

NEK



Technical Specification

Power Supply System for various Telecommunications Equipment

KRŠKO NUCLEAR POWER PLANT

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NON-NUCLEAR SAFETY RELATED

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1. SCOPE

1.1. Scope of Work

This specification establishes the technical requirements for the design, manufacturing, Factory Acceptance Testing, packing, documentation, delivery, removal of existing equipment, installation, and Site Acceptance Testing of the Power Supply System specified herein.

Supplier shall be responsible for compliance with all of the detailed requirements presented in this Specification. Supplier is responsible for performing, in addition to the requirements of this Specification, such analyses, tests, inspections, and other activities, which the Supplier considers necessary to ensure that the design, material, and workmanship are satisfactory for the service and classification intended, or as may be required by common usage or good practice.

1.1.1. Cabinets

Power Supply System (PSS) consist of three (3) cabinets. Each cabinet shall have its own battery installed in the lower part of the cabinet.

Each cabinet shall also contain the following equipment:

Modular Power Converters (PC), feeding both AC & DC loads, charging of batteries, balancing phase consumption, performing constant power battery tests, re-injecting power into a grid, with redundancy (N+1), electronic static switch or BOOST function, maintenance bypass switch, instrumentation and alarms, as specified herein and etc. Cabinet shall be screwed to the pedestal which shall be anchored to the concrete floor. The size of the individual PC should be standardized.

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 steel plate of the cabinet shall be not accessible without opening the front door, this does not apply to the graphic display. Batteries shall be accessible through the front door.

PC shall be powered from three (3) phase AC source. Selector switch (1-0-2) shall be installed before the AC input MCB. Position 1 is for normal AC input source, position 2 is for back-up AC source. Both Incoming sources shall be wired to incoming terminal blocks. PC shall also have an associated battery source.

1.1.2. Battery and belonging accessories

Two (2) existing Enersys SBS580 batteries shall be used in new cabinets beside one (1) new battery which shall be supplied for the third cabinet. Each battery consists of 24 VRLA 2 VDC cells. Size of third battery shall be calculated on base of the battery sizing calculation.

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. PSS

- [1] Three (3) complete cabinets, fully assembled and operational PSS within the scope of this specification.
- [2] One (1) Temperature probe for battery voltage compensation. In case that it is possible, each battery string shall have its own temperature probe to display battery temperature.
- [3] Connection module to LAN for remote monitoring.
- [4] Anchoring bolts, bolts, nuts, washers links, cable lugs, and other installation hardware shall be supplied in sufficient quantities, in order to assemble equipment on site.
- [5] Mounting details and calculations with the selected bolts.
- [6] 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.
- [7] FAT.
- [8] Packing and shipping to NEK site.
- [9] Removal and after the finished works return of a part of the wall consisting of aluminum profiles, glass and door due to the transportation of the equipment to the assembly place if needed. This should be included as an option in proposal.
- [10] Temporary 48 VDC rectifier and distribution panel for connection of priority loads which shall be supplied during the replacement of PSS. One phase AC power supply for the rectifier will be provided by NEK. Size of the charger shall be min 80 Amps.
- [11] All DC and AC loads wirings shall be marked and record into the table of the as found state (wire markings, terminal numbers, number and size of MCBs and sizes of conductors cross-sections).
- [12] Removal of existing wirings of all DC loads from terminals and connecting to the temporary distribution panel supplied from the associated rectifier for the time of replacement of the existing system with the new one.
- [13] Removal of two existing cabinets which are screwed to the pedestals and placing them into a suitable and secured place. When the new PSS will be fully operational, cabinets shall take away to the controlled decommissioning.
- [14] Designing and manufacturing of one (1) new pedestal. If necessary, also existing two pedestals shall be replaced with new ones (in case of different sizes of standing part of cabinets).

- [15] Installation of pedestals.
- [16] Installation of all three (3) new cabinets with all the equipment.
- [17] Arrangement of the raised floor according to the new conditions.
- [18] Installation of all three (3) batteries and connections.
- [19] Connection of all needed external (AC power supply, alarm, AC & DC loads) and internal cables.
- [20] Grounding of pedestals and cabinets.
- [21] SAT.
- [22] Connection of all DC loads from the temporary rectifier to the load terminals in the new cabinet.
- [23] Removing of the temporary rectifier.
- [24] Final arrangement of the room in an orderly state after the works are finished and final cleaning of the entire used workplace.
- [25] Information shall be provided to allow 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.
- [26] All special tools required for maintaining the PSS.
- [27] Necessary software and access passwords required for maintenance of the UPS (download data and upload software and setting of PSS in case of module replacement or changing of set-points or alarm settings).
- [28] Detailed training for maintenance personnel at manufacturers' facility on the offered PSS model (highest level) for 3 attendees. This should be included as an option in proposal.
- [29] Supply of the documentation required herein.

1.2.2. Battery and belonging accessories

- [1] One (1) complete VRLA battery, of the same manufacturer and design as the existing batteries, horizontally positioned, consisted of 2 VDC battery cells and technically appropriate with the PSS requirements specified herein. In case that is needed on base of battery sizing calculation, additional battery replacement of the existing two, both existing batteries shall be delivered and replaced with new ones.
- [2] Six (6) additional "spare" battery blocks with interconnections and isolated covers for battery terminals. This should be included as an option in proposal.
- [3] 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.

- [4] Cable lugs on the side of battery for connections to the corresponding DC MCCBs.
- [5] Isolated covers for all battery terminals, including cables to the MCCB.
- [6] Labels for marking battery blocks from No 1 to No n inside of string. Suffix of the string shall be added to each cell No (S1/1...n, S_n/n).
- [7] All special tools required for maintaining the battery. Each item shall be shown in the offer as optional with unit pricing.
- [8] Special handling devices specified under section 21 herein. Each item shall be shown in the offer as optional with unit pricing.
- [9] FAT of new batteries at the manufacturer site.
- [10] Packing and shipping to NEK site.
- [11] Removal of two (2) batteries from the existing cabinets and put off in a suitable and secured place. In case that batteries will be replaced with new ones, they must be taken away to the controlled decommissioning.
- [12] Installation of all three (3) batteries and connections.
- [13] SAT.
- [14] Supply of the documentation required herein.

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 Supplier 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
E&DC	Engineering and Design Change
ESD	Engineering Service Division
EMC	Electromagnetic Compatibility
FAT	Factory Acceptance Test
MCC	Motor Control Center
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
MECL	Master Equipment Component List
N/A	Not Applicable
NCR	Non-Conformance Report
NEK	Nuklearna elektrarna Krško (Nuclear Power Plant Krško) - Purchaser
OEM	Original Equipment Manufacturer

PC	Power Converters
PDR	Problem Deficiency Report
PNL	Panel
PSS	Power Supply System
PQP	Project Quality Plan
SAT	Site Acceptance test
SIS	Switchboard wire, 90°C, 600V with XLPE isolation
SPWAR	System Performance/Warranty Action Request
UPS	Uninterruptible power supply
VRLA	Valve Regulated Lead Acid (Battery)

3. 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. PSS, Cabinets and belonging material

[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”.

[2] NEMA –National Electrical Manufacturers Association:

- a) NEMA AB 4-2003, “Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications”.

[3] IEC (EN) – International Electrotechnical Commission (European Standards)

- a) IEC (EN)62040-% (multiple), “Uninterruptible power systems (UPS)”.
- b) IEC (EN) 61000-% (multiple), Electromagnetic Compatibility (EMC), Part 3 “Limits” and Part 4 “Testing and Measurement Techniques”.
- c) IEC (EN) 60950-1, “Information technology equipment – Safety – Part 1: General requirements”.
- d) IEC 60529-2019, “Degrees of protection provided by enclosures”.
- e) IEC 60332-3-22/23, “Tests on electric and optical fibre cables under fire conditions”.

3.2. Battery

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

- a) IEEE 1187-2013, “IEEE Recommended Practice for Installation Design and Installation of Valve-Regulated Lead-Acid Batteries for Stationary Applications”,
- b) IEEE 1188-2005, “IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications”,

- c) IEEE 485-2010, "Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications",
- d) IEEE 1184-2006, "IEEE Guide for Batteries for Uninterruptible Power Supply Systems".

[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 62485-2:2018, "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".

3.3. Codes, standards and procedures for site installation and testing

[1] Administrative procedures for performing activities related to the work process in the NPP Krsko:

- a) ADP-1.1.125; Izvedba delovnega naloga,
- b) ADP-1.1.126; Testiranje po vzdrževalnih posegih (TPV),
- c) ADP-1.1.127; Zaključitev delovnega naloga,
- d) ADP-1.3.004; Osamitev opreme in naprav,

[2] Administrative procedures related to safety and health at work in the NPP Krsko:

- a) ADP-1.1.033; Varnost in zdravje pri delu v Nuklearni elektrarni Krško, ADP-1.14.221; Varstvena pravila in ukrepi pri delu pred nevarnostjo električnega toka,
- b) ADP-1.1.222; Delo pod napetostjo na nizki napetosti,
- c) ADP-1.1.101; Preprečitev vnosa tujkov,
- d) ADP-1.6.701; Kontrolirani vstop nevarnih kemikalij v NEK,
- e) ADP-1.1.051; Vstop, izstop in gibanje v tehnološkem delu NEK,
- f) FPP-3.7.004; Kontrola vnosa gorljivih snovi,
- g) ADP-1.1.128; Kontrola izvajanja vzdrževalnih aktivnosti z namenom preprečitve vnosa tujkov v sisteme NEK,
- h) ADP-1.1.158; Vzdrževanje reda in čistoče, kontrola čistoče in stanja opreme na področju tehnološkega procesa,
- i) ADP-1.1.142; Uporaba dvigal, dviznih naprav, vilicarjev in pomožnih nosilnih sredstev v NEK,

- j) Splošni pogoji za izvajanje remontnih del in ostalih storitev.

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

5. DOCUMENT SUBMITTAL

The Supplier 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 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, whenever is 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 Technical 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 matrix which will show that are all Technical specification items from 5.1 referenced in 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.
- [3] Preliminary dimension drawings, showing side views, Layout drawing showing location and position of all components, pedestals and anchoring details.
- [4] Layout of the battery cells positioned in the cabinets.
- [5] Layout of the PSS positioned per Attachment 3 "Dimensions of the PSS room".
- [6] PSS schematics including size and type of MCCBs/MCBs & all terminals for EXT connections.
- [7] Preliminary Bill of Material (BOM).
- [8] Installation, Commissioning, Technical, Operational and Maintenance manuals.
- [9] Identification of Components with prices and their replacement schedules to achieve qualified life of 20 years.
- [10] Battery sizing Datasheet with voltage/time profile during discharge.
- [11] Tabular presentation which shows maximal available AC & DC power, AC & DC power without redundancy, battery charging power (max power and power at max AC & DC loads) & needed AC input power and the highest AC input current.
- [12] Fulfilled Attachment 1.
- [13] Detailed production and delivery schedule.
- [14] List of accessories, spare parts (such as startup kit and operational kit) and special tools, if needed, with prices.
- [15] A statement from the manufacturer/supplier that different sizes of batteries and ages in cabinets can be connected in parallel or that a different technically suitable solution is offered.
- [16] List of known cyber security vulnerabilities for each digital device (The source of such data is the public CVE database. If such CVE records exist for new digital equipment, it is necessary to check whether a solution exists and whether it has already been implemented.

