that the equipment is in conformance with the requirements of this Technical Specification and Purchase Order have been met and that the Seismic & EMC qualification is in accordance with specified standards. The Supplier and its Sub-Suppliers shall provide the Purchasers Quality Assurance personnel in writing that all referenced standards, codes and procedures have been compiled with.

[8] Final QA package with all non-conformance reports, repair records etc.

25.1. UPS specific documentation

[1] Standard catalog information covered UPS and accessories offered

[2] Manufacturer specification sheet, which cover technical data for offered model together with all options and accessories that are manufacturer standard option

[3] Equipment drawings as follows:

a) Physical Outline,

b) Front Panel Outline,

c) Assembly Drawing,

d) Component Positions Drawing,

e) Connection Details,

f) Mounting Details,

g) Interconnection Diagrams,

h) Internal Schematic One Line Diagrams,

i) Schematic for all printed circuit boards (PCB),

j) 3D drawings for UPS in electronic file.

[4] Bill of Material, which include all electrical and mechanical items installed in the UPS, their catalog numbers, type or style designation, each PCB's software versions, manufacturer name, electrical rating and replacement schedule. It shall be in form of spreadsheet.

[5] Installation, Operation and Maintenance Instructions which shall also include preparation, startup testing and programming of PCB for replacements purposes and handling with software.

[6] Spreadsheets with torque requirements for all bolted connections.

[7] List of spare parts with prices for items, which must be periodically replaced in order to meet qualified life criteria, need to be identified in accordance with Section 11.5. Each item shall have specified it's design/qualified life and maintenance replacement interval.

[8] Copies of all test reports performed by the Supplier and requested under item 10.0. & 11.

[9] Copies of all tests which confirms adequate technical characteristics specified under paragraph 6.0 & 7.0.

[10] Protective device coordination curves for all protective devices (breakers, etc.).

[11] Protective device time /current curves for all current ratings. They shall be delivered as drawing and as spreadsheet

[12] Protective devices time / current temperature shift curves for temperature range from 20°C to 60°C.

[13] Instructions for In-Storage Maintenance of recommended or ordered spare parts. Instructions shall include such activities, which will allow using parts during complete design/qualified life of parts.

[14] Software for communication with UPS and adjusting/setting all necessary parameters. Passwords for full access to PCB's parameters.

26. NEK PROPRIETY DATA

NEK has a proprietary interest in all drawings, designs, specifications, documents' information or know-how which may be furnished pursuant contract execution and in any know-how improvement, discovery or invention which may be made, developed or conceived in the performance of work hereunder or which may arise or result therefrom (hereinafter collectively referred to as the "Information"). All such information shall be considered proprietary of the NEK. The right to use of all such Information shall be transmitted to the contractor only for its personal use and shall be entirely restricted to the performance of the contract and subject to the confidentially provision.

27. NON-CONFORMANCE REPORTS

The Supplier shall issue a nonconformance report for any deviation that violates environmental qualification, interchangeability, design, operating

parameters, or any other request per this specification during procurement, manufacturing, testing, and commissioning of equipment per this specification. Such report shall have technical justification for nonconformance resolution dispositions and be submitted to NEK for approval prior to continuation of activities.

Any disposition, which cannot be returned to acceptable conditions, specified in approved drawing or specification, shall be rejected or specifically approved and accepted by NEK, prior to the shipment of equipment.

28. REPAIR RECORDS

Production repair records shall be included in the final quality release documentation. As a minimum, following information shall be provided in each of those:

a) Summary of repair/refurbishment work that has been performed on the equipment

b) Brief root cause analysis

c) Details about any "special process" used during repairs

d) A list of replacement parts installed in the repaired equipment

29. SOURCE INSPECTION / SURVEILLANCE NOTIFICATION

The contractor shall provide access to Contractor's plant facilities and records pertaining to the purchase order for the purpose of planning and performing source inspection/surveillance activities.

Inspections or examinations performed by NEK representatives or designated representatives do not relieve the Contractor of its responsibility to meet the requirements of this specification and purchase order.

