NEK

Technical Specification

UPS AND BATTERY WITH CABINETS for OSC

KRŠKO NUCLEAR POWER PLANT

SP–E 3036

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AUGMENTED QUALITY

Damjan Bizjak	Originator	11.07.2019 Date
Rajko Petan	Verifier	11. 7. 2019 Date
Damijan Gregorič	Reviewer (QA)	12. 7. 2019 Date
Janko Cerjak	Engineering and Design Change Superintendent	12/07/2019 Date

TABLE OF CONTENTS

Section	Title Description	Page
1.0	SCOPE	1
2.0	DEFINITIONS AND ABBREVIATIONS	3
3.0	CODES STANDARDS AND REGULATORY REQUIREMENTS	3
4.0	SUPPLEMENTAL DATA	4
5.0	DOCUMENT SUBMITTAL	5
6.0	DESIGN REQUIREMENTS AND DESIGN INPUTS	10
7.0	PERFORMANCE REQUIREMENTS	17
8.0	MATERIAL REQUIREMENTS	18
9.0	FABRICATION AND ASSEMBLY	19
10.0	INSPECTION AND TEST	20
11.0	ITEM QUALIFICATION	24
12.0	CLEANING	24
13.0	CORROSION PROTECTION / COATING	25
14.0	MARKING AND IDENTIFICATION	25
15.0	PACKAGING, HANDLING AND STORAGE	25
16.0	NONCONFORMING MATERIALS	26
17.0	RECORDS	26
18.0	OTHER REQUIREMENTS	27
19.0	RIGHT OF ACCESS	27
20.0	QA PROGRAM REQUIREMENTS	27
21.0	SPECIAL HANDLING	28
22.0	SHELF LIFE	28
23.0	10CRF21 REPORTING (For US supplied equipment only)	28
24.0	COMMERCIAL GRADE DEDICATION	28
25.0	SUPPLIER DOCUMENTATION REQUIREMENTS	29
26.0	NEK PROPRIETY DATA	31
27.0	NON-CONFORMANCE REPORTS	31
28.0	REPAIR RECORDS	31
29.0	SOURCE INSPECTION / SURVEILLANCE NOTIFICATION	32
30.0	SHIPPING REQUIREMENTS	32
31.0	DELIVERY SCHEDULE	32
32.0	HOLD POINTS	32
33.0	VENDOR TECHNICAL MANUAL AND REGISTERED UPDATES	32
34.0	TRAINING	33
35.0	ATTACHMENTS	34

1.0 SCOPE

1.1 Scope of Work

This specification establishes the technical requirements for the design, manufacturing, testing, packing, documentation, and supply of:

1.1.1 UPS

One (1) uninterruptible power supply assembly. UPS shall be of modular type. Assembly shall contain rectifier, DC/DC converter if needed for battery charging/discharging, inverter, electronic static switch, maintenance bypass switch, instrumentation and alarms, as specified herein. The uninterruptible power supply assembly shall henceforth be referred to as UPS.

The UPS shall be 40 kVA (36kW), 230V/400V, 50Hz. It will be anchored to the concrete floor in a closed and ventilated room.

UPS will be powered from the MCC, which has the primary (grid) power source and back-up diesel-generator power source. It shall have also an associated battery source.

1.1.2 Battery, Cabinets and belonging accessories

One (1) battery consisted of 12 VDC battery blocks which shall fulfill technically requirements for the battery input to UPS and requirements of Technical Specification specified herein, battery cabinets and all cable connections.

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] One complete, fully assembled and operational UPS unit.
[2] Temperature probe for battery voltage compensation: Cable length shall be at least 35m (one piece).
[3] The Supplier shall include all materials, internal wiring, and components needed for complete installation, operation and functionality of equipment within the scope of this specification, and required service conditions.
Anchoring bolts, nuts, links, 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.
[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 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.
[9] Necessary software required for maintenance of UPS (download data and upload software and setting of PCB's).
[10] Detail training for maintenance personnel at manufactures facility on the offered UPS model. This should be included on proposal as an option.
[11] Start-up and site acceptance test procedures.
[12] Seismic qualification

[13] Supply of the documentation required herein.
[14] Prototype UPS[1], as applicable.

1.2.2 Battery, Cabinets and belonging accessories

[1] One (1) complete VRLA battery with front terminal design, consisted of 12 VDC battery blocks and technically appropriate with UPS requirements specified herein.
[2] Battery cabinets and anchoring bolts.
[3] Four (4) additional "spare" battery blocks.
[4] All interconnections between the battery blocks, battery rows, and battery cabinets in order to conform a complete battery. The interconnections shall not impede the way through for maintenance activities and shall be supported so as to protect the cables and avoid mechanical stresses of the terminals.
[5] Cable lugs on the side of battery for external connections for connecting the external cables from the battery to the corresponding DC Molded Case Circuit Breaker (section of external cables is 2 x 1/0 AWG, per polarity).
[6] External cables in length of 2x30m per pole, shall be shown in the offer as optional.
[7] Isolating covers for all battery terminals including external cables.
[8] Labels for marking battery blocks from No1 to No40.
[9] All special tools required for maintaining the battery. Each item shall be shown in the offer as optional.
[10] Special handling devices specified under section 21 herein. Each item shall be shown in the offer as optional.
[11] Detailed Training for installation and maintenance of batteries by the battery manufacturer, as required by section 34 herein shall be shown in offer as optional.
[12] Seismic qualification.
[13] Supply of the documentation required herein.
[14] Prototype cabinet[1] with battery and associated connections, 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.

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

2.0 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

CoC	Certificate of Compliance
E&DC	Engineering and Design Change
ESD	Engineering Service Division
FAT	Factory Acceptance Test
NCR	Non-Conformance Report
NEK	Nuklearna elektrarna Krško (Nuclear Power Plant Krško)
SIS	Switchboard wire, 90°C, 600V with XLPE isolation
UPS	Uninterruptible power supply
OEM	Original Equipment Manufacturer
OSC	Operating Safety Centre
SSE	Safety Shutdown Earthquake
VRLA	Vented Relief Lead Acid (Battery)
MCC	Motor Control Center

3.0 CODES STANDARDS AND REGULATORY REQUIREMENTS

All equipment to be furnished under this Specification shall conform to portions of the following codes as applicable.

3.1 UPS

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

a) IEEE 944-1986, "IEEE recommended practice for the application and testing of uninterruptible power supplies for power generating stations".
b) IEEE 344-2004, " Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations".

[2] NEMA –National Electrical Manufacturers Association:

a) NEMA AB 1-1975, "Molded Case Circuit Breakers".
b) NEMA AB 4-2003, "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-%, "Uninterruptible power systems (UPS)".

3.2 Battery, Cabinets and belonging material

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

a) IEEE 450-2010, "Recommended Practice for Maintenance, Testing and Replacement of Vented Lead-Acid Batteries for Stationary Applications".
b) IEEE 485-2010, "Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications"
c) IEEE 344-2004, "Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations"

[2] IEC - International Electrotechnical Commission

a) IEC 60896-21, "Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test".
b) IEC 60896-22, "Stationary lead-acid batteries - Part 22: Valve regulated types - Requirements".
c) IEC 62485-2:2010, "Safety requirements for secondary batteries and battery installations - Part 2: Stationary batteries".
d) IEC 62485-1:2015, "Safety requirements for secondary batteries and battery installations - Part 1: "General safety information".

[3] UL

a) UL94 V-0, "Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances".

Any conflict between the above requirements and those specified herein shall be reported to the NEK 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.

4.0 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.

Supplemental data items:

[1] QS-610, Rev. 1, "Generic Quality Assurance Program Requirements".
[2] SP-S702, Rev. 10, "Seismic Analysis, Testing and Documentation".

NOTE: The specification SP-S702 is provided without Appendices with floor response spectra figures. Applicable floor response spectra figures are provided in Attachment 4 and Attachment 5 of this specification.

5.0 DOCUMENT SUBMITTAL

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

All documents (including drawings, graphs, specifications, etc…) submitted shall be in the form of hard copies and 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); and

Computer Aided Drafting: AutoCAD (dwg).

All documents in electronic media shall be provided in original format, as well as directly converted to 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.

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.
[3] Preliminary dimension drawings, showing side views and layouts.
[4] Installation, Commissioning, Technical, Operational and Maintenance manuals.
[5] Component replacement schedules to achieve qualified life of 20 years.
[6] Bill of Material (BOM).
[7] Detailed production and delivery schedule.
[8] List of documents to be submitted.
[9] List of accessories, spare parts (such as startup kit and operational kit) and special tools, if needed.