5.2. Documentation Required after Contract Award

5.2.1. PSS

	Content of documents	Fulfill (F) Approval(A⁵) Certified (C) Record (R)	Maximum delivery period after contract award
	Contact information's (name, address, e-mail, phone, mobile phone) of the responsible engineers from the battery manufacturer and power convertors for contacting them in connection with technical solutions for deviations that may occur during the design of the project and for the subsequent possibly necessary advisory assistance for troubleshooting during the operation of the devices.	R	1 week
	Detailed Project Quality Plan (PQP) with approved R (record), W (witness) and H (hold) points	F/A	3 weeks
	List of all documents	F/A	8 weeks
	Equipment/parts catalogues/Datasheets	R	8 weeks
	Certified datasheets	A/C	8 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) Detailed Mechanical drawings of cabinets and pedestals, d) Connection details, e) Interconnection diagrams, f) Mounting details, g) Shipping dimensions and weights, h) Structural drawing (weights, center of gravity, etc).	F/A/C	8 weeks
	Complete, itemized Bill of Material:	A	12 weeks

⁵ Fabrication prior to approval of drawings marked "A" shall be at the Supplier's own risk.

	<p>a) BOM of main components with unique identification number specified on associated drawings.</p> <p>b) BOM detailed to the smallest parts level, indicating the OEM descriptions, part numbers and. Shown shall be also PCB software versions.</p> <p>The design/qualified life and maintenance replacement interval to achieve qualified life of 20 years shall be specified for each item.</p> <p>BOM shall be submitted in the form of a spreadsheet.</p>		
	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
	Software User Manual, Manual for Configuration Backup and Restore	F/A/R	4 weeks before FAT
	<p>Instruction manuals (storage, installation, test & commissioning, maintenance and operation), including:</p> <p>a) Instructions for handling and storage prior to being put into service.</p> <p>b) Installation instructions and spreadsheets with torque requirements for all electrical and mechanical bolted connections.</p> <p>c) Activities which will allow use of parts during the complete design/qualified life of parts.</p> <p>d) Detailed maintenance program, including troubleshooting.</p> <p>e) In Storage Maintenance (ISM) Instructions.</p> <p>f) Spare parts list.</p> <p>g) List of spare parts, which must be periodically replaced in order to meet the qualified life criteria, in accordance with section 11 herein.</p> <p>The design/qualified life and maintenance</p>	A/R	16 weeks

	replacement interval of each item shall be specified.		
	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
	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
	Details of anchoring, showing static and dynamic support reaction forces with mounting details and calculation for choosing appropriate anchor bolts.	A/C	One week after FAT is finished
	Final installation protocols (before installation)	F/A/R	4 weeks before inst.
	Final SAT protocols (before SAT).	F/A/R	4 weeks before SAT
	Final test protocols and reports (after SAT).	A/R	One week after SAT
	Procedure for the performing of battery capacity test by cabinet and on all cabinets at once with the internal PSS and also with the possibility to perform capacity tests with external load and long-term maintenance for complete PSS in accordance with NEK requirements for writing procedures.	A/R	Two weeks after SAT

5.2.2. Battery

	Content of documents	Fulfill (F) Approval(A ⁶) Certified (C) Record (R)	Maximum delivery period after contract award
	Detailed Project Quality Plan (PQP) with approved R (record), W (witness) and H (hold) points	F/A	3 weeks
	List of documents	F/A	4 weeks
	Equipment/parts catalogues	R	4 weeks
	Certified datasheets	A/C	4 weeks
	Substantiating battery sizing calculation, charge and discharge graphics, according to IEEE 485	A/C	8 weeks

⁶ Fabrication prior to approval of drawings marked "A" shall be at the Supplier's own risk.

	<p>Certified drawings of the general arrangement and dimensions (battery and cabinets), including:</p> <ul style="list-style-type: none"> a) Different views and layouts of the battery cabinets. It should also include the minimum clearance to be kept free at the front, rear, top and sides of the battery cabinets, b) Detailed drawings of battery cabinets, c) Layout of the battery cells positioned in the battery cabinets, d) Detailed drawing of the battery cells connection details (connections between: battery blocks, battery blocks at different rows, different cabinets, external connections), e) Detailed drawings of the battery cells and subcomponents (battery cells and their connections, cables, bolts, lugs, isolated connections & isolated covers), f) Shipping dimensions and weights, g) Drawing for Post sealing design, h) Connection and mounting details, i) Structural drawings (weights, center of gravity, dimensions of the frame, etc). 	A/C	8 weeks
	<p>Complete, itemized Bill of Material: BOM shall be submitted in the form of a spreadsheet.</p>	A	12 weeks
	Test procedures and protocols.	F/A	12 weeks
	<p>Installation, commissioning and operating instructions including:</p> <ul style="list-style-type: none"> 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. 	A/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).	F/A	4 weeks before FAT
	Final test protocols and reports (after FAT).	A/R	One week after FAT
	Details of anchoring, showing static and dynamic support reaction forces with mounting details and calculations for choosing appropriate anchor bolts.	A/R	One week after FAT
	Final installation protocols (before installation)	F/A/R	4 weeks before inst.
	Final SAT protocols (before SAT).	F/A/R	4 weeks before SAT
	Final test protocols and reports (after SAT).	A/R	One week after SAT

6. DESIGN REQUIREMENTS AND DESIGN INPUTS

Power Supply System (PSS) consist of three (3) cabinets.

Each cabinet shall contain the following equipment:

Battery installed in the lower part of the cabinet. Modular Power Converters (PC), feeding both DC (priority & non priority loads) & AC (priority & non priority loads), charging batteries, balancing phase consumption, performing constant power battery tests, re-injecting power into a grid, with redundancy (N+1), electronic static switch or BOOST function, maintenance bypass switch, associated MCCBs & MCBs, instrumentation and alarms, as specified herein and etc. PC shall be installed above the batteries. The size of the individual modular PC should be standardized.

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 steel plate of the cabinet shall be not accessible without opening the cabinet doors, this does not apply to the graphic display.

PC shall be powered from three (3) phase AC source. Selector switch (1-0-2) shall be installed before the AC input MCB. Position 1 is for normal AC input source, position 2 is for back-up AC source. Both Incoming sources shall be wired to incoming terminal blocks. PCs shall be powered by a battery from its cabinet.

Output of PCs from each cabinet shall be wired to the middle cabinet where shall be common DC and common AC bus.

6.1. Cabinets

6.1.1. Existing cabinets

- [1] Prepared shall be temporary 48 VDC rectifier and distribution panel for priority loads which shall be supplied all the time during the replacement of the PSS. Size of the rectifier shall be min 80 Amps.
- [2] All DC and AC loads wirings shall be marked and record to the table as the as found state (wire markings, terminal numbers, MCBs and size of conductors cross-sections).
- [3] Power supply system shall be completely shuts downed by NEK, all MCBs and fuses shall be turned off by NEK.
- [4] All DC loads shall the disconnected from the existing terminals and connected back to the temporary distribution panel supplied from the temporary rectifier for the time of the replacement of the existing system with the new one.
- [5] AC supply cable shall be marked if it is not yet and removed from the cabinet.
- [6] AC loads wirings shall be removed from the cabinet.
- [7] Alarm wiring shall be marked if it is not yet and removed from the cabinet.
- [8] Earthing shall be removed from the cabinets.
- [9] Batteries from the existing cabinets shall be removed and placed in a suitable and secured place. When the new PSS will be fully operational and in a case that existing removed batteries will not be returned back to the cabinets, batteries shall be taken from the NEK to appropriate decommissioning in accordance with Slovenian legislation.
- [10] Two existing cabinets which are screwed to the pedestals shall be removed and placed in a suitable and secured place. When the new PSS will be fully operational, cabinets shall be taken from the NEK to appropriate decommissioning in accordance with Slovenian legislation.

6.1.2. New cabinets

- [1] Power supply system shall consist of three (3) cabinets.
- [2] Cabinets shall be designed in such a way that one cabinet can always be taken out of operation for maintenance activities, battery capacity testing with the external or internal loads and by returning energy back to the AC grid, charging of discharged battery after capacity test etc. The remaining cabinets in operation shall continue to operate normally without interruption.
- [3] Equipment that is installed in only one cabinet and is required for operation in all cabinets must be separated by mechanical partitions from

the rest of the equipment and marked that tampering with this part of the equipment has an impact on uninterrupted operation of the PSS.

- [4] Each cabinet shall have its own 24 cell battery consisted of 2V cells. Two existing batteries shall be placed to the first two cabinets viewed from the left side. Cabinets shall be designed so, that at the bottom of the cabinet's batteries will be placed. The design must be consistent with the reference 3.2.
- [5] Batteries shall be accessible through the front door.
- [6] Batteries shall be adequately cooled, which shall be considered when designing.
- [7] The upper part of the upper row of the cells must be properly separated from the rest of the equipment.
- [8] For the Load cables in the middle & in the right cabinet there shall be a cable channel above the batteries and along the back side of the cabinet to the floor.

- [9] Size of the cabinets (Footprint)

Size of existing cabinets: W x D x H [mm]: 900 x 705 x 2200 per cabinet.

Size of existing steel pedestals: W x D x H [mm]: 1800 x 665 x (300±10mm) per pedestal.

Size of maximum allowed dimensions for new cabinet: W x D x H [mm]: 900 x 800 x 2200 per cabinet. Maximum width of all cabinets if really necessary can be maximum of 3000 mm.

Door dimensions for transporting equipment into the PSS room [cm]: (199 x 79) -5mm.

Distance from the back wall to the cabinets shall be 50 mm. On the left side, the cabinets must be installed completely up to the wall.

See Attachment 3.

- [10] Size of pedestals

Height of pedestals is 300 mm ±10 mm. Width and length can be seen from Attachment 3. New measurements before designing phase shall be made.

- [11] Pedestals and cabinets shall be grounded with the existing Copper braids according to NEK requirements.

- [12] Painting of cabinets and pedestals.

RAL 7035 (Light Grey). For area where batteries will be installed acid resistant paint shall be used to protect cabinets proven by documents on the appropriate colors and the appropriate painting process

- [13] Panels must have opening handles and cybersecurity proof locks with unique keys.

- [14] Mounting

Cabinets shall be screwed to the pedestals.

New pedestals shall be anchored to the concrete floor. Any leveling necessary of the pedestal should be performed professionally. Existing pedestals can be used if they are right sized for the new cabinets. Pedestals shall have an L profile welded to them on which the existing walking raised floor panels shall be placed. In case that floor panels will be cut, it is necessary to properly reinforce them from the bottom side.

The appropriate structural load capacity of the pedestals must be calculated. Calculation shall be added the final documentation package.

[15]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 for PCs only.

PCs shall be positioned in a housing that is constructed in such a way (the air outlet from the PC) that they do not heat the components inside the cabinets.