30. SHIPPING REQUIREMENTS

Vendor shall be responsible for packaging and shipping of equipment to NPP Krško site.

Appropriate means shall be provided for safe transportation and lifting of equipment.

31. DELIVERY SCHEDULE

See requirements inside of public Tender documentation.

32. HOLD POINTS

NEK shall have the right to establish hold points, which will be designated in the final PQP, as defined.

NEK keeps the right to cancel presence during such activities.

NEK keeps the right to request additional hold points, if found necessary, to ensure resolution of unexpected quality problems or any other technical issue.

Predetermined hold or notification points require receipt of notification at least twenty (20) working days in advance of the scheduled time of performance. The following hold points for which prior notification is required are mandatory:

a. The beginning of the UPS assembling,
b. UPSs pre-EMC testing
c. EMC testing of the UPSs,
d. Seismic testing,
e. FAT for UPSs,
f. Shipping release.

33. VENDOR TECHNICAL MANUAL AND REGISTERED UPDATES

Manuals shall be delivered with all necessary information for installation, operation and maintenance and updated specific data and drawings for equipment.

All manuals shall be provided to the NEK for review and comments before final issue and delivery. Preliminary versions shall be clearly marked and in proper PDF searchable format and drawings also in ACAD format. Final version shall be furnished in one (1) hard copy and two (2) searchable electronic version on USB key.

If during required lifetime, any UPS component is replaced with new version, the Contractor is responsible to send update technical manual to NEK together with the replacing component.

34. TRAINING

34.1. UPS training

Contractor shall organize training for NEK maintenance personnel (3 participations). It shall take place at manufacturing plant after FAT.

34.1.1. Topic that shall be covered are (the most comprehensive level):

a) Detail Principe of Operation,

b) Installation of equipment,

c) Regular and in Depth Maintenance,

d) Detail Diagnostic and Troubleshooting,

e) Replacement of all parts and components,

f) Settings and adjustments of all PCB and other components that have adjustable settings,

g) Use of software for adjusting any electronic devices and parameters,

h) Training for In-Storage Maintenance for all parts that will be offered and have to be maintained to reach qualified life.

34.1.2. Training providers obligations

a) Instructor providing training must possess adequate technical knowledge and experience of the course content and must possess adequate instructional skills.

b) Preparation and development of training materials and other documentation.

c) Copying of required number of student handouts.

d) Delivery of training course and conduct of examination.

e) Responsibility and care for student safety during hands-on training.

f) Issuing training certificates for participants that successfully complete training course to perform maintenance work on trained systems and installations of new systems. Certificate shall be sent to participants & NPP Krško Training department.

g) Preparation and submittal of short training course report (scope of training course, specific dates and duration, list of instructors, list of participants, examination results, instructor comments, post-course student feedback analysis and results, other relative information, ...).

h) Providing a copy of student handout and other written training materials to NPP Krško training department for archiving (hardcopy and electronic version).

i) All training material shall be delivered to NEK (e-formats: CAD, ppt, pdf and other original format).

j) The contractor shall send to NEK detail training description with all training documentation 2 months before training shall take place for review, fulfillment and approval.

k) The requested training content shall be fully met.

35. WARRANTY

All equipment herein shall have at least 24 months of warranty after installation of the equipment in the NEK. Details are specified in the tender.

36. ATTACHMENTS

[1]Attachment 1: Technical data sheet & questionnaire for the UPS,

[2]Attachment 2: Simplified UPS drawing

[3]Attachment 3: Bolt and hole positions for the cabinet ,

[4]Attachment 4: OBE, SSE & DEC Floor Response Spectra Figures for ,

[5]Attachment 5: PDR - Problem Deficiency Report,

[6]Attachment 6: SPWAR - System Performance/Warranty Action Request.