5.2 Documentation Required after Contract Award

5.2.1 UPS

	Fulfill (F) Approval (A[2]) Certified (C) Record (R)	Maximum delivery period after contract award
List of documents	F/A	2 weeks
Equipment/parts catalogues	R	2 weeks
Detailed Quality Plan with approved R (record), W (witness) and H (hold) points	F/A	3 weeks
Certified datasheets	A/C	2 weeks
Certified drawings of the general arrangement and dimensions, including: a) Outline drawing, showing weight, cable openings details, minimum clearances at the front, top, rear and sides. b) General arrangement, showing location and position of all components. c) Details of anchoring, showing static and dynamic support reaction forces. d) Connection and mounting details. e) Shipping dimensions and weights. f) Structural drawing (weights, center of gravity, dimensions of the frame, etc).	F/A/C	8 weeks
Nameplates and rating plates of main equipment.	A	12 weeks
Complete, itemized Bill of Material: a) BOM of main components. b) BOM detailed to the smallest parts level, indicating the OEM descriptions and part numbers. The design/qualified life and maintenance replacement interval to achieve qualified life of 25 years shall be specified for each item. BOM shall be submitted in the form of a spreadsheet	A	10 weeks
One-line diagram	A	8 weeks
Internal schematic, wiring diagrams and interconnection diagrams.	A	8 weeks
Breaker settings, time curves characteristics and coordination tables.	A	8 weeks
Test procedures and protocols.	F/A	10 weeks
Final test protocols and reports (after FAT).	A	One week after FAT

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

	Fulfill (F) Approval (A[2]) Certified (C) Record (R)	Maximum delivery period after contract award
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
All equipment data required for plant Master Equipment Component List	R	One week after FAT is finished
Seismic 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.	A/R	4 weeks prior to qualification tests
Final test protocols (before FAT).		4 weeks before FAT
Certificate of Conformance (CoC) certifying that all the requirements of this Technical Specification and purchase order have been met and that the qualification is in accordance with specified standards.	A/R	One week after FAT
Final Seismic qualification documentation package	A/R	One week after FAT
Final test protocols and reports (after FAT).	A/R	One week after FAT

5.2.2 Battery, Cabinets and belonging material

	Fulfill (F) Approval (A[3]) Certified (C) Record (R)	**Maximum delivery period after contract award**
List of documents	F/A	2 weeks
Equipment/parts catalogues	R	2 weeks
Detailed Quality Plan with approved R (record), W (witness) and H (hold) points	F/A	3 weeks
Certified datasheets	A/C	2 weeks
Substantiating battery calculation and charge and discharge graphics, according to IEEE 485		
Certified drawings of the general arrangement and dimensions (battery and cabinets), including: a) Different views and layouts of the battery cabinets in the battery room. It should also include the minimum clearance to be kept free at the front, rear, top and sides of the battery cabinets. b) Detail drawing about battery cabinets. c) Layout of the battery blocks positioned in the battery cabinets. d) Detail drawing about battery blocks connection details (connections between: battery blocks, battery blocks at different rows, different cabinets, external connections) e) Calculation which shows how big forces act on anchoring. f) Detail drawings about battery blocks and subcomponents (battery block and its connections, cables, bolts, lugs isolating covers). g) Shipping dimensions and weights. h) Drawing for Post sealing design. i) Details of anchoring, showing static and dynamic support reaction forces. j) Connection and mounting details. k) Structural drawing (weights, center of gravity, dimensions of the frame, etc)	A/C	8 weeks
Complete, itemized Bill of Material: a) BOM of main components. b) BOM detailed to the smallest parts level, indicating the OEM descriptions and part numbers. The design/qualified life and maintenance replacement interval to achieve qualified life of 25 years shall be specified for each item. BOM shall be submitted in the form of a spreadsheet	A	10 weeks
Test procedures and protocols.	F/A	10 weeks

[3] Fabrication prior to approval of drawings marked “A” shall be at the Supplier’s own risk.

	Fulfill (F) Approval (A[3]) Certified (C) Record (R)	**Maximum delivery period after contract award**
Installation, commissioning and operating instructions including: a) Instructions for battery 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.	R	16 weeks
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.	R	One week after FAT is finished
All components data required for plant Master Equipment Component List	R	One week after FAT
Final test protocols (before FAT).		4 weeks before FAT
Seismic 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.	A	4 weeks prior to qualification tests
Certificate of Conformance (CoC) certifying that all the requirements of this Technical Specification and purchase order have been met and that the qualification is in accordance with specified standards.	R	One week after FAT is finished
Final Seismic qualification documentation package.	A/R	One week after FAT
Final test protocols and reports (after FAT).	A	One week after FAT

6.0 DESIGN REQUIREMENTS AND DESIGN INPUTS

6.1 UPS

6.1.1 General

The UPS shall be capable to supply, phase unbalanced, 230/400VAC power to plant electronic components. Most loads will be single-phase.

It shall be 40 kVA (36kW), 230V/400V, 50Hz. It will be anchored to the concrete floor in a closed and ventilated room.

UPS will be dually powered with 3 phase, 50 Hz AC sources: from the grid (normally) and from diesel-generator (back-up). There will also be a DC power source from the battery.

UPS shall be assembled from modules of (N+1) redundancy. Each module shall have its own three phase rectifier, three phase inverter, three phase electronic bypass switch, DC/DC converter for battery charging/discharging and redundant regulation/control unit.

UPS shall have integrated 3 phase maintenance bypass switch. Charger, as part of UPS, shall be also designed for charging the battery. UPS shall be capable to perform discharge test of the battery with the UPS load, preferably by returning excess energy back to AC input grid through rectifier part of UPS.

All UPS operating mode transfers shall be without any interruption on the load side at full load.

6.1.2 Modules

[1] UPS shall be assembled from modules of (N+1) redundancy,
[2] Modules shall have function of self-configuration,
[3] Maximum size of one module shall not exceed 20 kVA,
[4] Each module shall consist of:

a) Three-phase rectifier with IGBT,
b) Three-phase inverter with IGBT,
c) DC/DC converter for battery charging/discharging,
d) Electronic bypass switch,
e) Redundant regulation/control unit.

[5] In case of failure on one module, this module shall be automatically disconnected from the operation and other modules shall take the load from the disconnected module. On the output of the UPS shall not be any signs of malfunction of the module.
[6] Hot swap modularity that can replace an entire UPS module during operation in less than 5 min.
[7] No single points of failure through:

a) Redundant critical circuits in each module
b) Multi-master operation
c) Decentralized parallel architecture

[8] Efficiency

a) Up to 96 % efficiency in double conversion mode,
b) Up to 99 % efficient in “super efficiency” mode.

[9] Super efficiency mode

Modules shall have capability of Super efficiency mode in which loads are fed via electronic static switch until the voltage and frequency of the by-pass remain within acceptable values. At this point the critical load is break-free transferred onto the UPS inverter and is therefore fully protected from damaging mains borne

disturbances including brown-outs and black-outs.

[10] Sleep mode

All modules in sleep mode shall remain fully ready to instantaneously provide power to the load should the need arise 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).

6.1.3 System operation

See Attachment 2 (B-206-926 - One-line diagram of UPS).

6.1.4 Normal operation:

UPS shall be constructed to operate in **Super Efficiency Mode** or in **Inverter Mode**. User can choose either operating mode.

In Super Efficiency Mode the critical load is fed via the electronic bypass line until the voltage and/or frequency of the bypass moves outside of pre-set tolerances. At this point the critical load is break-free transferred onto the UPS inverter and is therefore fully protected from damaging mains borne disturbances including brown-outs and black-outs.

In Inverter Mode the critical load is fed via the inverter which is supplied from internal DC bus. In case of overload, manual initiation, depleted battery, or malfunction it shall transfer to electronic bypass switch.

UPS output shall be constantly synchronized to bypass power source when it is available.

6.1.5 Loss of Bypass input

Super Efficiency Mode:

Load shall be transferred break-free to the UPS inverter. The primary source will be AC rectifier input. The backup power source will be the DC battery.

Inverter UPS Mode:

In a case of loss of both AC sources (Rectifier input and bypass input) inverter shall be fed from the battery. When the battery is near exhaustion, and the bypass source is not available, the unit shall shutdown to prevent excessive discharging of the battery. After the return of any of AC sources, UPS shall start automatically, and start with battery recharging.

6.1.6 Loss of Normal AC Input Power

Super Efficiency Mode:

In case of loss of AC sources, load shall be transferred break-free to the UPS inverter which will be fed from the battery. No interruption in the inverter UPS output shall occur during the switching from the Super Efficiency Mode to Inverter UPS Mode. When the battery is depleted and the bypass source is not available the unit shall shutdown to prevent excessive discharging of the battery. After the return of any of AC sources, UPS shall start automatically, and start with battery recharging. Inverter shall resume normal operation (and auto transfer back to Super Efficiency Mode when battery is at least 50 % charged).

Inverter UPS Mode:

Inverter shall be supplied from the battery. In case that battery is depleted and bypass supply is available, load should be transferred from battery to bypass source without interruption with the electronic bypass switch. When the AC rectifier source is available, load shell be automatically transferred back to Inverter UPS mode. If the bypass source is not available the unit shall shutdown to prevent excess discharging of the battery. After returning of AC rectifier source UPS shall automatically start, and start with the battery recharging and inverter shall resume normal operation.

6.1.7 Battery charging current:

Battery charging current shall be limited and adjustable.

Completely discharged battery shall be fully recharged in up to 10 hours.

6.1.8 Load shall be transferred to the bypass in the following cases:

a) Manual initiation,
b) Overloaded UPS,
c) Failed UPS,
d) Battery is depleted,
e) Other determined signals.

Load transfer from the UPS mode to the bypass supply shall be without any interruption on load side. If the bypass supply is outside of the specified voltage and frequency limits, then the transfer shall be blocked.

6.1.9 Transfer back to the inverter UPS mode after transferring to the Bypass Supply mode

The electronic bypass switch shall be capable of automatically re-transferring the load back to the inverter UPS mode after the UPS has returned to normal output parameters and stabilized for a predefined period of time. If the inverter is not within the specified voltage and frequency limits this transfer shall be blocked.

6.1.10 Communications

UPS shall have a color graphic touchscreen display (with good resolution and visibility) providing mimic diagram, showing energy flow, UPS operational data, status, and alarms. All inputs and outputs breakers/fuses and statuses shall be seen on this display.

The default screen display shall show statuses of various assemblies (rectifier, battery, inverter, bypass) and mimic diagram showing energy flow.