[16]A suitable mesh shall be installed at the bottom side of the cabinets to prevent entry of pests. Suitable openings must be arranged for the cable entries.

[17]Environmental conditions are specified in section 11.0.

[18]User Panel

PSS shall be operated via a graphic touch screen display installed on the front panel or front door and it shall be seen without opening of the front door. MCCBs & MCBs shall have its control handles reachable on the front steel plate behind the cabinet front door. They shall be reachable only after opening the cabinet door.

[19] Cables

Red color cables shall be used for (+) potentials and blue color cables shall be used for (-) potentials. It is also necessary to mark the meaningful individual locations of the potentials with labels. Cable conductors shall have XLPE/EPR insulation, sheathing shall be from CSPE. Any insulation used shall be flame retardant, self-extinguishing, free from halogens (chloride, etc).

[20]LVD & disconnecting of non-priority loads

Mechanically latched contactors shall be used which do not require a continuous control power source. A short control power signal is needed to close a contact and become latched. If a mechanically latched contactor loses control signal, the contacts will stay closed. A separate, short power signal is required to release mechanically latched contacts.

For disconnection of non-priority loads also motor operated MCCB can be used.

[21]Key switch for enabling and disabling of non-priority loads

Toggle switch shall be installed inside of the cabinet which disable and enable function of disconnection of non-priority loads after 4 hours of

operation on battery operation only (no AC source is available) and at certain battery voltage.

- [22] Key switch for enabling and disabling of the battery charging function based on external signal (low room airflow switch or hydrogen monitoring).

Toggle switch shall be installed inside of the cabinet which disable and enable battery charging based on external signal of air control switch (with NC or NO contact). In case that the air flow or Hydrogen concentration is not adequate, battery charging should stop automatically. An alarm should also be initiated (low room airflow/Hi Hydrogen, battery charging stopped). The time parameter for how long it is allowed to charge batteries without adequate air flow must be determinable (in hours). When the function is active, it should be shown the time on the screen until the battery charging stop has expired.

Loads shall be powered all times, even when charging is stopped. (AC→DC load, AC→AC load, BAT→DC load, BAT→AC load).

- [23] Key switch for enabling and disabling of the battery charging.

Toggle switch shall be installed inside of the cabinet which disable and enable battery charging. An alarm should also be initiated (battery charging is disabled).

Loads shall be powered all times, even when charging is stopped. (AC→DC load, AC→AC load, BAT→DC load, BAT→AC load).

6.2. PC (Power Converters)

Each cabinet shall contain all the specified equipment bellow.

6.2.1. PC (Power Converters)

- [1] PC shall be assembled from number of necessary modules with additional redundancy module (N+1).
- [2] PC in each cabinet shall be powered by three phase AC input source. If needed due to design of working of the PC electronic bypass switch or BOOST mode function it is permissible that PC are powered in each cabinet from only one power supply phase, but in this case, there must be a different supply phase in each cabinet.
- [3] PC shall have function of self-configuration in case of replacement.
- [4] Maximum size of one module shall not exceed 3,0 kVA and minimum size of the module shall not be less than 2,0 kVA.
- [5] Each module shall consist of:
 - a) AC to DC converter – bi-directional rectifier with IGBT,
 - b) DC to AC converter - One-phase inverter with IGBT,
 - c) DC/DC converter for battery charging/discharging and supplying DC loads,
 - d) Front indicator to indicate operation status of modules and size of load,

- e) Electronic bypass switch or BOOST mode function which shall provide > 8x nominal current to clear the fault within 20 ms,
 - f) Galvanic isolation between DC load side/battery and DC/DC converter,
 - g) Redundant regulation/control unit.
- [6] In case of failure of one module, this module shall be automatically isolated from the operation and other modules shall take the load from the disconnected module. On the output of the PSS there shall not be any signs of the module malfunction.
- [7] Hot swappable and hot pluggable modularity that can replace an entire PC module during operation in less than 5 min shall be provided.
- [8] Modules shall be equipped with soft start.
- [9] Fans shall be equipped with alarms and run time meters. The fans shall be field replaceable by the NPP Krsko.
- [10] No single points of failure through:
- a) Redundant critical circuits in each module,
 - b) Multi-master operation,
 - c) Decentralized parallel architecture.
- [11] Efficiency
- a) AC to AC >96%,
 - b) DC to AC >93%,
 - c) AC to DC >93%.
- [12] 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).
- [13] The rotation speed of the fans depends on the output power.
- [14] Switching of the mechanical bypass switch must be allowed in both directions even if the output voltage of the PC is more than 5 V different from the input supply voltage to PC.
- [15] PSS shall continue to supply all the DC & AC loads in case that one of the cabinets is disconnected from the other two which are in operation. This does not apply for the equipment which purpose is to continue uninterruptedly supplies loads (DC & AC Load distribution terminals and associated MCBs and common buses and input components for supplying AC power to PC, etc).
- [16] Performing constant power or current battery tests and re-injecting power into a grid. This should be possible only on one cabinet at the same time and also on all of them at the same time.

- [17] Perform capacity test with the external load on only one cabinet at the same time, charging discharged battery after capacity test to full charge and bringing the cabinet back into operation with the other two cabinets in operation.
- [18] On each battery string shall be measured voltage, charging/discharging current and temperature.
- [19] DC voltage shall be temperature compensated.
- 6.2.2. System operation
- See Attachment 2 (Block Diagram).
- 6.2.3. Normal operation:
- DC:
- DC load is feed from the common DC bus which are supplied from the PC from all three cabinets.
- Charging of the batteries are feed from the PC which are located in the same cabinet as battery.
- AC:
- AC load is fed via the inverter which is supplied from internal DC bus.
- PC output shall be constantly synchronized to AC input power source when it is available.
- AC & DC:
- In case of malfunction of one module, it shall be automatically disconnected from operation and redundancy module shall take the load.
- 6.2.4. Overload operation
- DC:
- In case of overload outside of the overload capacity it should initiate alarm.
- AC:
- In case of overload outside of the overload capacity, PC shall transfer to bypass if modules are equipped with this function and initiate alarm, otherwise it shall stay in operation and initiate alarm. If the PC detect short circuit condition at the AC output level it shall transfer to bypass or start the Boost mode function to clear the fault within 20 ms.
- 6.2.5. Loss of Normal AC Input Power
- Cabinet shall be equipped with a key switch which can enable or disable that non-priority loads are disconnected in a case of supplying loads without AC input power. See point 6.1.2[21].
- DC:
- [1] DC loads shall be supplied from the battery. In case that the battery is depleted, battery shall be disconnected from the load.

- [2] After 4 hours of operation on battery only (no AC source is available) and at certain battery voltage (based on computer simulation of voltage during battery discharge), all loads shall be disconnected from the battery supply only priority loads shall stay in operation (see Attachment 5).

AC:

- [1] Inverter shall be supplied from the battery. In case that battery is depleted the inverter part of PC shall shutdown or battery shall be disconnected from the load to prevent excessive discharging of the battery.
- [2] After 4 hours of operation on battery only (no AC source is available) and at certain battery voltage (based on computer simulation of voltage during battery discharge), all loads shall be disconnected from the battery supply only priority loads shall stay in operation (see Attachment 5).

When the AC input source is available again, PC shall start to supply all DC & AC loads and charging of the battery.

6.2.6. Battery charging current and voltage:

- a) Battery charging current shall be limited and adjustable per manufacturers' specifications,
- b) Completely discharged battery shall be fully recharged in up to 12 hours,
- c) Charging of the battery shall be temperature compensated,
- d) Timer setting for equalizing charge shall be up to 48 hours. Adjustable range for equalizing charge shall be up to 2.50 V/cell,
- e) PC shall have the possibility to charge the batteries after carrying out the capacity test on the individual cabinet when it is disconnected from the other two cabinets in operation.

6.2.7. AC Load shall be transferred to the bypass (in case of installed electronic bypass switch) in the following cases:

- a) Manual initiation,
- b) Overloaded PC,
- c) Failed module,
- d) Battery is depleted and AC source is available,
- e) Other determined signals.

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

In the case that only BOOST mode function is installed instead of electronic bypass switch and in the event of short circuit on the load side it shall provide > 8x nominal current to clear the fault within 20 ms.

6.2.8. Transfer back to the inverter mode after transferring to the Bypass Supply mode (in case of installed electronic bypass switch):

The electronic bypass switch shall be capable of automatically re-transferring the load back to the inverter mode after the inverter 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.

In case that BOOST function was activated and the short circuit was cleared inside of 20 ms, inverter shall continue to operate normally.

6.2.9. Communications

PSS shall have a color graphic touch screen display (with good resolution and visibility and the biggest standardized size and not smaller than 7") providing mimic diagram, showing energy flow, PSS operational data, status, and alarms. All inputs and outputs breakers and statuses shall be seen on this display. Only one display is allowed per cabinet for all the statuses and measurements.

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

PSS shall have external ethernet connection (port shall be installed inside of cabinet) to access operating parameters and statuses of device, history log, etc.

Ethernet port shall be installed also on PSS for laptop connection behind the closed cabinets doors and USB port for memory stick for data downloading.

6.2.10. The following electrical quantities shall be shown on 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) inverter output voltage, current, frequency, PF & Power (kVA, kW),
- d) Battery voltage and charging/discharging current, Power,
- e) DC load side voltage, current, Power,
- f) PC modules temperature and battery's temperatures,
- g) Loading of PC modules in %.
- h) Measurement failure of electrical quantities shall have no effect on PSS operation. Measuring circuits shall be separated from control or any other circuits required for proper UPS operation.

6.2.11. Recording of electrical quantities

The function of recording of electrical values must be enabled, if the controller allows it. Memory cards (>1GB) shall be supplied with the PSS.

6.2.12. Alarms

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

- a) Common failure (PSS trouble),
- b) Load transferred to electronic bypass switch (if equipped) or BOOST function was initialized,
- c) AC Manual bypass switch operation,
- d) Rectifier failure,
- e) DC/DC converter failure,
- f) Inverter failure,
- g) inverter out of synchronization,
- h) Battery voltage HI,
- i) Battery voltage LO,
- j) Battery charging not O.K.
- k) Battery supplying load,
- l) Battery near exhaustion,
- m) Low DC disconnect,
- n) AC primary voltage input LO/HI,
- o) AC Output voltage LO,
- p) AC Output Voltage HI,
- q) DC Load voltage LO,
- r) DC Load Voltage HI
- s) Fan Failure,
- t) High temperature of PC module,
- u) Battery temperature,
- v) PSS firmware or configuration change,
- w) Open cabinet doors (only present for one minute (time shall be adjustable), re-reinitiates every hour (time shall be adjustable) if the initialization request still exists),
- x) Low room airflow or Hi Hydrogen, battery charging is stopped.
- y) Status which indicates whether non-priority loads are enabled or disabled.
- z) Status which indicates whether battery charging function based on external signal (low room airflow switch or hydrogen monitoring) is enabled or disabled.
- aa) Status which indicates whether battery charging is enabled or disabled.

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

UPS shall have a capability of an e-mail or SNMP alarming to the local Ethernet. In case that e-mail or SNMP alarming is not provided as built-in function, Supplier shall provide a device (for example: Damocles2 MINI) to which above common failure alarm shall be connected.