[7]Attachment 7: QS-610, rev.2 Generic Quality Assurance Program Requirements

Attachment 1: Technical data sheet & questionnaire for the UPS

1. Enclosure Dimension:
    a. Length _____
    b. Width _____
    c. Height _____
2. Total Equipment Weight _____
3. Equipment Heat Load (Btu/hr):
    a. 50% Load _____
    b. 100% Load _____
4. UPS Design Type: _____
5. Input Voltage Range: _____
    a. 400 V AC _____
    b. 230 V AC _____
6. Inverter Output Voltage Adjustability _____
7. Inverter Output Frequency Adjustability _____
8. AC Input data: _____
    a. Input current @ No Load, HI input AC voltage _____
    b. Input current @ No Load, LO input AC voltage _____
    c. Input current @ No Load, Nominal input AC voltage _____
    d. Input current @ Full Load, HI input AC voltage _____
    e. Input current @ Full Load, LO input AC voltage _____
    f. Input current @ Full Load, Nominal input AC voltage _____
    g. Max current at startup _____
9. UPS Harmonics Fed Back to 400 V AC Source at: _____
    100% load at 1.0 power factor _____
    100% load at 0.8 power factor (lag) _____
10. UPS Harmonics Fed Back to 220 V DC Source at: _____
    100% load at 1.0 power factor _____
    100% load at 0.8 power factor (lag) _____
11. AC Output data (load side) _____
    a. Max True Power _____
    b. Max Apparent Power _____
    c. Max current _____

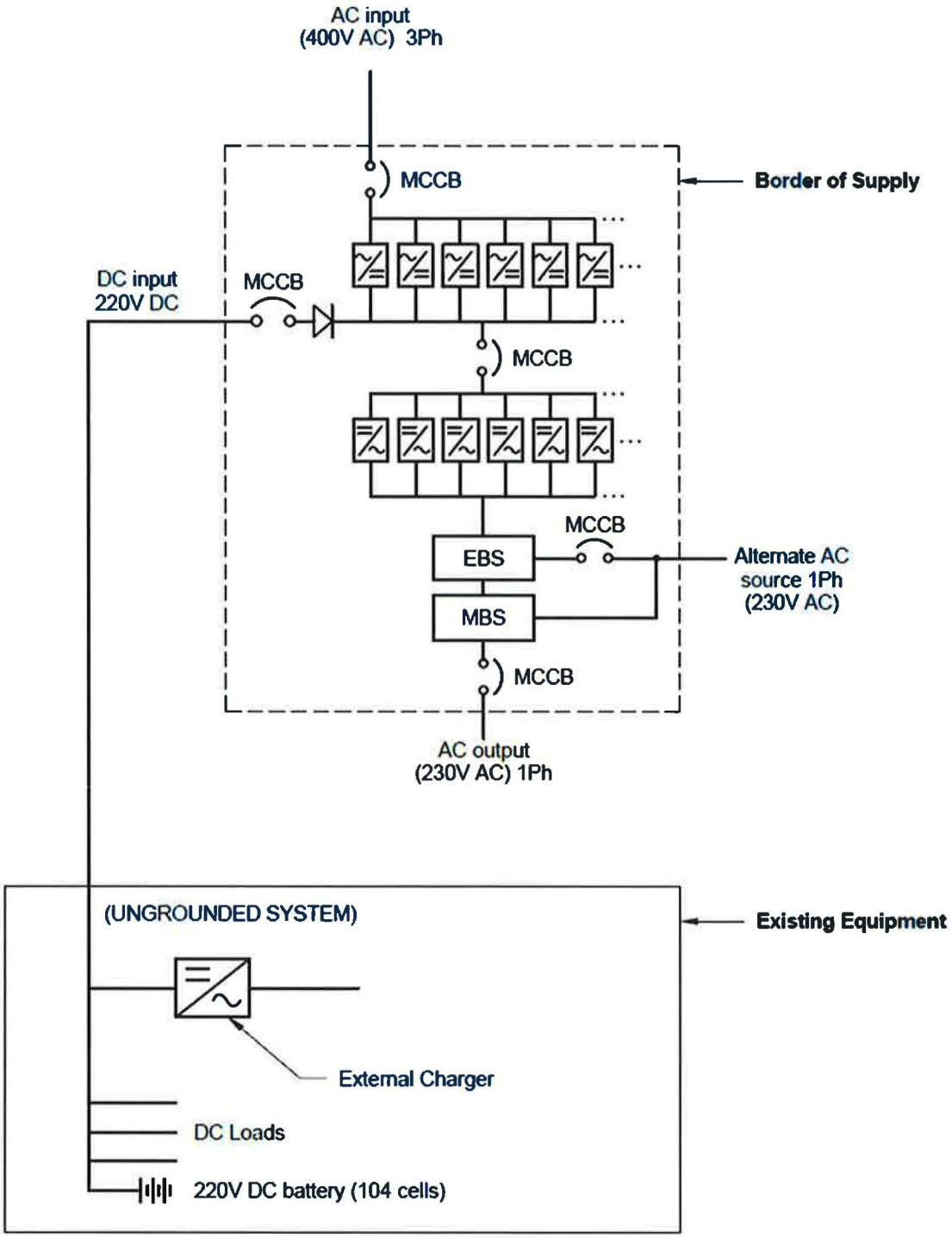
d. Max voltage
e. Min voltage
f. Frequency Adjustability
g. Voltage stability
h. UPS symmetrical short-circuit output in amps