UPS shall have external ethernet connection to access operating parameters and statuses of device, history log, etc. Connection shall be protected with password.

USB port for laptop connection and USB memory stick shall be installed.

6.1.11 Size of UPS cabinet (Footprint)

Max dimensions: W x D x H [mm]: 600 x 800 x 2000

6.1.12 Painting of UPS cabinet

RAL 7035 (Light Grey)

6.1.13 Mounting

UPS shall be seismically qualified and assembled in appropriate cabinet. It will be anchored to the concrete floor. Provisions shall be made for anchoring to the floor with bolts. Mounting details, with the selected bolts, shall be delivered to NEK as specified under item 25.0. The minimum distance from the wall shall be specified.

6.1.14 Cooling

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

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

Environmental conditions are specified under item 11.0.

6.1.15 Instrumentation

Instrumentation shall be of 1 % accuracy and shall include:

a) AC rectifier input voltage and current (each phase), PF & Power (kVA, kW),
b) Rectifier output current and voltage
c) AC bypass input voltage, current (each phase),
d) UPS output voltage, current (each phase), frequency, PF & Power (kVA, kW),
e) Battery voltage and charging/discharging current, Power,
f) UPS modules and battery temperature,
g) Inverter loading in %.

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

6.1.16 UPS Equipment Protection

UPS shall have adequate protection against external short circuits, open circuits, overloads and transient surge voltage conditions. Molded Case Circuit Breaker protection shall be provided for the 400/230V AC supply (primary and bypass), battery and 230V inverter output.

6.1.17 Alarms

The following conditions shall be provided for remote alarming as a minimum:

a) Common failure (UPS trouble),
b) Load transferred to electronic bypass switch,
c) Manual bypass switch operation,
d) DC ground fault,
e) Rectifier failure,
f) DC/DC converter failure,
g) Inverter failure,
h) UPS out of synchronization,
i) Battery voltage Hi,
j) Battery charging O.K.
k) Battery supplying load,
l) Battery near exhaustion,
m) Low DC disconnect,
n) AC primary voltage input LO/HI,
o) AC bypass LO,

p) AC Output voltage LO,
q) AC Output Voltage HI,
r) Fan Failure,
s) High temperature of module,
t) Battery temperature out of range.

At least above alarms (chosen by the user) shall be connected to Common failure alarm which shall be wired to alarm terminal blocks as digital NC/NO-COM contacts (two contacts).

All alarms and status set-points and adjustable ranges shall be sent to NEK in spreadsheets to review, fulfill and approve.

6.1.18 Terminal lugs and cable connection:

Provisions shall be made for power and alarm cable entrance from the top (flexible cable conduits, 2 inches). All External wiring shall be connected to terminals (power cable shall not be connected directly to breakers). Burndy Type YA lugs or equal shall be used by the NEK for cable connections. Size of terminals shall be appropriate with NEK Attachment 2, where are visible cable sizes.

Additional UPS AC output terminals shall be provided for testing purposes. This can be solved also with double terminals (additional terminals beside main terminals).

6.1.19 User Panel

UPS shall be operated via a graphic touchscreen display, and associated breakers.

It shall be installed on front panel or front door. Graphic display shall be seen without opening of front door.

6.1.20 History LOG

All possible alarms and states shall be recorded to History Log. List of all alarms with setpoints and adjustments shall be sent to the NEK for comments and approval.

6.1.21 Molded case circuit breakers:

On all power inputs and outputs Molded Case Circuit Breakers shall be installed.

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

Manipulation with breakers (AC rectifier input, DC input, Bypass input, Manual bypass and UPS output) shall be from the front side of control panel and not form inside of UPS. Control panel can be covered with the door.

All molded case circuit breakers shall conform to NEMA AB-1, Parts 1, 2, 3 and 9.

Circuit breakers shall have screw-compression (ring) type lugs compatible with the breaker rating.

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

6.1.22 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 2 AWG copper ground wire. Grounding cable entrance shall be provided from the top. Any additional requirements for proper grounding shall be described by the contractor.

6.1.23 Ground fault detection

Since DC part of UPS system is ungrounded, UPS shall have possibility to detect ground fault on DC side. Alarms shall be seen from graphic display and common failure alarm shall be initiated.

Alarm initiation set-point will be determined later.

UPS shall store time of initiation of alarm also to UPS Alarm History In case that the center of the battery will be connected to Neutral, then Ground Fault Detection cannot be implemented.

6.1.24 Nameplates

UPS shall have nameplates on front Each item mounted on front panel shall have 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 ¼ inch. 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 shall be submitted to the NEK for comments and approval before installation.

One-line schematic shall be placed on front panel showing main components (breakers, inverter, rectifier, transfer switch …) and electrical interconnections between them. Schematic shall be engraved on stainless steel plate or similar with good visibility and mounted so that shall not interfere with UPS operations. If one-line schematic is seen from graphic display when it is in normal operation then there is no need for it.

If user short instructions for operating with the UPS will be provided on UPS, all text shall be with black letters on white background.

NEK designation for new UPS shall be EP901UPS. Nameplate shall be placed on front side at middle top location.

6.1.25 Insulation against unintentional contacts

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

Between different breakers, terminals/connections shall have appropriate distances. Breaker terminals and connection screws shall be isolated.

6.2 Battery & Cabinet

6.2.1 General

The Battery shall be capable to supply UPS in case of loss of AC input power. Details about UPS are specified herein in Technical Specification.

Battery shall be installed in cabinets with appropriate connections between battery blocks, outgoing power cable connections and appropriate ventilation of cabinet.

Requested autonomy is 60min at nominal load 25 kW @ PF=1.0. See sizing details in Paragraph 7.2.1. Sizing of the battery shall be attached in the offer documentation, as well as technical data of the battery, including discharging tables (Wats & Amps/battery block).

Battery shall be long life, 12 years min.

Maintenance activities and replacement or installation of the battery blocks shall be easy with the least possible touch to parts under voltage. All parts under voltage shall be isolated.

Charging of battery shall be temperature compensated.

It is desirable that the battery is ungrounded.

6.2.2 Battery design

a) VRLA type, front terminals (connections from vertical side),
b) Consisted of 12 V battery blocks connected in series to reach needed nominal voltage for supplying UPS.
c) All battery terminals shall be protected with insulation covers.
d) Cable connections between battery blocks shall be solid or flexible.
e) Easily accessible battery connections

6.2.3 Battery cabinet

[1] Size of cabinet

See the available size of the battery room in the Attachment 3. The final layout shall be confirmed by NEK.

Batteries shall not be installed too high due to maintenance and seismic requirements.

[2] Mounting

Cabinet shall be anchored to the concrete floor with bolts in a closed and ventilated room. Fulfilled shall be qualification requirements (environmental and seismic) specified in paragraph 11.0. Mounting details, with the selected bolts, shall be delivered to NEK as specified under item 25.0. The minimum distance from the wall, at which the cabinet can be fastening, shall be specified and shall follow the latest EU standards,

[3] Grounding

Requirements for proper grounding of cabinets shall be determined by the supplier and shall follow the latest EU standards.

[4] Doors

It is desired that Cabinets have front doors.

[5] Installation and deinstallation of batteries

Installation and deinstallation of batteries shall be easy and safe.

[6] Painting of cabinet

RAL 7035 (Light Grey). Trays shall be coated with electrically resistant insulation.

7.0 PERFORMANCE REQUIREMENTS

7.1 UPS

7.1.1 AC Input Characteristics (Primary input and bypass)

AC Input Voltage	400V + 20% - 30%, (3ph + N + PE)
AC Frequency:	50 Hz ± 5 Hz
AC Inverter Magnetizing Inrush Current	Less than 400% of rated current
Total distortion THDi (100 % load)	≤ 3 %
Power Factor	≥ 0.99

7.1.2 DC Input/Output Characteristics

a. Nominal DC voltage: Minimum required (30-40 12V battery blocks)
b. Possibility of float and equalize charging
c. Timer for equalize charging
d. Completely discharged battery shall be fully recharged in up to 10 hours with parallel inverter load supply

7.1.3 Output Characteristics

Output Rating:	40 kVA, 36KW, @ PF=0.9
Size of one module	< 20 kVA
Output Voltage	230/400V, 50Hz, (3ph + N + PE)
Phase unbalance	100%
type of loads	Almost all loads will be single phase 230 VAC
Total Harmonic Distortion:	< 1%
Voltage tolerance (static	±1%
Frequency:	50 Hz, ± 0,1%
Audible noise at 1m (from 0 to full load):	≤ 48 dB
Crest factor	≥ 3:1 at full load
Overload operation, inverter	150 % for 60 s, 125 % for 10 min, 110 % for 30 min
Overload operation, bypass	1000 % for 100 ms, 150 % for 10 min, 125 % continuously
Short circuit response, inverter	≥ 300 %
Short circuit response, bypass	800 % for 100 ms
Efficiency:	99% (SE mode); 96% (Double conversion)

7.2 Battery, Cabinet & accessories

Battery shall be type VRLA and they shall be long life design, at least 12 years min.

Battery shall be made up from no more than 40 battery blocks. Desired is that the battery consists of less battery blocks.

Battery shall be sized per IEEE 485.

The design of the battery and float voltage shall eliminate periodic equalizing charges.