6.2.13. Setpoints and alarms

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

6.2.14. Cybersecurity requirements (system is classified as Critical Digital Asset)

- [1] Access to the digital device through the computer network connection must be regulated using username & password. All default passwords must be reset. Number of usernames and their rights shall be defined. At a minimum, these rights are divided into three groups. One group is for basic users who can only read data, second group is for users who can read and also change the operating statuses of the PSS and the third group with the highest rights level who can also change all the data, firmware or the configuration of a digital system and defines rights for subordinate users. All requirements from this point will be verified on the FAT. If necessary, other groups can also be defined.
- [2] All services which are not in use shall be disabled. For each service that is used, it is necessary to check whether there is a way of abuse or the possibility of a cyber attack. It is necessary to think about the security measures that will be implemented. For example, setting up the internal FW for services (If it exists on the device itself).
- [3] All interfaces which are not used shall be disabled. For each interface that is used, it is necessary to check whether there is a way of abuse or the possibility of a cyber attack. It is necessary to think about the security measures that will be implemented. For example physical locking of the UTP & USB ports, all communication ports are located inside of the cabinets, access to them is possible only by unlocking the cabinets with keys, segmentation of the computer network...
- [4] If the digital device has the possibility of wireless communication (Wi-Fi, Bluetooth, Wireless...) and is not specifically necessary and permitted, it must be disabled.
- [5] The FAT shall check how the configuration of the digital device is saved and how this configuration is restored. After the restore, it is checked whether the configuration is returned correctly. It must also be defined how often the configuration is saved, or after which events, and where this configuration is saved.

6.2.15. Terminals, cable lugs and cable connections:

- [6] All cables entrances shall be from the bottom side on the middle cabinet, except from the AC loads where cable entrances shall be in the same cabinet together with the AC load terminals and MCBs.

- [7] Cable channel shall be placed on the back part of the cabinet from the bottom to the top of the batteries, then it should go just above the batteries to the front panel where the cables will be connected to the terminal blocks.
- [8] All External wiring shall be connected to terminal blocks, they should not go directly to MCBs/MCCBs. Ring tongue isolated cable lugs shall be used for cable connections. Size of terminals shall be appropriate with NEK Attachment 5, where sizes of terminals are visible.
- [9] Additional MCCB and output terminals shall be provided for testing purposes for the battery and rectifier part of PC (one connection point per cabinet). Additional MCB and output terminals shall be provided for testing purposes of the inverter part of PC (one connection point per cabinet). For details see Attachment 2. Terminal blocks for testing purposes shall be mounted in the position that the safe distance to the live parts is large enough! They must be easily accessible from the front side of the PSS. There must be additional gap between terminals (use a BLANK space between them). During the normal operation these terminals shall be closed with a cover which is screwed to the front metal plate.
- [10] Terminal blocks for AC input source 2 shall be mounted in position where the safe distance to the live parts is large enough! They must be easily accessible from the front side of the UPS. There must be a gap between L, N & GND terminals (use a BLANK space between them).
- [11] All inputs and outputs terminal blocks shall be Type RT bolt connection from Phoenix contact or similar design.
- [12] DC (+) bus shall be permanently connected with cable to the ground.

6.2.16. Load buses

- [1] DC & AC load buses consists of Non-priority & Priority bus.
- [2] Non-priority buses shall be automatically shut down after 4 hours of operation on battery only (no AC source is available) and at certain battery voltage (based on computer simulation of voltage during battery discharge). Only priority loads (see Attachment 5) shall stay in operation.
- [3] When the AC input source is back, charger part of PC shall start to supply all DC & AC loads and charging of the battery.

6.2.17. History LOG

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

6.2.18. PSS Equipment Protection

- [1] PSS shall have adequate protection against external short circuits, open circuits, overloads and transient surge voltage conditions.
- [2] MCB protection shall be provided for: each AC circuit, each DC & AC output loads.

- [3] For DC circuits, DC breakers shall be used and not AC/DC breakers.
- [4] MCCB protection shall be provided for: batteries, term. for ext. loads for capacity testing, DC output from the cabinet to main DC bus and AC main power supply to the cabinet below the Y switch.
- [5] Breakers with larger-short circuit characteristics can be used in less demanding positions, the reverse is not allowed.
- [6] All breakers except for the test ones shall be equipped with the auxiliary switches which shall be wired to main controller.
- [7] Auxiliary switches from DC & AC output loads shall be connected in parallel and separately for DC & AC loads. Wiring must be connected in such a way that it is possible to easily find the fault on the auxiliary contact.
- [8] Size of MCB/MCCBs can be seen from Attachment 5.

6.2.19. MCCB (Molded Case Circuit Breakers):

Installation locations see under paragraph 6.2.18 & Attachment 2 & 5.

- [1] DC breakers shall be 2 poles.
- [2] MCCBs shall be thermal magnetic with adequate interrupting ratings for AC and DC side.
- [3] Manipulation with all MCCBs (AC, DC and Manual bypass switch) shall be from the front side of the cabinet and shall not be accessible without opening the door.
- [4] Circuit breakers shall have screw-compression (ring) type lugs compatible with the breaker rating.
- [5] 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.
- [6] A push-to-trip button on the front of the circuit breaker shall be provided to exercise the trip mechanism during maintenance activities.

6.2.20. MCB (Miniature Circuit Breakers):

Installation locations see under paragraph 6.2.18 & Attachment 2 & 5.

- [1] MCB shall be thermal magnetic with adequate interrupting ratings for AC and DC side.
- [2] Manipulation with the MCBs (AC, DC and Manual bypass switch) shall be from the front side of the cabinet and shall not be accessible without opening the door.

6.2.21. Selector switch (Y)

- [1] Positions of the selector switch shall be as defined in Attachment 2.
- [2] Selector switch shall be rated for 80 Amps per phase due to reason that it will have greater air gaps between connections.
- [3] Selector switch shall have screw-compression (ring) type lugs compatible with the switch rating.
- [4] Manipulation with the selector switch shall be from the front side of the cabinet and shall not be accessible without opening the door.

6.2.22. 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 4 AWG copper ground wire. Grounding cable entrance shall be provided from the bottom side of the cabinet. Any additional requirements for proper grounding shall be described by the contractor.

6.2.23. Ground fault detection

Since DC part of PSS system is grounded, ground fault detection is not applicable.

6.2.24. Nameplates

Each mounted item on the UPS 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 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 designation for new PSS shall be PC103CMER002. Nameplate shall be placed on front side at middle top location. The individual cabinet shall also be marked with additional tag suffix (CAB1/CAB2/CAB3).

6.2.25. Insulation against unintentional contacts

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

Terminals/connections between different breakers shall have appropriate distances.

6.3. Batteries

6.3.1. General

All three (3) strings of batteries shall be capable to supply full loads specified in section 7.0.

Battery shall be installed in the bottom part of the cabinets with appropriate connections between battery cells, outgoing power cable connections and appropriate natural ventilation.

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

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

6.3.2. Battery design

- [1] Battery shall be sized from three 48 VDC strings.
- [2] Existing two (2) strings (Energys SBS 580) shall be used in two new cabinets. In third cabinet new battery shall be installed the size of which is calculated by the battery sizing program. The new battery shall be of the same Manufacturer and model as existing ones. Manufacturer/Supplier must prepare a written response if he has concerns about installing a larger battery in the third cabinet due to different sizes and ages in cabinet 1 & 2. A technically adequate solution must be offered.
- [3] VRLA, type tower block, mounted in horizontal position.
- [4] Consisted of 2 V battery cells connected in series to reach needed nominal voltage for supplying PSS.
- [5] Up to three strings shall be designed. Each string shall be installed in its own cabinet.
- [6] Easily accessible battery connections.
- [7] Containers shall be from UL94 V-0 rated flame retardant ABS material, highly resistant to shock and vibration.
- [8] Designed for operational in float applications without need for periodic equalize operation.
- [9] Battery cell shall not be heavier than 50 kg.

6.3.3. Battery interconnections

- [1] Cable connections between battery cells shall be solid. Connections between rows shall be flexible.
- [2] All battery terminals shall be insulated including external cables.
- [3] The interconnections shall not interfere with maintenance activities and shall be supported to protect the cables and avoid mechanical forces to the terminals.
- [4] Cables connecting battery strings with DC MCCB shall be the same size as are connections between cells and rows.

6.3.4. Battery cabinets

- [1] Size of cabinets

See paragraph 6.1.2. & Attachment 4. Used are 3 cabinets for the whole PSS.

[2] Installation of batteries

Maintenance activities and replacement or installation of the battery blocks shall be easy and safe with the least possible contact with the parts under voltage.

[3] Spill control & neutralization

Passive spill control around the cabinets or inside on the cabinets floor. shall be evaluated. If needed, it shall be the part of the supply.

6.3.5. Battery testing

[1] Performing of constant power battery tests partially by cabinet and on all cabinets at once with re-injection of power with PC into an AC grid and partially to loads.

[2] Battery testing with an external load shall be also enabled.

[3] Configuration of battery testing components must be designed to correspond to the block diagram of Appendix 2 in black color, if such a design is not possible, the configuration in red color is also acceptable.

7. PERFORMANCE REQUIREMENTS

7.1. PSS (Power Supply System)

7.1.1. AC Inputs Characteristics (Grids & Diesel generator)

AC Input Voltage	400V + 20% - 30%, (3P + N + PE)
AC Frequency (grid)	50 Hz \pm 3 Hz
AC Frequency (Diesel generator)	50 Hz \pm 5 Hz
AC Inrush Current	Less than 400% of rated current
Total distortion THDi (100 % load)	\leq 3 %
AC input maximum current	Supply breaker is 40 Amps

7.1.2. DC Input / Output Characteristics

Nominal DC voltage	48 VDC (40 - 60 VDC)
Application: DC load – primary function	Various telecommunications equipment, network switches, inverters, etc
Expected DC loading	See battery load details in paragraph 7.1.5
Size of DC load breakers	See Attachment 5 + SPARES (25%)

Battery charging time of the fully discharged battery	Up to 12 hours with parallel supply of all DC & AC loads
Possibility of float and equalize charging	Yes
Timer for equalize charging	Yes
Max. Voltage interruption / total transient voltage duration (max)	0 ms / 0 ms

7.1.3. AC Output Characteristics

Application	AC loads
Expected loading of the UPS	See battery load details in paragraph 7.1.5
Size of output breakers	See Attachment 5 + SPARES (25%)
Size of one module	>1 kVA < 2,5 kVA
Output Voltage	230 VAC, 50Hz, (1P + N + PE)
Type of loads	Single phase 230 VAC (computers, network switches, various telecommunications equipment, etc.)
Admissible load power factor	Full power rating from 0 inductive to 0 capacitive
Short time overload capacity	> 125 % @ > 15 second
Total Harmonic Distortion:	< 3 %
AC output voltage stability	±1% from 10 % to 100 % load
Load impact recovery time (10-90%)	≤ 0.4 ms
Frequency:	50 Hz, ± 0,1%
Audible noise at 1m (from 0 to full load):	≤ 65 dB
Crest factor	≥ 3:1 at full load
Efficiency AC/AC, DC/AC, AC/DC	> 96% / > 93.0% / > 93.0%
Max. Voltage interruption / total transient voltage duration (max)	0 ms / 0 ms

7.1.4. Sizing parameters for battery

Battery shall be sized per IEEE 485-2010 by applying the following factors:

Application	DC loads & Inverter AC loads
Lowest temperature	20°C (see section 11.2)
Min cell voltage	1,80 V/cell or higher due to 24 h autonomy. It shall be determined by the manufacturer.