12. Inverter Continuous Output Power Rating:
    a. kVA
    b. Power factor
13. Inverter Required Minimum Load:
14. AC Output Total Harmonic Distortion at:
    a. 100% load at 1.0 power factor
    b. 100% load at 0.8 power factor (lag)
15. AC Output Maximum Single Harmonic Distortion at:
    a. 100% load at 1.0 power factor
    b. 100% load at 0.8 power factor (lag)
16. Static Switch Transfer Time:
    a. From Inverter to Bypass Supply
    b. From Bypass Supply to Inverter
    c. Maintenance Bypass Switch Design Type:
17. UPS Efficiency Using 400 V AC Source at:
    a. 100% Output
    b. 50% Output
    c. 25% Output
18. UPS Efficiency Using 220 V DC Source at:
    a. 100% Output
    b. 50% Output
    c. 25% Output
19. Time to Ramp from Zero to Full Load:
20. Audible Noise (dBA at 1,5 m)
21. Type of Cooling (ambient, fans, etc.):
22. Minimum Clearances Required Around Enclosure:
    a. On the back
    b. At sides

c. Front

23. Short Circuit Rating of 400 VAC Input
24. Short Circuit Rating of 220 VDC Input
25. Short Circuit Rating of Regulated Bypass Source Input (230 VAC)
26. Allowable Input Voltage Variation for 400 VAC Supply
27. Allowable Input Voltage Variation for 220 VDC Supply