7.2.1 Sizing parameters for battery:

Application:	UPS
Lowest temperature	5°C (see Paragraph 11.0)
Min cell voltage:	1,75 V/cell
Design Margin:	1,0
Aging Factor:	1,25

7.2.2 Battery load details

Load kW:	25
Power Factor:	1
Efficiency of UPS:	Determine the supplier of UPS
Discharge time (min):	60
Number of cells:	Determine the supplier of UPS

7.2.3 Ambient conditions

See paragraph 11.0

7.3 Seismic performance requirements

See paragraph 11.0

8.0 MATERIAL REQUIREMENTS

The Contractor shall be responsible for all materials and their procurement specification. All current carrying parts shall be copper made. Control, instrumentation and alarm wiring shall be a minimum of 14AWG 7-strand copper conductors, 600V 90°C flame retarding insulation. Where wire is subjected to flexing on hinged panels 14AWG 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 in UPS shall be suitable for environmental qualification as specified under item 11.0.

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

Enclosures shall consist of rigid welded or bolted steel frames with a minimum 12GA framework. Door panels shall be a minimum of 14GA commercial steel and side panels shall be a minimum of 18GA. 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.

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.

9.0 FABRICATION AND ASSEMBLY

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

9.1 UPS

UPS shall be assembled so it shall sustain environmental conditions according to item 11.0. 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.

Jumpers shall be installed between AC input and Bypass input. During the test of UPS jumpers will be removed when needed. UPS shall be supplied with installed jumpers.

9.2 Battery, cabinet & accessories

All battery blocks shall be made from the same production lot.

The cells shall be made of thermoplastic containers and covers, highly resistant to impacts and seismic activities, flame-retardant with self-extinguishing properties and heat resistant.

The battery shall be shipped complete with all battery block connections, end connections and outgoing cable (as option), lifting devices, and any other equipment necessary for handling (installation of cells and uninstallation of cells). All connections shall ensure electrical contact and they shall have enough cross section to minimize voltage drop between connections.

Interconnections shall avoid stresses in the terminals.

The polarity of the terminals of each cell shall be clearly indicated with indelible markings.

Battery shall be supplied with battery cabinet. Cabinet shall be electrically insulated from battery blocks.

The dimensions of the cabinet shall fit in the battery room (Attachment 3). Additional space shall be available around equipment for maintenance.

The Supplier shall propose a layout in the battery room that allow enough clearance for proper maintenance.

The battery cabinet will be anchored by expansion bolts to the floor structure. The Supplier shall calculate and show on the drawings the static and dynamic support reaction forces.

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

It is desirable that all metal parts of cabinet in contact with the battery are protected with electrically resistant insulation.

10.0 INSPECTION AND TEST

Certified data shall be submitted by the Supplier to show the characteristics of the UPS, battery, cabinet 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 final UPS assembly with all software setups and factory acceptance test.

NEK intents to witness factory battery capacity test

In case that seismic test will be performed instead of seismic analysis, NEK will witness seismic test.

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 all necessary voltage and current signals on the equipment specified in this specification during FAT with NEK own or manufacturer measuring system. In a 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

Circuit breakers shall conform to the production testing requirements of NEMA AB 1, part 2. For each installed breaker, the following tests shall be done, according to NEMA AB-4 and applicable paragraph, and breaker test data sheet included in final documentation send to NEK:

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)

All bolted connections shall be checked for proper torquing.

All performance and design requirements under paragraph 6.0 & 7.0 shall be checked.

Rectifier, Inverter & Super Efficiency Mode full load test at 4 h duration shall be performed.

10.1.2 Testing before the FAT

a) Detail Visual inspection,
b) Review of installed of all wire and cable marks,
c) Review of installed component marks
d) All bolted connections shall be checked with adequate torques.
e) All characteristics under paragraph 7.0 shall be checked.
f) Rectifier, Inverter & Super Efficiency Mode full load test at 4 h duration shall be performed.
g) Factory standard tests.
h) Testing per IEC-62040%.

Manufacture 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 failure simultaneously,
h) AC Mains Failure and DC failure simultaneously,
i) All AC failures,
j) Automatic Shutdown of the UPS to prevent excessive discharging of the battery. After the return of any of AC sources, UPS shall start automatically, and start with battery recharging when AC main source is back.

[6] Overload tests
[7] Input Voltage Tolerance test.
[8] Input Frequency Tolerance test.
[9] Inrush Current measurement.
[10] Input Current Harmonics measurement.
[11] Input Power Factor measurement.
[12] Efficiency test.
[13] Battery Ripple Current measurement.
[14] Output Voltage Transients:

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%
d) 100% Load Step from 0% to 100% of load: ± 1%

e) 500% Load Step from 0% to 50% of load: ± 1%

[15] Resistive and inductive loading from 0 to 100 % (20 % steps):

a) Loading from 0 to 100% shall be performed with resistive load only.
b) Loading from 0 to 100% shall be performed with resistive and inductive load. *Power factor shall be at all the time around 0.8 (inductive character -lagging).

[16] Voltage Regulation: ±1% for 0 to 100% (20 % steps) of rated power output at 0,8 power factor lagging and all specified variations of input voltage (+ 20% -30%).

[17] Three Phase Input Voltage transients:

Input voltage transient from rated voltage 400 VAC to 480 VAC in ½ s, immediately reduced to 320 VAC in 1s and raised to rated voltage (400 VAC) in ½ s. Transient shall be performed at full and ½ load.

[18] Overload Testing (all design limits).
[19] Crest Factor Testing.
[20] Battery Boost Testing
[21] Checking of alarms
[22] Checking of initiating of all alarms on graphic display and history log,
[23] Checking of initiating of all alarms on remote signaling contact,
[24] Checking of remote shutdown,
[25] Checking of correct operation of battery temperature probe.
[26] Checking of system set-points
[27] Rectifier, Inverter & Super Efficiency Mode full load test at 4 h duration shall be performed (@room temperature and Max environmental design temperature, see Paragraph 11.1):

*After 2 hour of operation AC inputs shall be disconnected for 10min and then return back,

**Measured shall be critical temperatures during the test (connections, cabinet inside temperature, fan air outlet temperature, room temperature etc.)

[28] Perform of partially battery test (one of available battery) with the UPS.

10.2 Battery FAT Testing

Battery Capacity test on all battery blocks together with spares shall be performed in accordance with IEEE 450 and data specified herein before shipment

Test procedure shall be sent to buyer for review, fulfil and approval before the capacity test is executed.

Complementary to the standard factory battery test, the following tests are required:

10.2.1 Prior to acceptance test

[1] All battery blocks shall be marked with serial Numbers if not yet. Establish shall be a list from which can be seen all serial numbers from first one (+ incoming power cable) and last one (- incoming power cable).
[2] Verify that battery is on float charge for 72 hours minimum before capacity test.
[3] During 72 hours float charge, measure and record battery terminal voltage, all battery blocks voltages and float current every 10 minutes with online recorder.
[4] Just before the start of capacity test additionally measure and record all battery blocks temperatures.
[5] Calculate and record the average battery blocks temperature before performing the capacity test.
[6] Visual inspection of readiness of battery for test.

[7] All battery blocks float voltages shall be inside of range 2.25 V/cell (Battery block: 13.5 V) @ 25°C ± 0.12/block VDC.

10.2.2 ACCEPTANCE TEST:

[1] Acceptance test/Capacity test shall be performed per IEEE 450 standard:

a) Perform Acceptance test/Capacity test with constant current of determined amps (@ C_5/1.75 V discharge rate).
b) Test can be continued bellow nominal terminal voltage 1.75 V/cell (C_5) V, time the number of tested cells (blocks), but this data cannot be used for final capacity calculation.

[2] During discharge test:

Measure and record battery terminal voltage, block voltages and discharge current with recorder from start to the end of test in at least following time sequences: 15 sec. and every 15 sec. after the test is stopped until the battery is returned back to charging.

[3] Calculate the % of the battery capacity (IEEE 450 standard).

[4] Acceptance criteria:

a) Battery capacity > 100%. Each battery block shall have capacity >100 %.
b) For battery calculation takes the time when the battery terminal voltage reach 1.75 V/cell (C_5: Battery block: 10.50 V) time the number of cells in the string and the lowest block voltage shall be greater or equal to 1.73 V /cell (Battery block: 10.4 V).
c) All cells which will be delivered to NEK shall have battery blocks voltages greater or equal to 1.75 V /cell (Battery block: 10.5 V) at the end of test (at the time which is used for battery capacity calculation). Cells with lover voltages shall be excluded.

[5] During recharge

a) Fully recharge battery after discharge test,
b) Start with recharging inside of one hour after test is terminated,
c) Measure and record battery terminal voltage, battery block voltages and charge current every 10 min until the battery is fully charged with online recorder.
d) During the recharge measure all battery blocks temperatures and record the highest temperatures.

[6] After recharge

a) One day after the recharge is finished Measure and Record all battery blocks Open Circuit Voltages (OCV). Record all possible deviations.

[7] Final inspection:

a) Perform Final visual inspection per manufacturer procedure. Prepare report.
b) Other required test by manufacturer requirements and appropriate standards.
c) Prepare report.
d) Preparation of documentation package of all documents.
e) Bill of Material (complete).

[8] Packing & shipping

a) Cleaning of battery blocks.
b) Serial numbers shall stay the same as they were during FAT.
c) Final visual inspection and other activities specified by the manufacturer.

11.0 ITEM QUALIFICATION

11.1 Environmental Qualification

UPS and batteries will be installed indoor. The expected environmental conditions are as follows:

Ambient temperature: 5°C to 40ºC

Maximum relative humidity: 95 % (without condensate)

The altitude does not exceed 200 m.