	Voltage drops from battery terminals to PSS terminals shall be considered.
Aging Factor	1,25
Number of battery cells per string:	24
Nominal battery block voltage	2 VDC
Number of strings	3
Existing strings which are transferred to new cabinets:	2 complete strings with Enersys SBS 580 cells. In case that on base of battery sizing calculation only one new string will not be enough, installed shall be all new strings.

7.1.5. Battery load details

		Autonomy-Discharge time	priority load
DC LOAD:		0-4 hours	N
-(existing),	3850 W (70 A)		
-MOD 1053	2590 W *1		Y
Inverter load	1200 W		N
DC LOAD:	2590 W *1	4-24 hours *2	Y
-MOD 1053			
Inverter load	0 W *1		Y
Design Margin	1.0		
Effic. of the PSS	Determined by the supplier of PSS		

NOTE *1: The buyer will choose when installing the PSS whether the specified load will be connected as a DC or as an AC load. The system configuration must take this into account.

NOTE *2: After 4 hours of operation on battery operation only (no AC source is available) and at certain battery voltage (based on computer simulation of voltage during battery discharge), all loads shall be automatically disconnected from the battery supply (switching off and switching on again after the return of the AC source must be done directly with the main controller), only priority loads shall stay in operation (see table above).

7.1.6. Cabinet

- [1] Cabinets shall be sized in accordance with Block Diagram in Attachment 2 and technical requirements specified herein.

- [1] MCCB/MCB and associated connections shall be sized for 8 hours battery discharge current of each battery string and for full load of the system. Voltage drops shall be as small as reasonably achievable.
- [2] It shall be considered that one cabinet which consist of battery string & associated PC can be taken out of service for maintenance purposes or other reasons.

8. MATERIAL REQUIREMENTS

The Supplier 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 16 AWG and a minimum of 14-strand copper conductors, 600V 90°C. Where wire is subjected to flexing on hinged panels 16 AWG 41-strand extra flexible, copper conductors with 600V, 90°C shall be used. Cable conductors shall have XLPE/EPR insulation, sheathing shall be from CSPE. Any insulation used shall be flame retardant, self-extinguishing, free from halogens (chloride, etc). All the rest shall be made from non-combustible materials.

Materials used in PSS shall be suitable for environmental qualification as specified in section 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 2,5 mm framework. Door panels shall be a minimum of 2 mm commercial steel and side panels shall be a minimum of 1,2 mm. 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 satisfactorily in the past and meet applicable code requirements.

9. FABRICATION AND ASSEMBLY, SITE INSTALATION & SAT

9.1. FABRICATION AND ASSEMBLY

- [1] During manufacturing and assembling the Foreign Material Exclusions procedure shall be considered.
- [2] PSS shall be assembled so that it shall sustain environmental conditions according to section 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.

- [3] Cabinets must be screwed to pedestal which shall 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 and determine the type of expansion bolts.
- [4] All battery cells shall be made from the same production lot.
- [5] The cells shall be made of thermoplastic containers and covers, highly resistant to impacts, flame-retardant with self-extinguishing properties and heat resistant.
- [6] The battery shall be shipped complete with all battery cell connections, end connections and any other equipment necessary for handling, lifting (installation and uninstallation of battery cells). All connections shall ensure electrical contact and they shall have enough cross section to minimize voltage drop between connections.
- [7] Interconnections shall avoid stresses in the terminals.
- [8] The polarity of the terminals of each cell shall be clearly indicated with indelible markings.
- [9] The dimensions of the cabinet shall fit in the room (see Attachment 3). Additional space shall be available around equipment for maintenance. The Supplier shall propose a layout in the PSS room that allow enough clearance for proper maintenance.
- [10] It is desirable that all metal parts of cabinet in contact with the battery are protected with electrically resistant insulation.
- [11] All bolted connections shall be torqued to required value.
- [12] Fabrication shall not begin until all deviations from this specification are resolved, design is approved by NEK, and Contractor receives written approval from NEK.
- [13] All parts in the PSS for which is needed periodic maintenance or replacement in case of failure shall not be mounted on back side of the cabinet but more to the front side of the cabinet (components must be mounted on "mounting plates or similar" so that they are closer to the front).
- [14] Nuts in the cabinets for screwing in the equipment must not fall off when the equipment is unscrewed, press nuts shall be installed or a better solution.

9.2. SITE INSTALATION AND SAT

- [1] The contractor must comply with the NPP Krsko procedures, standards and technical regulations relating to installation works and SAT. It must also ensure the following:
 - a) That all preconditions for the execution of works, such as tools, controlled parts, personal and other protective equipment, etc., are provided in a timely manner,

- b) For the execution of all works, detailed installation instructions must be written according to which the works are carried out. Instructions shall be part of work package.
 - c) That the instructions of work leader are followed in the execution of the works, that the works are carried out in accordance with the work order work package and in the planned time, of the appropriate expected quality and without additional repairs,
 - d) That only appropriate controlled parts are installed during installation,
 - e) To implement all the needed measures for Foreign Material Exclusion (FME) into open systems,
 - f) Strictly follow the rules of safety at work and fire protection,
 - g) Proper temporary storage of tools, storage and disposal of hazardous materials such as various cleaners, lubricants, etc.,
 - h) Maintaining order and cleanliness at the workplace at all times while performing all activities,
 - i) SAT was successfully performed according to the SAT procedure.
- [2] All identified deficiencies that may affect the operational capabilities of the equipment must be carried out in the checklist - a list of deviations and repairs performed (part of the work order work package) & initiate PDR. Information about deficiency must also be immediately reported to the NPP Krsko coordinator and if necessary, also to the responsible engineer.
- [3] Any corrective activity that exceeds the scope of the given instructions (work order, checklist, work procedure, manufacturer's instructions) must be approved by the responsible engineer of the NPP Krško.
- [4] During the implementation of activities, the contractor must immediately fill in all performed activities in the checklists of work order work package, as well as other related documentation that is created during the implementation of works.
- [5] The documentation of the work package must show that the equipment meets all the requested requirements and that the PSS is put into operation after the last activity has been completed. Upon completion of the activity, contractor is obliged to complete the activity at Nek-omat (computer for processing of electronic work orders) with the prior permission of the NPP Krsko coordinator and responsible engineer. The method and exact scope of entering the history must be coordinated with the responsible engineer.
- [6] Contractor is responsible to keep the workplace clean at all times and to clean the workplace after the work has been completed and to remove all equipment and parts that are not part of the installed PSS.

9.3. LABOR QUALIFICATION FOR EXECUTION OF SITE ACTIVITIES

- [1] All workers must have an appropriate electrical & mechanical (for constructions) education and be theoretically and practically qualified to

perform the required work. Also, their daily work should include activities from the electrical and mechanical (for constructions) profession, such as designing, maintenance, installation of new equipment and testing of identical electrical or similar equipment.

- [2] All work leaders must have completed NPP Krsko course for subcontractors works managers.
- [3] All workers must have completed NPP Krsko course for subcontractors.
- [4] All workers must be aware of the hazards at work.
- [5] All workers must meet the safety inspection requirements arising from the applicable legislation and the requirements of the NPP Krško Security Service.

9.4. During the performing of site works, the contractor is obliged to:

- [1] Performing of work in accordance with NPP Krsko procedures.
- [2] Ensure for the protection of equipment, disassembled parts of equipment and new parts at the work site where the work is performed.
- [3] Take care of internal transport of equipment and its parts.
- [4] Take care to the equipment located nearby.
- [5] Take care to the doors and frames over which the equipment is transported.
- [6] Inform on an ongoing basis the NPP Krsko coordinator and responsible engineer of any deficiencies and deviations they observe.
- [7] To comply with any subsequent oral or written instructions regarding the performing of works that will be received from the NPP Krsko coordinator or the responsible engineer.
- [8] Fill in the work package checklists on an ongoing basis.
- [9] Write any detected deficiency and corrective action in the checklist - A list of deviations and repairs performed (part of the work order work package) and initiate PDR. Information about deficiency must also be immediately reported to the NPP Krsko coordinator and if necessary, also to the responsible engineer.
- [10] Provide configuration control over the installed components and accompanying documents (serial numbers, revisions, etc.).
- [11] After the completion of the installation & SAT activities, work leader transfers all the information's, including the information that the equipment is ready and capable to put it into operation and indicate any restrictions and reasons for them to the NPP Krsko activity coordinator and responsible engineer. All required checklists must be completed before putting the equipment back into operation. Based on this information, NPP Krsko coordinator hands over the equipment back into operation and if necessary, also consults with the responsible engineer.
- [12] Work order history must be completed no later than one week after the completion of the activities of the electronic work order. However, with

essential data proving that the equipment is ready to take it into operation, the history must be completed immediately after the completion of the electronic work order, as this is a condition for putting the equipment into operation.

- [13] Submit the completed work package to the NPP Krško coordinator and responsible engineer for review and signatures. After that, the contractor takes care of the final entry of all data to the electronic history of the work order after approval of compliance by the NPP Krsko coordinator and, if necessary, from the responsible engineer. The electronic history for certain activities can be entered also by the NPP Krsko coordinator.
- [14] Configuration control must be provided and evident from the electronic history (electronically and from work package documentation).
- [15] After the work is completed, the work order must clearly show the procedures by which the work was performed and controlled, and a statement that the equipment is ready and capable of further operation and indicate any restrictions and reasons for them.

9.5. Implementation time plan of individual activities that must be prepared by contractor and reviewed and approved by NEK:

- [1] Time plan of individual activities which are divided into fabrication and assembly, pre-FAT, FAT, site installation & SAT for the implementation of the entire project shall be prepared.
- [2] When supervising activities from NEK side they must be planned in such a way that NEK employees do not work more than 8 hours a day, unless exceptionally otherwise agreed with NEK if the activity cannot be divided into the following day.
- [3] To carry out the site works, it is necessary to be prepared a detailed time plan for the implementation of all activities.
- [4] Switching loads to backup power and back to normal power shall be scheduled in the afternoon or during the weekend. Details will be determined just before the start of site works.
- [5] Activities implemented in site shall be scheduled so that the workers are not present in the site for more than 12 h a day.
- [6] Site works may not exceed 12 days together with 3 days for float charging before performing capacity test and 2 days for recharging of the battery after capacity test.

10. INSPECTION AND TEST

Certified data shall be submitted by the Supplier to show the characteristics of the PSS, battery, cabinets and associated materials supplied, to show that the materials are in compliance with the specified test values. Testing, inspection, and acceptance criteria shall conform to applicable codes and standards.