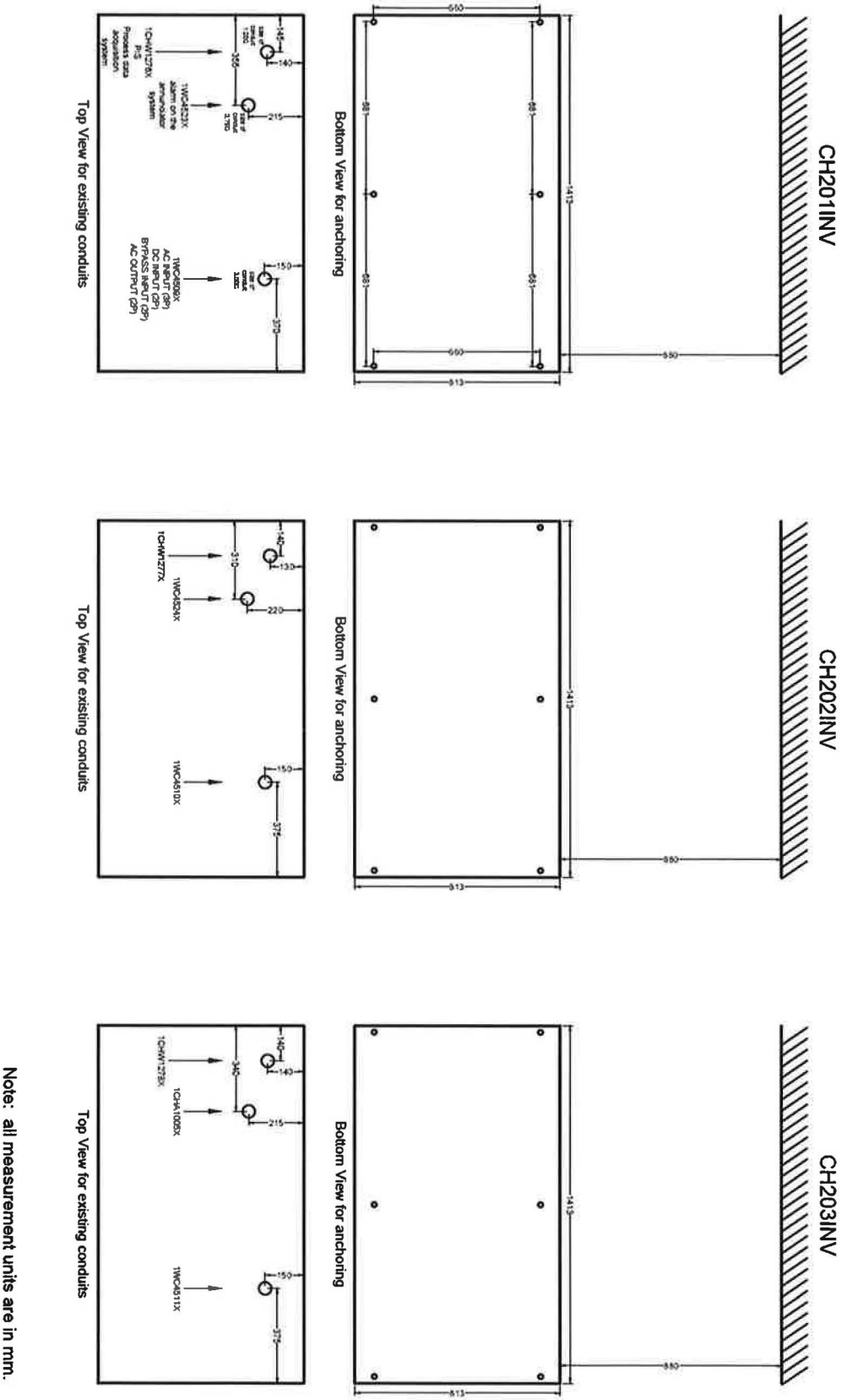
Attachment 2: Simplified UPS drawing



NOTES:

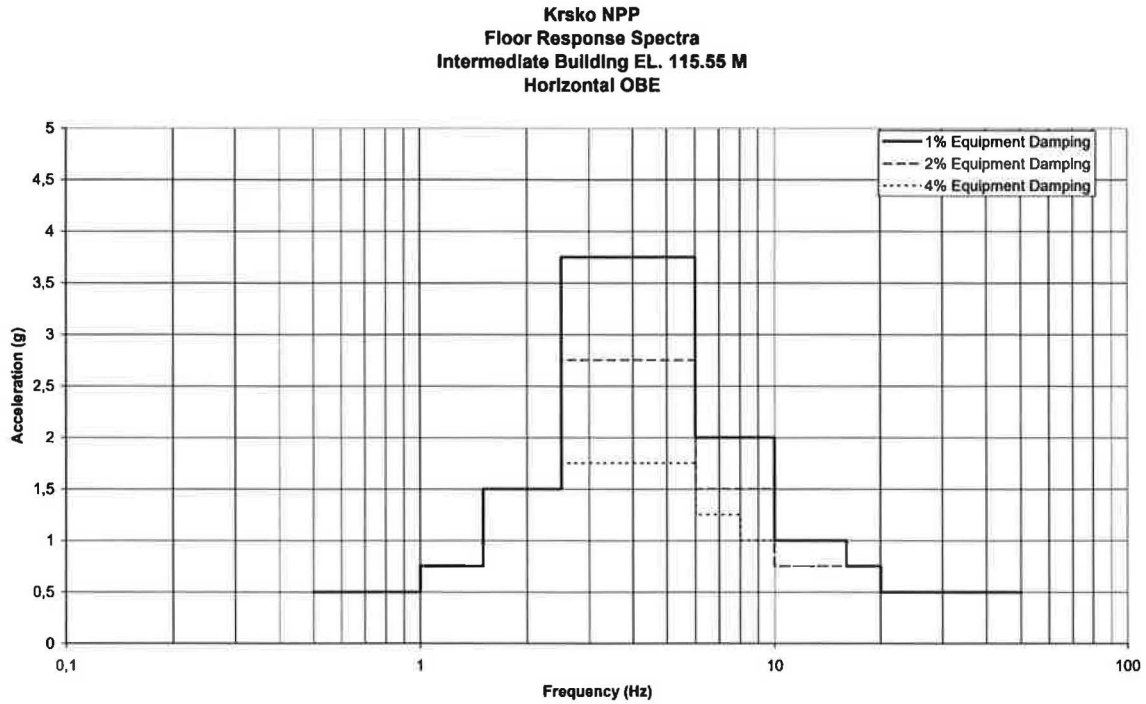
- EBS (Electronic Bypass Switch)
-MBS (Manual Bypass Switch)
- MCCB (Molded Cose Circuit Breaker)