11.2 Seismic qualification

Seismic qualification shall be performed in accordance with the requirements of IEEE 344 and specification SP-S702. Qualification can be justified based on analytical method (analysis) or by tests (generic test are acceptable if they can cover specified requirements herein).

Floor response spectra are shown in Attachment 4 (tabular data is also available upon request). UPS and battery will not be installed at the same floor therefore different seismic spectrums apply.

Vibration damping mounting devices, such as shock absorbers, shall not be used.

During the seismic test, UPS/battery shall be loaded. Connection cables shall be attached.

Analyzed or tested shall be Battery cabinet with installed batteries, cable connections between battery blocks, accessories and outgoing power cables.

11.3 Design life

11.3.1 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…

11.3.2 Battery, cabinet and accessories

Battery shall have a design life of at least 10 years minimum.

Cabinet and accessories shall have a design life at least 25 years.

12.0

12.0 CLEANING

The 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.

13.0 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 light grey conforming UL 1332 (2005). 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 finish coats. Paint shall be suitable for the operating temperatures of the equipment. Paint coating shall be free of sags, runs and incomplete coverage.

14.0 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 SWG 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.

15.0 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.

16.0 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 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:

d) Tag and segregate the non-conformance item to prevent any further processing which may result in a change of the non-conformance as identified
e) Make the NCR available to the responsible NEK inspector for review to ensure the non-conformance is completely identified and accurately stated
f) 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.

17.0 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 this record 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.

18.0 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.

19.0 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.

20.0 QA PROGRAM REQUIREMENTS

20.1 SUPPLIER's QA Program

The SUPPLIER shall maintain QA Program which comply with standard ISO 9001 or comparable standard and conforms to relevant PURCHASER QA requirements, specified in specification QS-610 Generic Quality Assurance Program Requirements. QA Program shall apply to all activities affecting the quality of supplied equipment, materials and services.

The SUPPLIER shall submit with Proposal one controlled copy of its Quality Manual to the PURCHASER for review and acceptance. All portion of the QA program that have been revised during the period under this specification must be accepted by PURCHASER.

20.2 SUPPLIER’s responsibility for Subcontractors

The SUPPLIER shall ensure that its subcontractors meet applicable requirements of this Specification.

The Specification requirements shall apply to subsuppliers 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.

20.4 Manufacturing and Inspection Plans

The SUPPLIER shall provide the Manufacturing and Inspection Plans with record (R), witness (W) and hold (H) 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.

21.0 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.

Evaluate the need for special handling device for battery installation or deinstallation to/from battery cabinet.

22.0 SHELF LIFE

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.

23.0 10CRF21 REPORTING (For US supplied equipment only)

N/A

24.0 COMMERCIAL GRADE DEDICATION

N/A

25.0 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 0 shall be submitted after contract award
[3] Documents requested in section 10.0 (Inspections and Tests) shall be submitted upon FAT completion.
[4] Seismic qualification report as requested in 11.2 shall be submitted in before FAT.
[5] Complete quality assurance package as requested in 20.0 shall be submitted upon shipment (factory release)
[6] 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 specification. 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.
[7] 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
[3] with all options and accessories that are manufacturer standard option
[4] 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) 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 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 11.3. 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.
[9] Copies of all tests which confirms adequate technical characteristics specified under paragraph 6.0 & 7.0.
[10] For all instruments and PCBs, Instrument and setpoint list shall be supplied, which shall include, besides general data specified under paragraph 25.c.10, input measurement range, dead-band accuracy, and output signal range. In addition, for all

measurement and control cards, all settings shall be listed. This include numerical values and physical settings (jumper position, capacitor and resistor settings, …).

[11] Certificate of Conformance certifying all requirements of this Technical Specification and purchase order have been met.

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

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

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

[15] 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.

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

25.2 Battery, cabinet and accessories specific documentation

The Supplier shall furnish copies of the documents to the NEK. This documentation shall include, but not be limited to:

25.2.1 Characteristics & Tables

[1] Table: Discharge rates (Amperes, Wats & common Ampere hours) to different Final voltages (1.60, 1.75, 1.77, 1.80) at different discharge times (5, 10, 15, 30 minutes, 1, 2, 3, 4, 5, 8 and 10 hours discharge time);

[2] Characteristic: Battery Life vs. Operating temperature,

[3] Value: Internal resistance/impedance,

[4] Characteristic: Internal resistance/impedance versus amount of discharges,

[5] Characteristic: Internal resistance/impedance change versus time,

[6] Characteristic: Float current as a function of time,

[7] Characteristic/Table: Lifetime in cycles,

[8] Characteristic: Cell voltage during constant current discharge @ C_1, C_5

[9] Table: Voltage drop across one inter-cell connection at the C_1, C_5,

[10] Characteristic: Self-discharges of cell.

25.2.2 Documents generating during manufacturing, testing, and final inspection before shipment

[1] Capacity discharge test report with final Capacity calculation:

a) Prior to capacity test report,
b) During discharge test report
c) Calculation of the battery capacity report,
d) During recharge report
e) After recharge report

[2] Final inspection report

[3] Packing & Shipping report

[4] Measurements & Test equipment’s Inspection and calibration documents for used measuring tools

[5] Open Circuit Voltage (OCV) readings measured before packing & shipping.

[6] Bill of material for all supplied items by this specification (PN, Item Description, associated Drawing Number)

[7] Testing procedures

25.2.3 Installation, operation and other documents:

[1] Installation & Operational Manual,

[2] Maintenance Instructions with troubleshooting,

[3] Battery sizing worksheet:

25.2.4 Outline drawings, installation instructions, other documents:

[1] Physical detail drawings of battery blocks connections,
[2] Battery block to battery block terminal connections (solid or flexible connections),
[3] Battery block to cable connections,
[4] Outline of the battery.

25.2.5 Battery cabinet drawings with all details, detail BOM, Cabinet assembling manual, battery installation manual, …

25.2.6 Accessories datasheets and drawings.

26.0 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.

27.0 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 specifically approved and accepted by NEK, prior to the shipment of equipment.

28.0 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

29.0 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.

30.0 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.

31.0 DELIVERY SCHEDULE

See requirements inside of public Tender documentation.

32.0 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 UPS assembling,
b) Battery FAT test,
c) Shipping release,
d) Seismic testing.

33.0 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 format and drawings also in ACAD format. Final version shall be furnished in six (6) hard copies and one electronic version on compact disc.

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.

Final versions shall be furnished in four hard copies and appropriate electronic version.

34.0 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:

a) Detail Principe of Operation,
b) Regular Maintenance,
c) Detail Diagnostic and Troubleshooting,
d) Able of replacement of all parts and components,
e) Settings and adjustments of all PCB and other components that have adjustable settings,
f) Use of software for adjusting any electronic device and parameters
g) 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 has to possess adequate technical knowledge and experience of the course content and has to 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 of training certificates for participants that successfully complete training course and sending them to 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) Contractor shall send to NEK detail training description with all training documentation 2 months before training shall take place for review, fulfill and approval.

34.2 Battery training

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

34.2.1 Topic that shall be covered are:

a) Detailed Training for installation and maintenance of batteries.
b) Training for In-Storage Maintenance of stored batteries in warehouse.

34.2.2 Training providers obligations

a) Instructor providing training has to possess adequate technical knowledge and experience of the course content and has to 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 of training certificates for participants that successfully complete training course and sending them to 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: Acad, ppt, pdf and other original format).
j) Contractor shall send to NEK detail training description with all training documentation 2 months before training shall take place for review, fulfill and approval.