The Supplier shall be responsible for conducting all inspections 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 Supplier's standard and have proven suitability for the service. The Supplier 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 by the Supplier to the NEK for review, fulfill and approval. NEK shall also be informed about time schedule of all tests and beginning of assembly.

Supplier shall provide overall inspection plan that will include all activities (design, fabrication, assembly, delivery, installation and SAT).

NEK intends to witness:

- a) Final PSS assembly with all software setups and factory acceptance test. At least testing of the appropriate setting of the configuration of the PSS controller must be performed at the manufacturer site of the PSS,
- b) Factory battery capacity test at the battery manufacturer site,
- c) FAT of the whole system,
- d) Removal, installation and SAT of the whole system.

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 in section 16.0.

NEK reserves the right to visit the Supplier's plant at any time to witness routine factory tests and other tests or controls as may be required to provide the correctness of wiring and operation. The Supplier 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. PSS

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

10.1.1. Testing before and during assembling of PSS

[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 torqued to the values in the prepared torque tables for individual screw connections.

10.1.2. Testing before the FAT

- [1] Detail Visual inspection,
- [2] Review of all installed wire and cable marks,
- [3] Review of installed component marks,
- [4] All bolted connections shall be torqued to the values in the prepared torque tables for individual screw connections.
- [5] All performance and design requirements in sections 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%.

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

10.1.3. Final FAT Testing

After manufacturing, pre FAT tests 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 to the values in the prepared torque tables for individual screw connections.
- [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 (in case of installed electronic bypass switch),
 - d) Bypass failure Return,
 - e) DC input failure,
 - f) DC input Return,
 - g) Bypass Failure and DC input failure simultaneously (in case of installed EBS),
 - h) AC Mains Failure and DC input failure simultaneously (in case of installed EBS),

- i) All AC failures,
- j) Transfer Y- AC input switch from source 1 to source 2,
- k) Transfer Y- AC input switch from source 2 back to source 1,
- l) Automatic Shutdown of the PSS (PC) to prevent excessive discharging of the battery. After the return of any of AC sources, PSS shall start automatically, and start with battery recharging and supplying DC & AC loads.

[6] Overload tests (DC & AC),

[7] Bypass transfer & Boost function test (if installed),

[8] Input Frequency Tolerance test @ Full Load & PF=1.0,

[9] Inrush Current measurement @ startup @ Full Load (DC & AC),

[10] Battery Ripple Current measurement, DC voltage_{peak to peak} & AC component of voltage from zero to full charging current.

[11] Output Voltage Transients (DC & AC side):

- a) 50% Load Step from 0% to 50% of load: $\pm 1\%$.
- b) 50% Load Step from 50% to 100% of load: $\pm 1\%$,
- c) 50% Load Step from 100% to 50% of load: $\pm 1\%$,
- d) 50% Load Step from 50% to 0% of load: $\pm 1\%$,
- e) 100% Load Step from 0% to 100% of load: $\pm 1\%$,
- f) 100% Load Step from 100% to 0% of load: $\pm 1\%$,

[12] Measurement of the following characteristics from zero to full load [AC input voltage from $-30\% \cdot U_r$ to $+20\% \cdot U_r$] and [from Lo DC to Hi DC input only without AC input]:

- 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 ($\pm 1\%$),
- g) AC Output PF measurement,
- h) DC output Current measurements,
- i) DC output Voltage measurements,
- j) Efficiency test (AC/DC, DC/AC, AC/AC),

[13] Three Phase Input Voltage transients

Input voltage transient from rated line to ground voltage 230 VAC to 280 VAC in $\frac{1}{2}$ s, immediately reduced to 161 VAC in 1s and raised to rated voltage (230 VAC) in $\frac{1}{2}$ s. Transient shall be performed at full and $\frac{1}{2}$ output load.

- [14] Overload Testing (all design limits),
- [15] Crest Factor Testing,
- [16] Battery Boost Testing,
- [17] Battery is in fault. Check the appropriate PSS response.
- [18] Checking of all alarms,
- [19] Checking of initiating of all alarms on graphic display and history log,
- [20] Checking of initiating of all alarms on remote signaling contact,
- [21] Checking of correct operation of battery temperature Probe from 10°C to 50°C and voltage compensation.
- [22] Checking of system set-points
- [23] Rectifier, Inverter & DC/DC converter full load test at 24 h duration shall be performed @ Max environmental design temperature, see section 11.2.
 - NOTE *1: All components shall be loaded.
 - NOTE *2: Critical temperatures during the test shall be measured (on connections, cabinet inside temperature, fan air outlet temperature, critical components, room temperature etc).
 - NOTE *3: Voltages and currents shall be measured (inputs and outputs).
 - NOTE *4: Measured shall be voltage drops & currents on MCCBs/MCBs, and other components (e.g. from output of rectifier to DC load terminals/battery terminals, inverter output to AC load terminals, etc).
- [24] Performance of the partial battery test with the PSS (Capacity test with returning energy back to the grid and recharging with equalized voltage @ defined time).
- [25] Checked shall be all the requirements from paragraph 6.2.14.

10.2. Battery FAT at the manufacturer site

10.2.1. PRIOR TO THE ACCEPTANCE TEST

- [1] All battery cells shall be marked with serial Numbers. A list with all serial numbers from the first one (+ incoming power cable) to the last one (- incoming power cable) shall be provided.
- [2] Verify that battery is on float charge for at least 72 hours before the capacity test.
- [3] During 72 hours float charge, measure and record battery terminal voltage, all battery cell voltages and float current every 10 minutes with online recorder.
- [4] Just before the start of the capacity test additionally measure and record all battery cell temperatures.
- [5] Calculate and record the average battery cell temperatures before performing the capacity test.

- [6] Visual inspection of readiness of battery for the test.
- [7] All battery blocks float voltages shall be inside of range 2.29 V/cell @ $20^{\circ}\text{C} \pm 0.03/\text{cell VDC}$.

10.2.2. ACCEPTANCE TEST:

- [1] Acceptance test/Capacity test shall be performed per IEEE 1188 standard:
 - a) Perform Acceptance test/Capacity test with constant current of determined amps (@ C24/1.80 V discharge rate or higher end voltage if so specified by manufacturer).
 - b) Test can be continued below nominal terminal voltage 1.80 V/cell (C24) time the number of tested cells, but this data cannot be used for final capacity calculation.
- [2] During discharge test:

Measure and record battery terminal voltage, cell 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 per IEEE 1188 standard for 20°C .
- [4] Acceptance criteria:
 - a) Battery capacity > 100%. Each battery cell shall have capacity >100 %.
 - b) For battery calculation takes the time when the cell terminal voltage reach 1.80 V/cell (C24) time the number of battery blocks in the string and the lowest battery cell voltage shall be greater or equal to 1.78 V/cell.
 - c) All cells which will be delivered to NEK shall have battery cells voltages greater or equal to 1.78 V /cell at the end of test (at the time which is used for battery capacity calculation). Cells with lower 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 cell voltages and charge current every 10 min until the battery is fully charged with online recorder.
 - d) During the recharge measure all battery cells temperatures and record the highest temperatures.
- [6] After recharge:
 - a) One day after the recharge is finished (charger is disconnected from the battery) Measure and Record all battery cells Open Circuit Voltages (OCV). Record all possible deviations.
- [7] Final inspection:

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

[8] Packing & shipping

- a) Cleaning of the 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.

10.3. SAT

The completely assembled cabinets delivered under this Specification shall be operationally tested as they will be installed at the NEK site. The tests would be performed by the Supplier personnel with the presence of NEK. The tests would include, but not be limited to the following:

Electrical & Functional tests to verify the PSS capability to meet the requirements of paragraphs 6., 7., 10. & 11. SAT procedure shall be prepared by the Supplier.

Acceptance shall be based on testing and inspection of the complete assembly and approval of the documented construction, testing and inspection procedures. Any components, which fails to meet the acceptance criteria for any test or inspection, shall be reported to NEK as PDR as specified under paragraph 10.4, be reworked or replaced, and retested. Panels shall be delivered to NEK site as specified under paragraph 31.0.

10.4. 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 Site Acceptance Testing (SAT) until 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 PSS is to provide DC & AC uninterruptible power to distribution to the NEK's various electronic equipment and thus assure stable operation without transients that could lead to potentially dangerous accidents.

PSS is qualified as Non-Nuclear Safety Related Equipment.

MECL: PC103CMER002.

11.2. Environmental Qualification

PSS and batteries will be installed indoors. The expected environmental conditions are as follows:

- Ambient temperature: 10°C to 40°C,
- Maximum relative humidity: 95 % (without condensate),
- The altitude does not exceed 500 m.

11.3. EMC qualification

A factory type test must be performed on the PC in accordance with the reference 3.1[3]a),b). Report shall be a part of the final documentation.

11.4. Design life

11.4.1. PSS

PSS 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.

11.4.2. Battery

Batteries shall be classified as "Very Long Life, 15 years @ 20 °C.

11.4.3. Cabinet and accessories

Cabinets and accessories shall have a design life of 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 must be shipped free of dirt, dust particles, corrosion and damages.

Ensuring cleanliness when performing installation work at the workplace. All foreign objects must be removed and dust particles captured with suction devices with a filter system of at least HEPA13.

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 in paragraph 6. 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. 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 PSS & panel 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 following:

- [1] PSS: PC103CMER002
- [2] CAB1: PC103CMER002A
- [3] CAB2: PC103CMER002B
- [4] CAB3: PC103CMER002C
- [5] BAT1 (CAB1): TBD
- [6] BAT1-CEL1: TBD
- [7] BAT2 (CAB2): TBD
- [8] BAT3 (CAB3): TBD
- [9] Other components: TBD

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.

Shock Watch 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 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 Supplier'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 Supplier 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 bidding, 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.

Removed equipment (Power Supply System and Batteries) must be taken away from the NEK for controlled decommissioning. For the battery, a record sheet on the acceptance of hazardous waste must be submitted.

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 of 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 will ensure that contractual quality-related requirements are fulfilled using his own quality management manual, to be complied and maintained with the requirements of ISO9001 standard or a comparable standard.

The Supplier shall submit with Proposal one controlled copy of its Quality Management 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 Sub-contractors

The Supplier shall ensure that its sub-contractors meet applicable requirements of this Specification.

The Specification requirements shall apply to sub-contractors for works and services not performed by the Supplier.

The Supplier shall be fully responsible for all actions of his sub-contractors in relation to the Purchaser.

20.3. Certificate of Compliance

The Supplier and its sub-contractors 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 fulfill (F), 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. 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 cabinets.

22. SHELF LIFE

Minimum operational life for all items specified herein shall be 20 years, except for the battery which shall be classified as "Very Long Life", 15 years @ 20°C.

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. and 33. herein.