Attachment 3: Bolt and hole positions for the cabinet anchoring

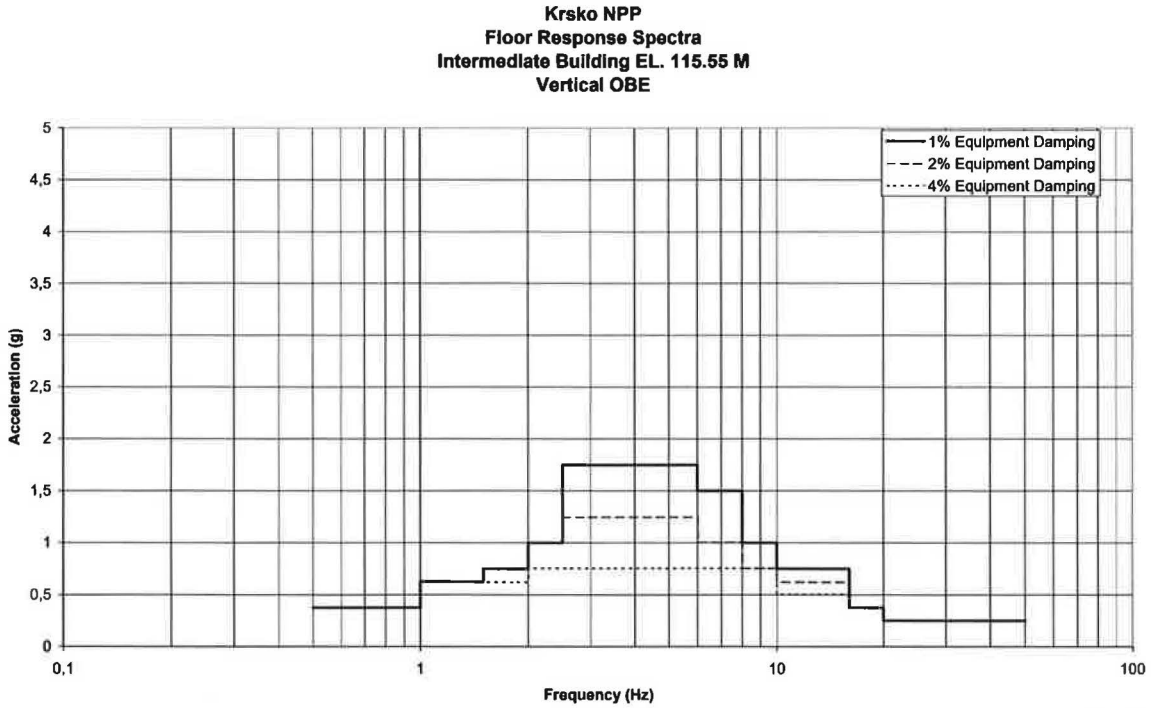


Note: all measurement units are in mm.