35.0 ATTACHMENTS

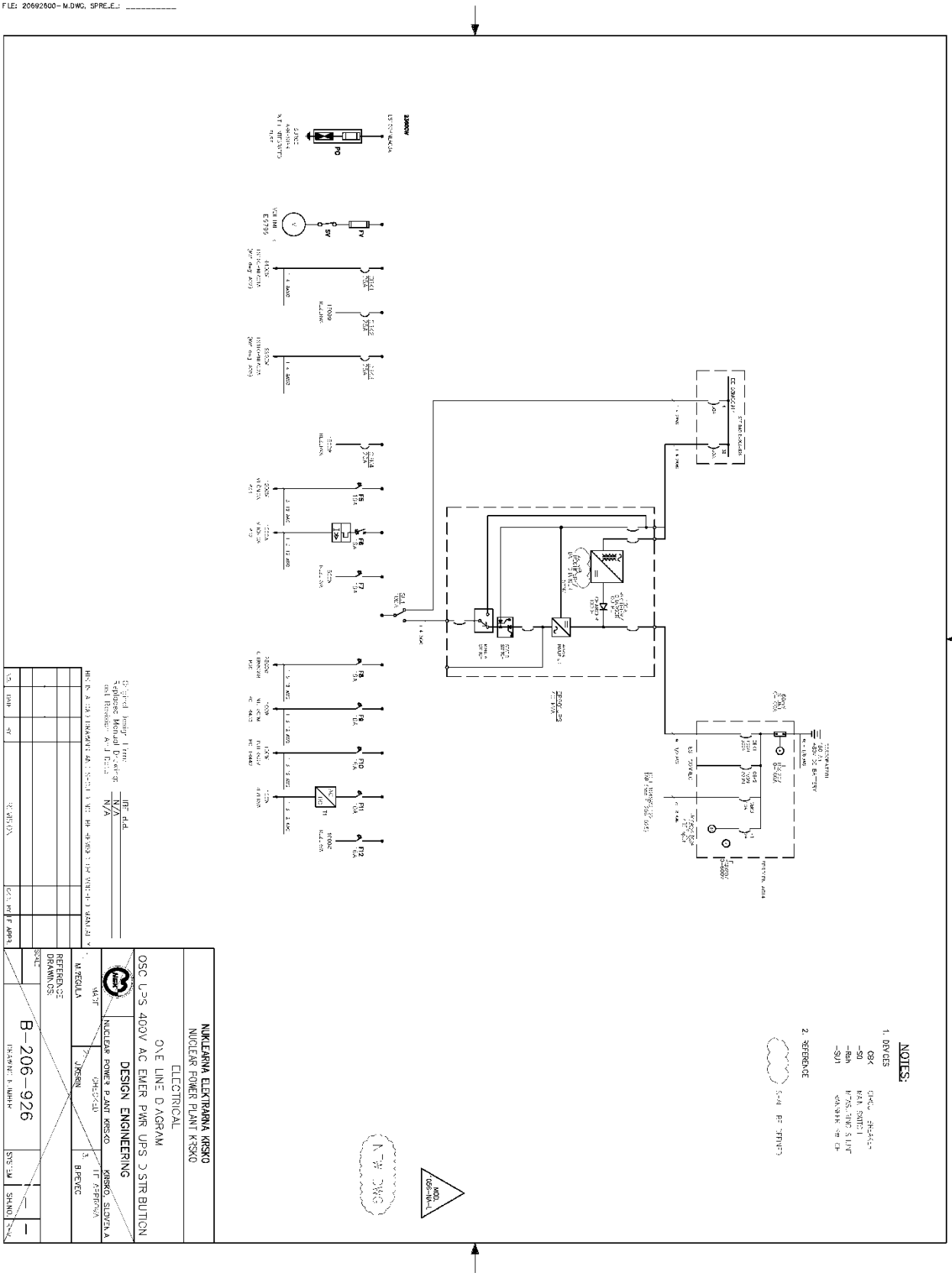
Attachment 1 : Technical data sheet & questionnaire for UPS
Attachment 2 : One line diagram
Attachment 3 : battery room
Attachment 4 : OBE and SSE Floor Response Spectra Figures for BATTERY room
Attachment 5 : OBE and SSE Floor Response Spectra Figures for UPS elevation

Attachment 1: Technical data sheet & questionnaire for 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. UPS (inverter) Required Minimum Load: _____
6. Inverter Input current @ No Load
   a. Min DC input voltage _____
   b. Nominal DC input voltage _____
   c. max DC input voltage _____
7. Inverter Input current @ Full Load
   a. Min DC input voltage _____
   b. Nominal DC input voltage _____
   c. max DC input voltage _____
8. Charger Max. Output current @ float & equalize voltage _____
9. UPS Input Current at Full Charger Load (floating mode)
   a. 400 V AC, 50Hz _____
   b. 400 V AC minus 10%, 50Hz _____
10. UPS input Current at Full Charger Load (equalizing mode)
    a. 400V AC, 50Hz _____
    b. 400V AC minus 10%, 50Hz _____
11. Charger current @ (No inverter load) _____
12. UPS Output Voltage Adjustability: _____
13. UPS Output Frequency Adjustability: _____
14. Max Inverter output current @ 0.8 power factor (lag) _____
15. UPS Total Harmonic Distortion at:
    a. 100% load at 1.0 power factor _____
    b. 100% load at 0.8 power factor (lag) _____
16. UPS Maximum Single Harmonic Distortion at:
    a. 100% load at 1.0 power factor _____
    b. 100% load at 0.8 power factor (lag) _____
17. UPS Harmonics Fed Back to 400 V AC Source at:
    a. 100% load at 1.0 power factor _____
    b. 100% load at 0.8 power factor (lag) _____

18. Static Switch Transfer Time:
    a. From Inverter to Bypass Supply
    b. From Bypass Supply to Inverter
19. Maintenance Bypass Switch Design Type:
20. UPS Efficiency Using 400 V AC Source at:
    a. a. 100% Output
    b. b. 25% Output
21. Time to Ramp from Zero to Full Load:
22. Audible Noise (dBA at 1 m)
23. Type of Cooling (ambient, fans, etc.):
24. Minimum Clearances Required Around Enclosure:
25. Short Circuit Rating of 400 Vac Input
26. Short Circuit Rating of Regulated Bypass Source Input
27. UPS symmetrical short-circuit output in amps
    a. UPS connected to 400V AC source
28. Additional questions regarding UPS operation:
    a. How fast can rectifier control board regulate DC bus (in mili seconds) if overvoltage (step change) appears on AC input?
    b. Specification requires output (system) breaker to be installed after manual transfer switch. How is UPS normally protected against short circuit on load side? Especially fast transfer switch, which automatically transfer on alternate source on overcurrent or peek?
    c. What happens if overload occurs and bypass source is not available?
    d. Show in table max. battery charging current depends on the size of inverter output load.
29. Nominal power
30. Active power
31. Inverter type
32. battery type
33. battery temperature compensation (yes/no)
34. Enclosure IP rating
35. Storage temperature

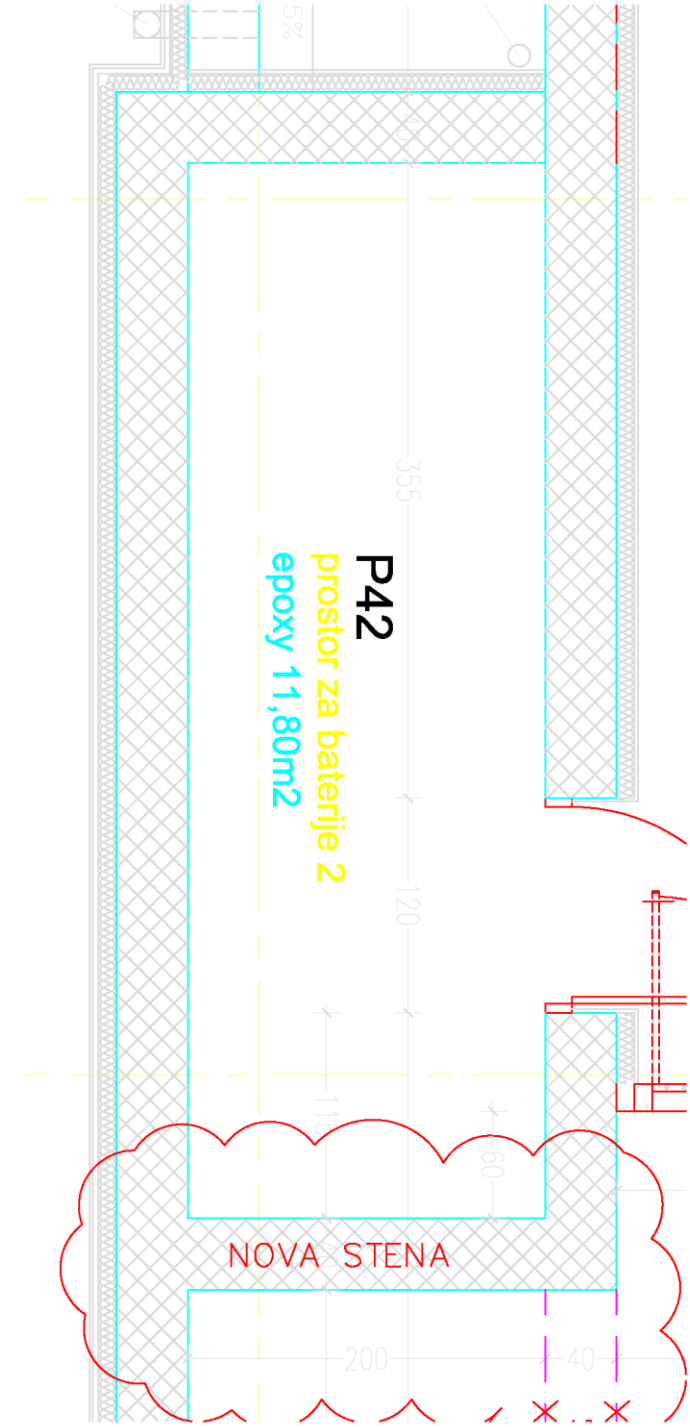
Attachment 2: One line diagram



Attachment 3: battery room

NOTES:

1. ALL DIMMENSIONS IN cm.
2. ROOM HIGHT IS 300 cm.



Attachment 4: OBE and SSE Floor Response Spectra Figures for BATTERY room

NOTES:

Names of Floor response spectra on each figure include considered direction (X, Y, Z), state (OBE, SSE), for Level 2 (nivo 2) and value of damping (%).