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

Documentation shall be delivered as follows:

- [1] List of all documents grouped by groups in the form of a matrix. Clicking a document name in the list opens the document. Added shall be a column in which the number of the paragraph from the Technical Specification and Purchase Order that is completed will be indicated. Clicking on a paragraph number will open the linked page of the document.
- [2] Documents requested in section 5.1 shall be submitted with the proposal.
- [3] Documents requested in section 5.2 shall be submitted after contract award.
- [4] Documents requested in section 10.0 (Inspections and Tests) shall be submitted upon FAT completion.
- [5] EMC Type test report as requested in 11.3 shall be submitted before FAT.
- [6] Details of anchoring with mounting details
- [7] Complete quality assurance package as requested in section 20.0 shall be submitted upon shipment (factory release).
- [8] 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 EMC qualification is in accordance with specified standards. The Supplier and its Sub-contractors shall provide written proof to the Purchasers' Quality Assurance personnel that all referenced standards, codes and procedures have been compiled with.
- [9] Final QA package with all non-conformance reports, repair records, etc.

25.1. PSS specific documentation

- [1] Standard catalog information covering PSS and accessories offered.
- [2] Manufacturer's specification sheets, which cover technical data for offered model together with all options and accessories that are manufacturer's 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) Block diagrams,
 - i) Internal Schematic One Line Diagrams,
 - j) Schematic for all printed circuit boards (PCB),
 - k) Bill of Material, which include all electrical and mechanical items installed in the PSS, 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.
- [4] Datasheets covering all installed components and drawings.
- [5] Parts on Outline drawings shall be identified and connected with BOM.
- [6] Installation, Operation and Maintenance Instructions with troubleshooting which shall also include preparation, startup testing and PCB programming for replacement purposes and handling with software.
- [7] Spreadsheets with torque requirements for all bolted connections.
- [8] 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. Each item shall have specified its design/qualified life and maintenance replacement interval.
- [9] Copies of all test reports performed by the Supplier and requested in sections 10.0. & 11.
- [10] Copies of all tests which confirms adequate technical characteristics specified in sections 6.0 & 7.0.
- [11] Protective device coordination curves for all protective devices (breakers, etc.).
- [12] Protective device time /current curves for all current ratings. They shall be delivered as drawing and spreadsheets.

- [13] Protective devices time / current temperature shift curves for temperature range from 20°C to 60°C.
- [14] 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.
- [15] Software for communication with the PSS and adjusting/setting all necessary parameters. Passwords for full access to PSS parameters.

25.2. Battery, 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 & associated Ampere hours) to different Final voltages (1.60, 1.75, 1.77, 1.80, 1.83 & 1.85) at different discharge times (5, 10, 15, 30 minutes, 1, 2, 3, 4, 5, 8, 10, 12, 20 & 24 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 @ C1, C4, C5, C8, C10, C20 & C24,
- [9] Table: Voltage drop across one inter-cell connection at the @ C1, C4, C5, C8, C10, C20 & C24,
- [10] Characteristic: Self-discharges of cell,
- [11] Spreadsheets with torque requirements for all bolted connections.

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, operating and other documents:
- [1] Mounting details,
 - [2] Installation & Operational Manual,
 - [3] Maintenance Instructions with troubleshooting,
 - [4] Battery sizing worksheet.
- 25.2.4. Outline drawings, installation instructions, other documents:
- [1] Physical detail drawings of battery cells connections,
 - [2] Battery cells to battery cells terminal connections (solid or flexible connections),
 - [3] Battery cells to cable connections,
 - [4] Outline of the battery,
 - [5] Connections Datasheets,
 - [6] Accessories datasheets,
 - [7] Datasheet for the acid resistant paint used to protect the cabinet.
- 25.2.5. Battery cabinets drawings with all details, detail BOM, Cabinet assembling manual, battery installation manual, etc.
- 25.2.6. Accessories datasheets and drawings.
- 25.2.7. Parts on Outline drawings shall be identified and connected with BOM.

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 Supplier 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 Supplier shall provide access to its and its sub-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 Supplier of its responsibility to meet the requirements of this specification and purchase order.

30. SHIPPING REQUIREMENTS

Vendor shall be responsible for packaging and shipping (DAP – Delivery at Place) of equipment to NPP Krško site per Incoterms 2010.

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

31. DELIVERY SCHEDULE

See requirements inside of public Tender documentation.

For implementation of all site works the duration time is specified in paragraph 9.5[6].

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 PSS assembling,
- b) FAT for PSS, and battery,
- c) 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 two (2) searchable electronic version on USB key.

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

34. TRAINING

34.1. PSS training

Supplier shall organize training for NEK maintenance personnel (three (3) attendees). It shall take place at the manufacturing plant of the PC after FAT.

34.1.1. Topic that shall be covered are:

- a) Detailed Principle of Operation,
- b) Regular Maintenance,
- c) Detailed Diagnostic and Troubleshooting,

- d) Replacement of all parts and components and adequate setting of the parameters,
- e) Settings and adjustments of all PCB and other components that have adjustable settings,
- f) Use of software for adjusting any electronic devices 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.
- 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 (in e-formats: CAD, ppt, pdf and other original format).
- j) Supplier shall send to NEK detailed training description with all training documentation two (2) months before training shall take place for review, fulfill and approval.

35. WARRANTY

- [1] All equipment herein shall have at least 24 months of warranty after installation of the equipment in the NPP Krško.
- [2] Batteries shall also have at least 10 years of Pro rata warranty.

36. PROJECT CONTACTS

The Supplier shall assign its Project Manager for coordinating all project matters with the NEK originator of Technical specification. All commercial items are to

be addressed with the NEK Purchasing Department and originator of Technical specification.

37. ATTACHMENTS

- [1] Attachment 1: Technical data sheet & questionnaire for PSS
- [2] Attachment 2: Block Diagram of PSS
- [3] Attachment 3: Dimensions of the PSS room
- [4] Attachment 4: Arrangement of components in cabinets
- [5] Attachment 5: DC & AC load table with the size of MCBs and terminals
- [6] Attachment 6: PDR - Problem Deficiency Report
- [7] Attachment 7: SPWAR - System Performance/Warranty Action Request

Attachment 1: Technical data sheet & questionnaire for PSS

1. Cabinets Dimension:

a. Length

b. Width

c. Height

2. Total Cabinets Weight with & without batteries

3. Equipment Heat Load (Btu/hr):

a. 50% Load

b. 100% Load

4. 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 inrush current of charger & inverter at startup