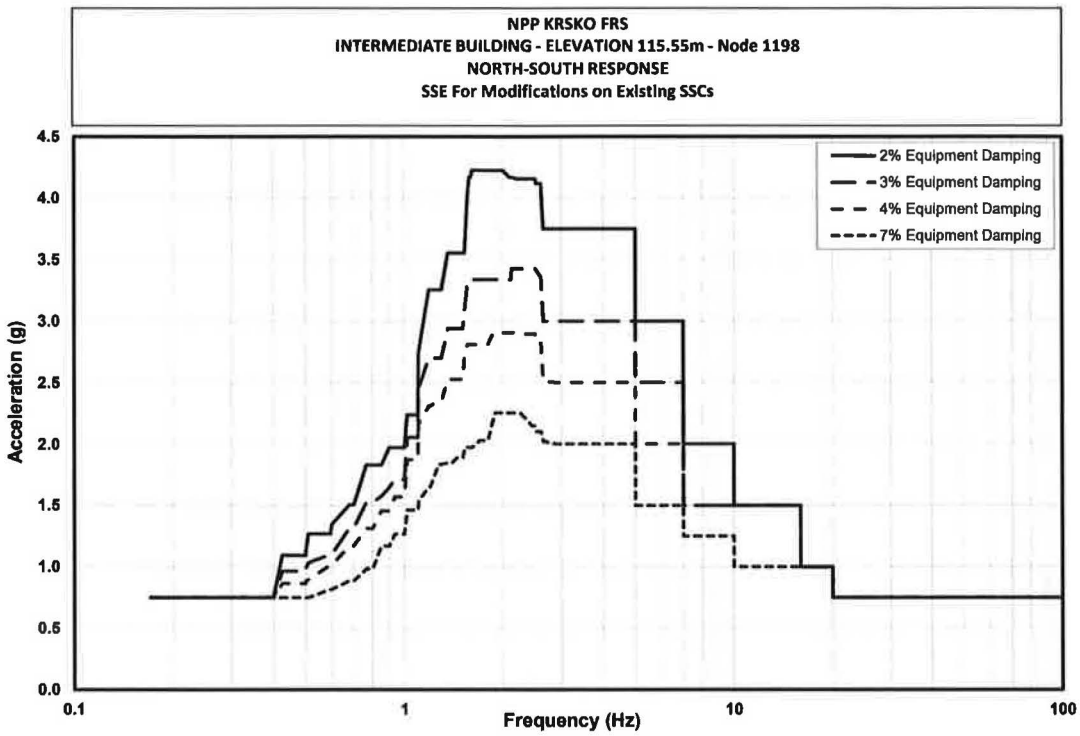
Attachment 4: OBE, SSE & DEC Floor Response Spectra Figures for Intermediate Building (IB), elevation 115.55, room 040