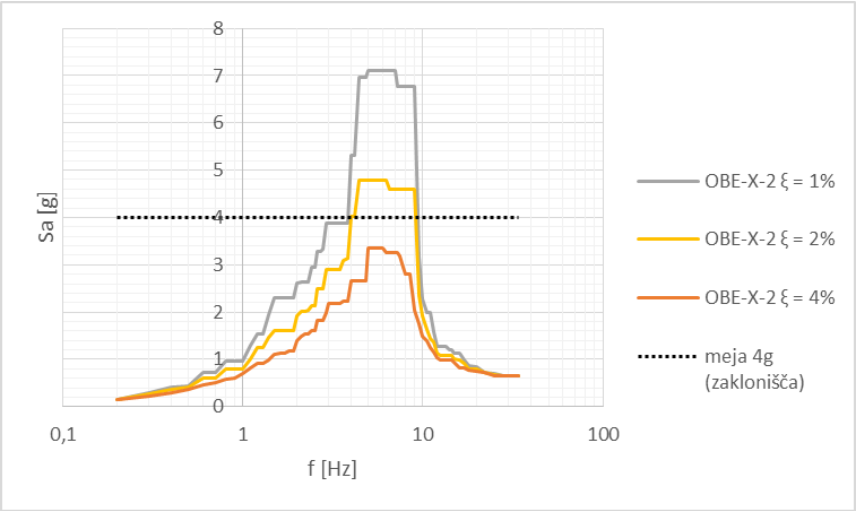
Considered directions according to “true north” and “plant north”:

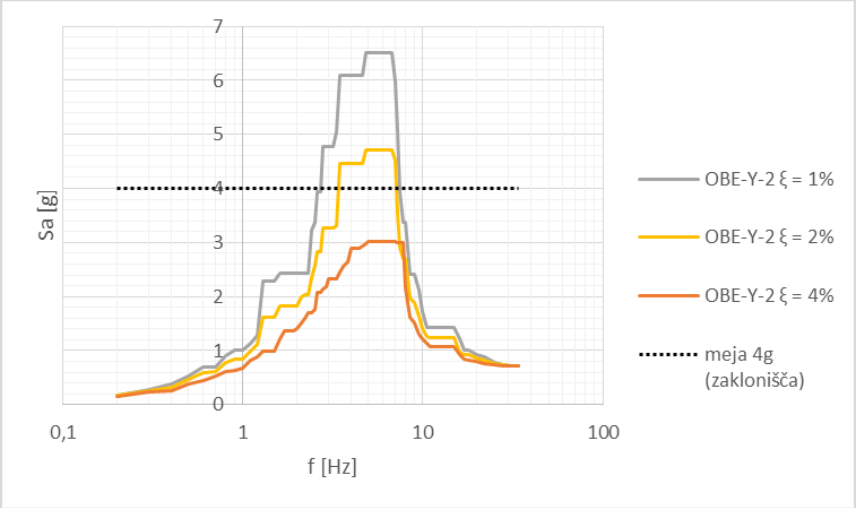
- Direction X = East – West response,
- Direction Y = North – South response,
- Direction Z = Vertical response.

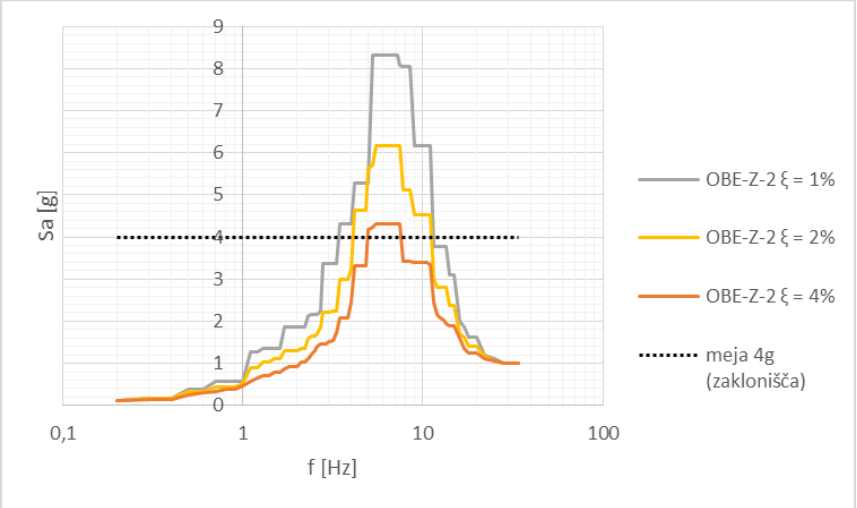
Included floor response spectra:

- OBE: Level 2 (Etažni spektri – OBE – nivo 2) for all directions and damping (page 4 of Appendix A of Document OSC Seismic Analysis 1056-NA-L-PZI-3/1-A1);
- SSE: Level 2 (Etažni spektri – SSE – nivo 2) for all directions and damping (page 4 of Appendix B of Document OSC Seismic Analysis 1056-NA-L-PZI-3/1-A1).

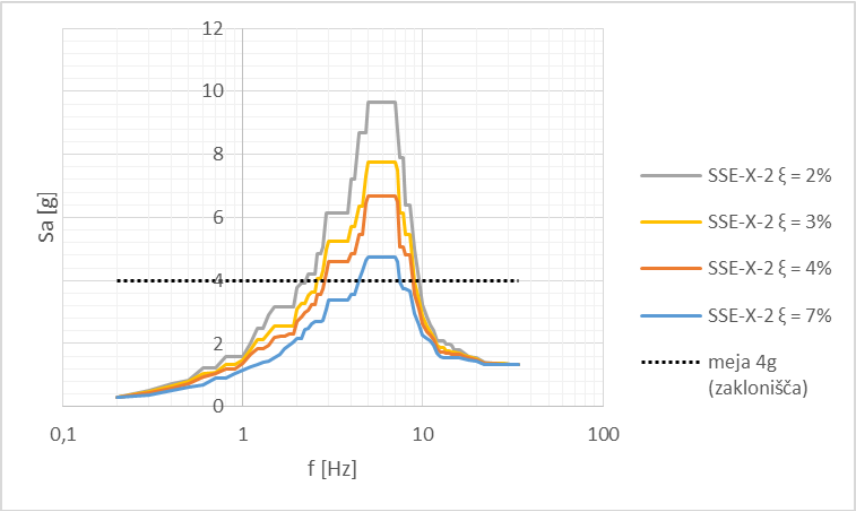
- OBE: Level 2 (Etažni spektri – OBE – nivo 2)

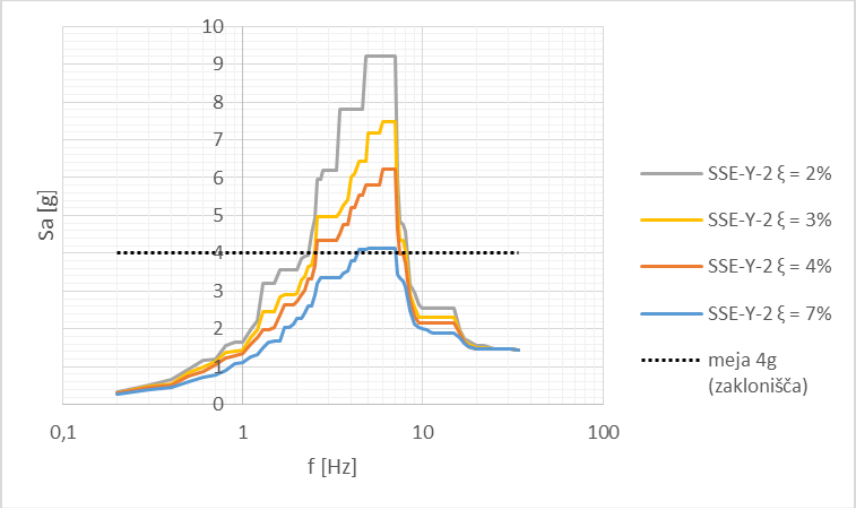


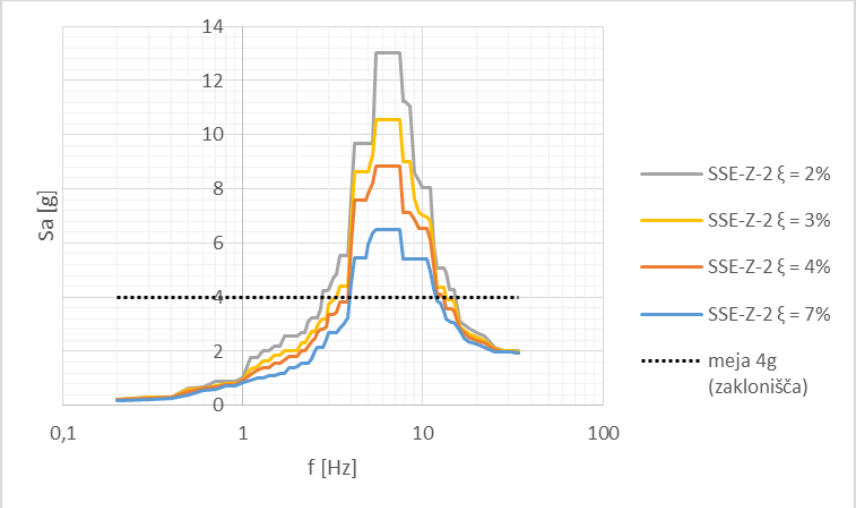




- SSE: Level 2 (Etažni spektri – SSE – nivo 2)







Attachment 5: OBE and SSE Floor Response Spectra Figures for UPS elevation

NOTES:

Names of Floor response spectra on each figure include considered direction (X, Y, Z), state (OBE, SSE), for Level 1 (nivo 1) and value of damping (%).