5. DC output data (load side)

a. Min DC input voltage/current @ Full Load

b. Nominal DC input voltage/current @ Full Load

c. max DC input voltage/current @ Full Load

d. Voltage stability

6. DC output data (battery charging)

a. Min charging voltage/max current

b. Nominal charging voltage/max current

c. Max charging voltage/max current

7. AC Output data (load side)

a. Max True Power

b. Max Apparent Power

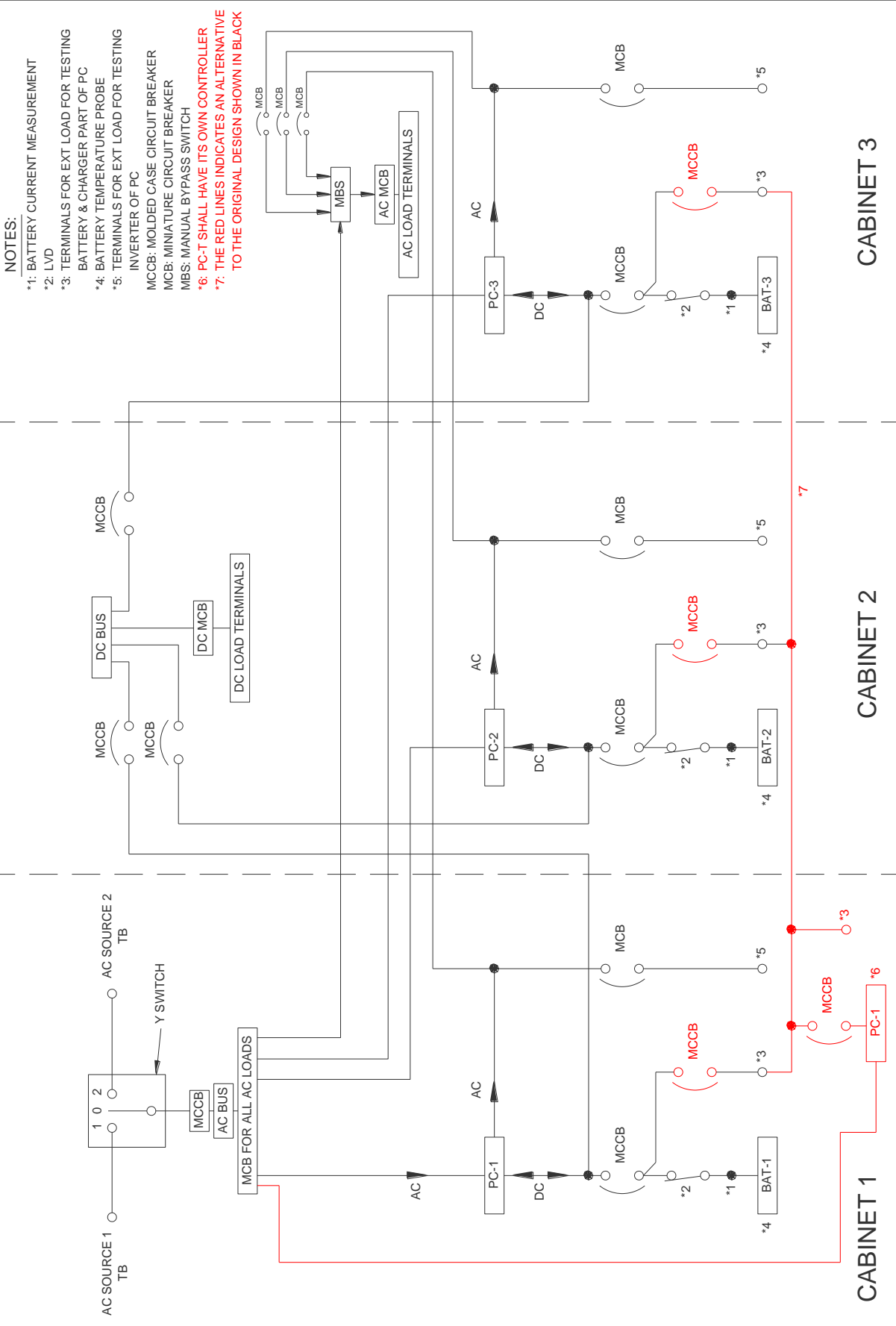
c. Max current

d. Min, nominal & Max voltage

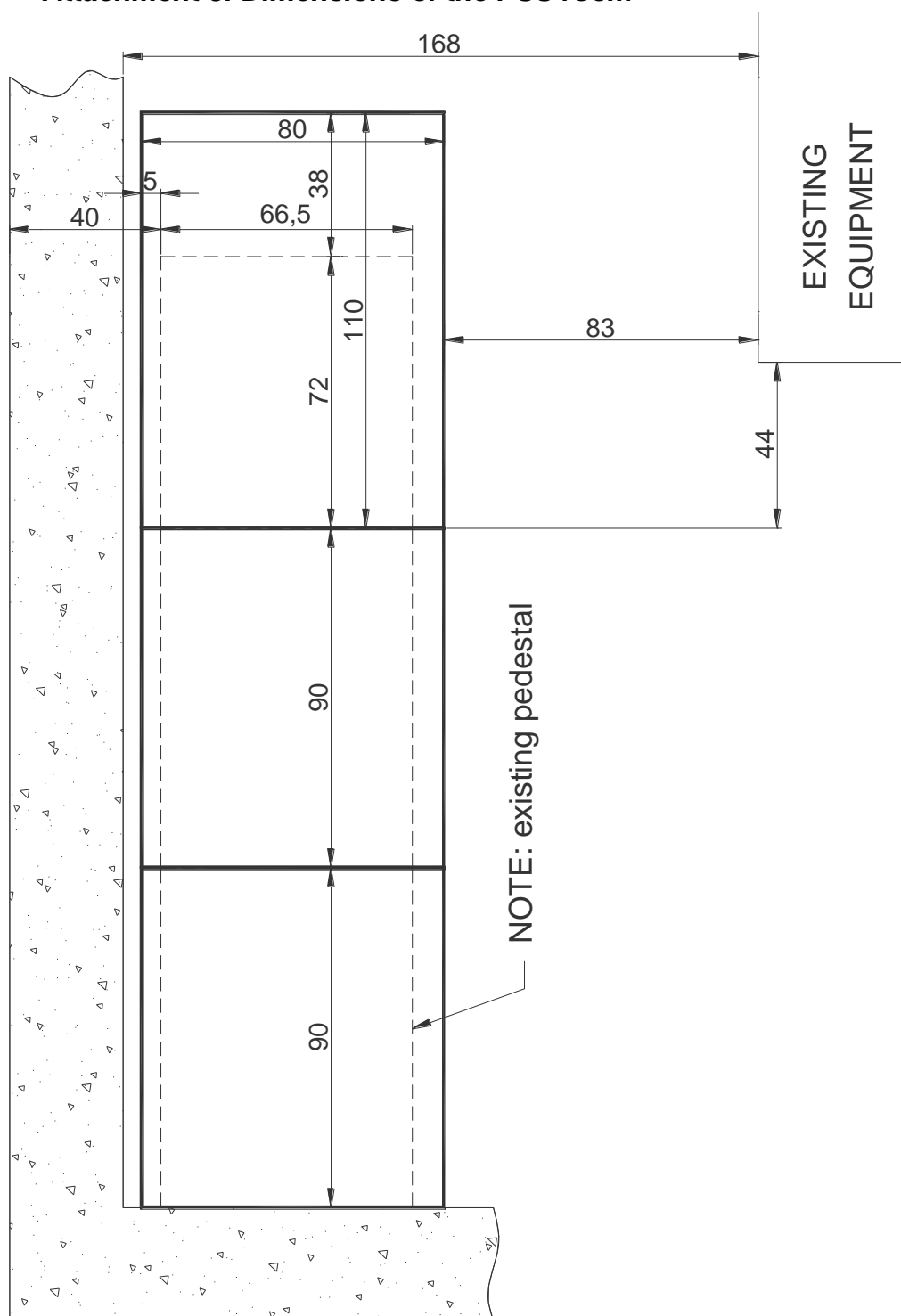
e. Bypass frequency tracking

-
- f. Voltage stability
-
8. Static Switch Transfer Time (if equipped):
- a. From Inverter to Bypass Supply
 - b. From Bypass Supply to Inverter
 - c. Maintenance Bypass Switch Design Type:
-
9. Charger & Inverter eff. using 230 V AC Source at:
- a. 100% Output
 - b. 50% Output
 - c. 25% Output
 - d. Time to Ramp from Zero to Full Load:
-
10. Audible Noise (dBA at 1 m)
-
11. Type of Cooling of cabinets, batteries & PC's (ambient, fans, etc.):
-
12. Minimum Clearances Required Around Cabinets:
- a. On the back
 - b. At sides
 - c. Front
-
13. Clarify, if it is possible to charge battery strings with lower voltage in case of discharged only of one string due to service.
-

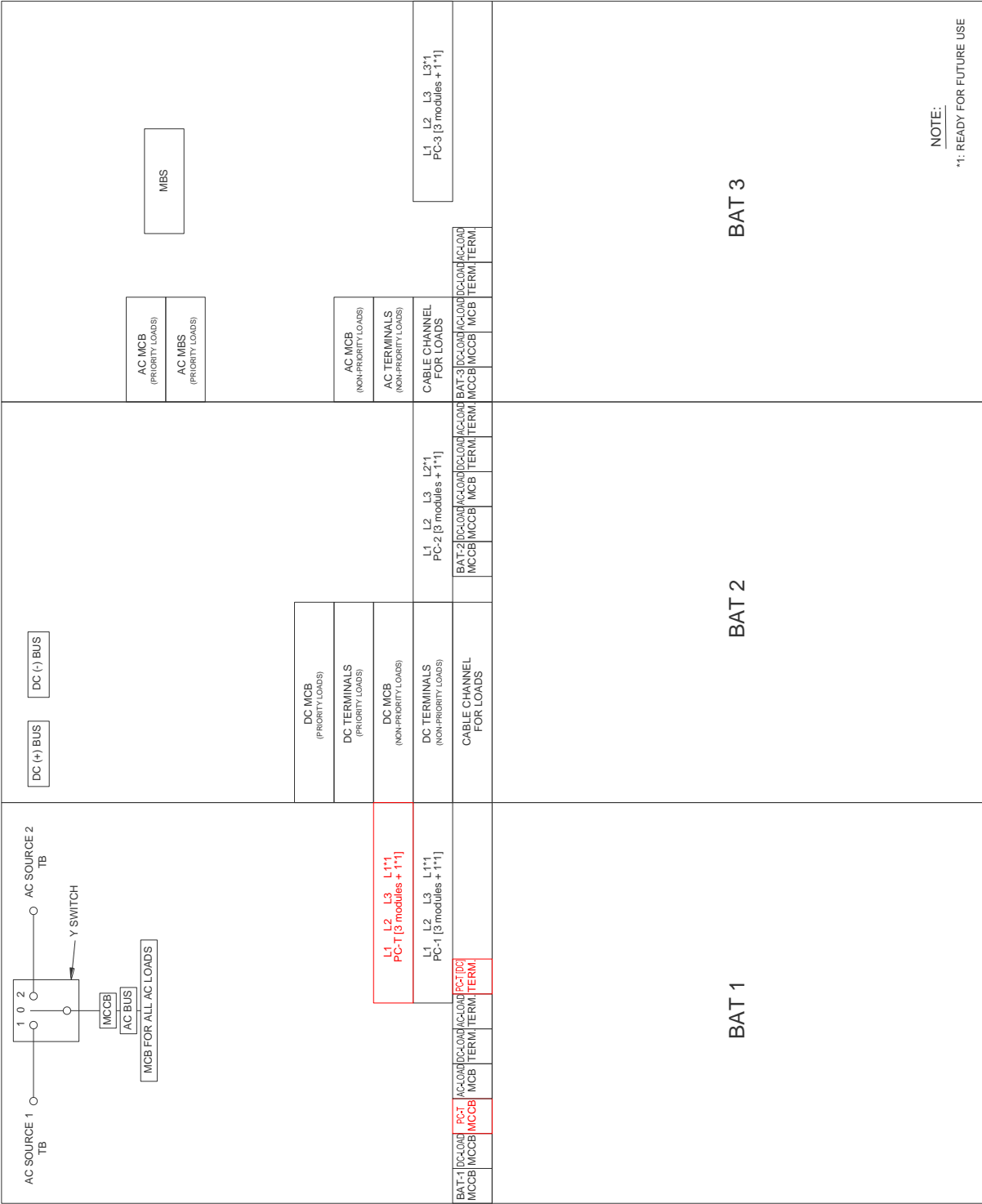
Attachment 2: Block Diagram of PSS



US

Attachment 3: Dimensions of the PSS room

Attachment 4: Arrangement of components in cabinets



Attachment 5: DC & AC load table with the size of MCBs and terminals

Type of Load	Size of MCB [A]	No. of priority loads	No. of Non-priority loads	Size of terminals [mm ²]
DC	C2	1	3	2,5-6
DC	C4	1	4	2,5-6
DC	C6	1	4	2,5-6
DC	C10	1	4	2,5-6
DC	C20	1	2	2,5-6
DC	C32	0	1	10-35
DC	C40	2	2	10-35
DC	80A *1	1	0	10-35
AC	C2	1	2	2,5-6
AC	C4	1	2	2,5-6
AC	C6	1	2	2,5-6
AC	C10	1	1	2,5-6
AC	C16	1	0	2,5-6
AC	C20	1	0	4-35

NOTE: *1 : Installed shall be a 80 A gG fuse dimension of 22 x 58 mm.

Attachment 6: PDR - Problem/Deficiency Report Form**PDR – Problem/Deficiency Report**

PDR Number (mm):	Priority (A-D):	Date of PDR Issue (dd/mm/yy):		
000X				

Initiated by NEK ☐ / Supplier ☐**NEK/ Supplier: PDR Issue****PROBLEM TITLE:**

Affected Components:

Reference documents:

NEK/ Supplier: Scenario Identification

Environment description and order of events that were predecessors to the problem appearance:

Identified by:

NEK/ Supplier: Description of the Problem or DeficiencyProblem/deficiency existence
verified and approved by:

Date (dd/mm/yy):

Problem is
repeatable:

YES

NO

N/A

☒☐☐**Supplier: Troubleshooting and Problem/Deficiency Root Cause Explanation**

Troubleshooting and Explanation Provided by:

Date (dd/mm/yy):

Supplier: Corrective Action Proposal and Corrective Action Tracking Log and Tracking References

Corrective Action Description:

Corrective Action Performed by:

Date (dd/mm/yy):

Supplier Track Changes References:

Other Applicable Documentation
References and Attachments:**NEK: Resolution and/or Answer Acceptance**

NEK Comments:

Accepted by:

Date (dd/mm/yy):

Attachment 7: SPWAR - System Performance/Warranty Action Request Form**SPWAR – System Performance/Warranty Action Request**

SPWAR No. (nm):	Priority (A-D):	SPWR Issue date (dd/mm/yy):		
00X				

Form to be issued by NEK as problem reporting and problem resolution tracking tool during the generator warranty period

NEK: SPWAR Issue				
PROBLEM TITLE:				
Affected Components:				
Reference documents:				

NEK: Scenario Identification				
Environment description and order of events that were predecessors to the problem appearance:				
				Identified by:

NEK: Description of the Problem or Deficiency				
Problem/deficiency existence verified and approved by:	Date (dd/mm/yy):	Problem is repeatable:	YES <input checked="" type="checkbox"/>	NO <input type="checkbox"/> N/A <input type="checkbox"/>

Supplier: Troubleshooting and Problem/Deficiency Root Cause Explanation				
Troubleshooting and Explanation Provided by:				Date (dd/mm/yy):

Supplier: Corrective Action Description, Corrective Action Tracking Log and Tracking References				
Corrective Action Description:				
Corrective Action Performed by:				Date (dd/mm/yy):
Supplier Track Changes				
References:				
Other Applicable Documentation				
References and Attachments:				

NEK: Resolution and/or Answer Acceptance				
NEK Comments:				
Accepted by:				Date (dd/mm/yy):