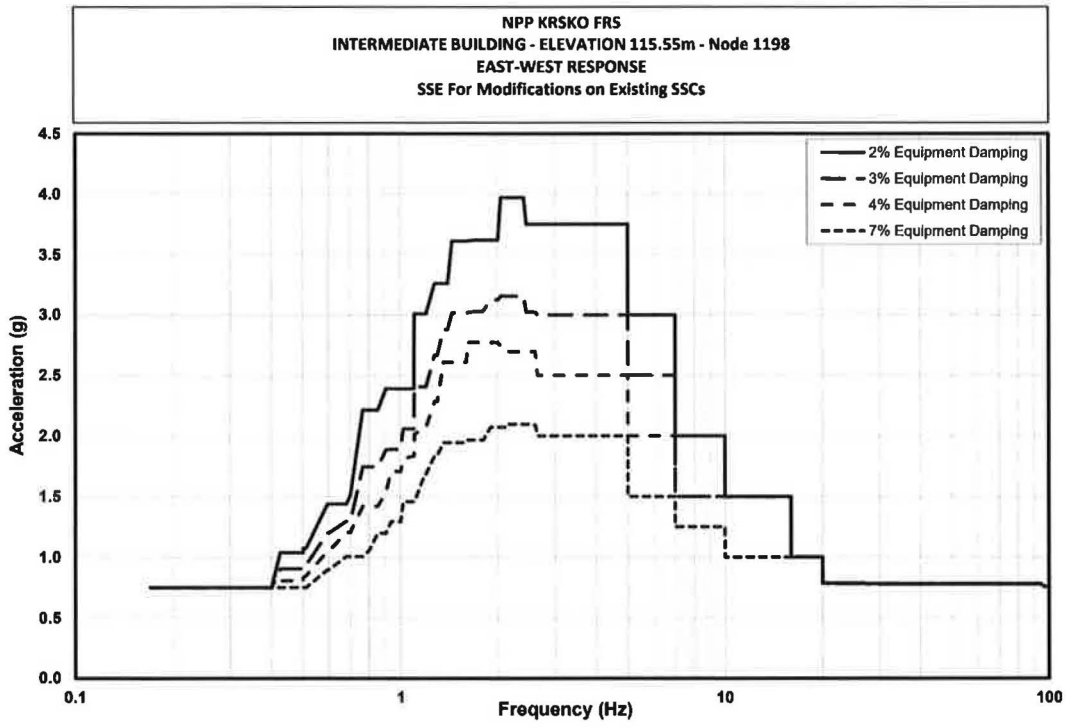
Appendix A Figure A61 Revision 11
November 2024



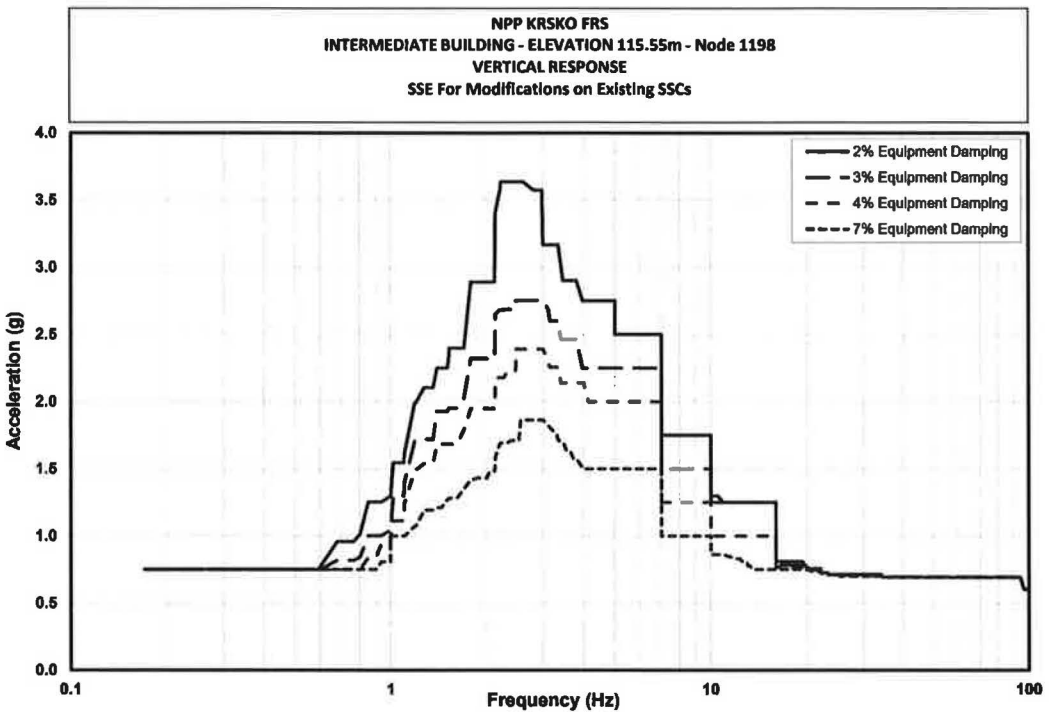
Appendix A Figure A62 Revision 11
November 2024



Appendix B Figure B46



Appendix B Figure B47



Appendix B Figure B48