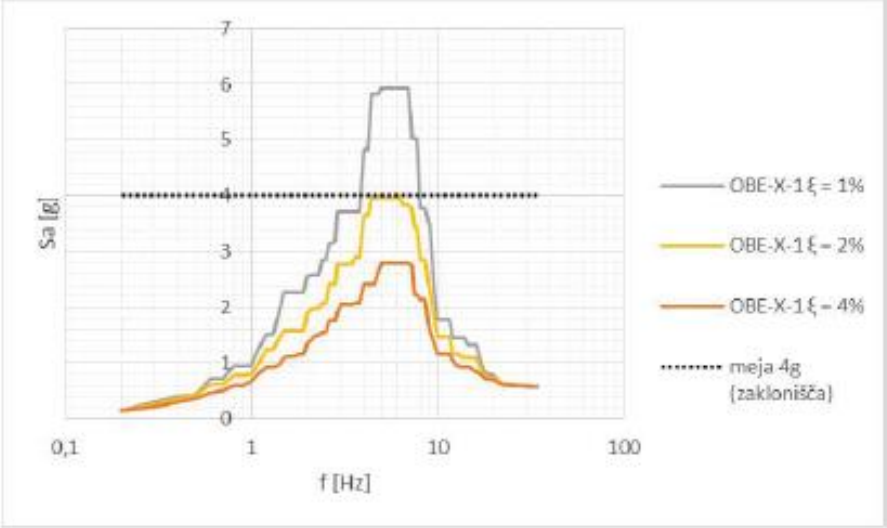
Considered directions according to “true north” and “plant north”:

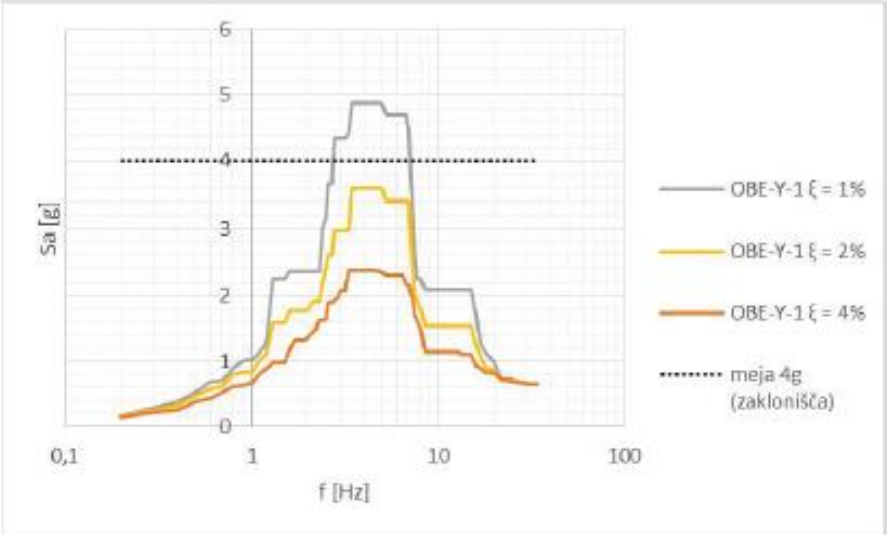
- Direction X = East – West response,
- Direction Y = North – South response,
- Direction Z = Vertical response.

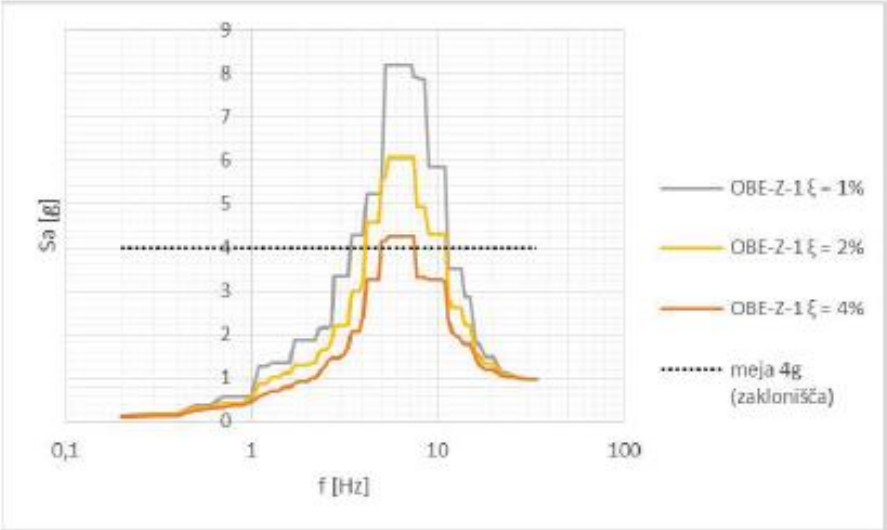
Included floor response spectra:

- OBE: Level 1 (Etažni spektri – OBE – nivo 1) for all directions and damping (page 5 of Appendix A of Document OSC Seismic Analysis 1056-NA-L-PZI-3/1-A1);
- SSE: Level 2 (Etažni spektri – SSE – nivo 1) for all directions and damping (page 5 of Appendix B of Document OSC Seismic Analysis 1056-NA-L-PZI-3/1-A1).

Floor Response Spectra - OBE - Level 1[4]

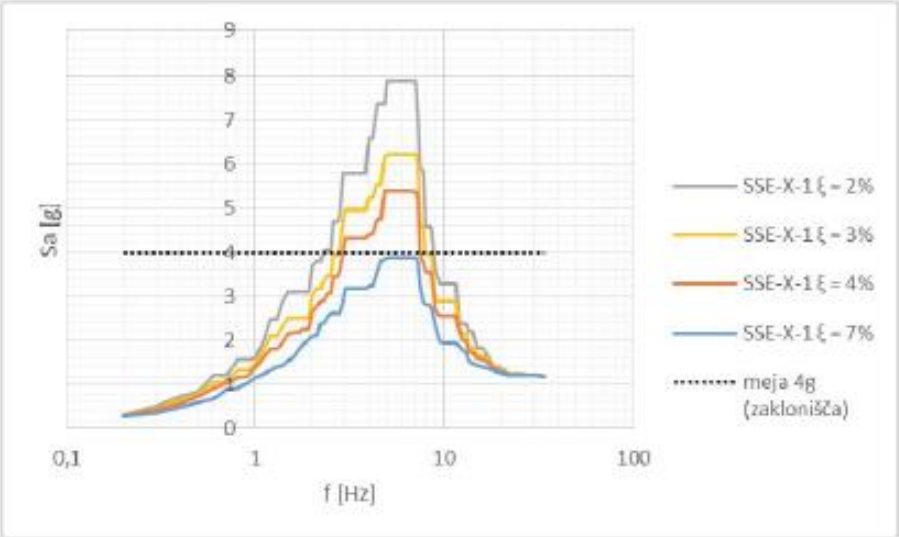


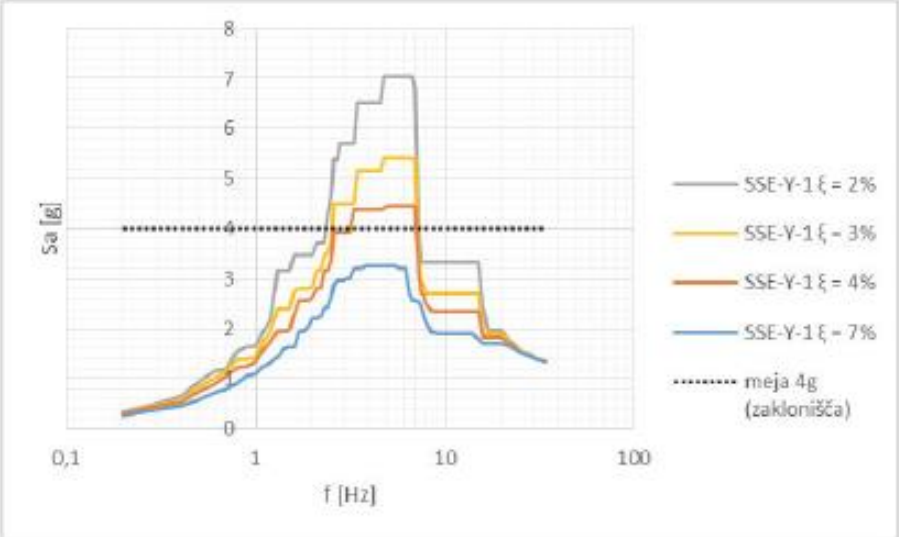


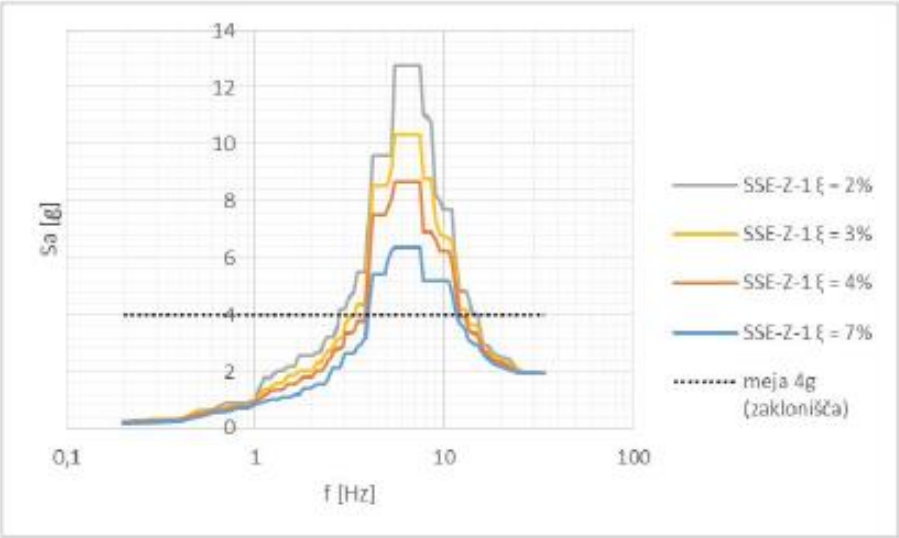


[4] Limit 4 g is not based on seismic demands and shall not be considered.

Floor Response Spectra - SSE - Level 1[5]







[5] Limit 4 g is not based on seismic demands and shall not be considered.