



Technical Specifications

In Mast Sipping System Upgrade

KRŠKO NUCLEAR POWER PLANT

Specification Number: SP-ES1493

Date: 22.01.2026

Revision: 1

AUGMENTED QUALITY

Prepared by:

Robert Planinc

Date: 22.01.2026

Reviewed by:

Mitja Robek

Date: 22.01.2026

Reviewed by:

Andrej Kavčič

Date: 23.01.2026

Reviewed by:

Boris Bognar

Date: 23.01.2026

Approved by:

Peter Jan

Date: 27.01.2026

TABLE OF CONTENTS

| | | |
|----|--|----|
| 1 | BACKGROUND AND SYSTEM DESCRIPTION | 3 |
| 2 | ABBREVIATIONS AND DEFINITIONS | 4 |
| 3 | SCOPE OF SERVICES AND DELIVERY | 6 |
| 4 | SAFETY CLASSIFICATION OF CONTRACTED WORK | 9 |
| 5 | DESIGN INPUTS | 9 |
| 6 | APPLICABLE NEK-SUPPLIER DESIGN CONTROL PROGRAM | 10 |
| 7 | APPLICABLE CODES, STANDARDS AND DESIGN CRITERIA FOR THE WORK | 10 |
| 8 | AFFECTED SYSTEM(S) | 14 |
| 9 | IDENTIFICATION OF AFFECTED EQUIPMENT | 14 |
| 10 | SUPPLEMENTAL DATA | 14 |
| 11 | DOCUMENT SUBMITTAL | 15 |
| 12 | PERFORMANCE REQUIREMENTS | 21 |
| 13 | MATERIAL REQUIREMENTS | 21 |
| 14 | FABRICATION AND ASSEMBLY | 21 |
| 15 | INSPECTIONS AND TESTS | 22 |
| 16 | QUALIFICATION, PARTS CLASSIFICATION & DOCUMENT TRACEABILITY | 23 |
| 17 | OTHER REQUIREMENTS | 25 |
| 18 | CLEANING | 27 |
| 19 | CORROSION PROTECTION / COATING | 27 |
| 20 | MARKING AND IDENTIFICATION | 27 |
| 21 | PACKAGING, HANDLING & STORAGE | 27 |
| 22 | SOURCE INSPECTION/SURVEILLANCE NOTIFICATION | 28 |
| 23 | NONCONFORMING MATERIALS | 28 |
| 24 | SPECIAL HANDLING | 29 |
| 25 | SHELF LIFE | 29 |
| 26 | 10CFR21 REPORTING | 29 |
| 27 | COMMERCIAL GRADE ITEM DEDICATION | 29 |
| 28 | SUPPLIER DOCUMENTATION REQUIREMENTS | 29 |
| 29 | REPAIR RECORDS | 29 |
| 30 | SHIPPING REQUIREMENTS | 29 |
| 31 | VENDOR TECHNICAL MANUAL AND REGISTERED UPDATES | 30 |
| 32 | TRAINING PROGRAM | 30 |
| 33 | REVIEW & VERIFICATION OF WORK | 30 |
| 34 | SCHEDULE REQUIREMENTS | 30 |
| 35 | STATUS REPORTING REQUIREMENTS | 31 |
| 36 | WORK OR INFORMATION TO BE PROVIDED BY NEK | 32 |
| 37 | CHANGES OF WORK SCOPE | 32 |
| 38 | RECORDS | 32 |
| 39 | ORGANIZATIONAL CONTACT | 33 |
| 40 | SUPPLIER'S TECHNICAL APPROACH TO THE WORK | 33 |
| 41 | ACCESS TO SUPPLIER FACILITY AND DOCUMENTS | 34 |
| 42 | SUBCONTRACTED WORK | 34 |
| 43 | QUALITY ASSURANCE REQUIREMENTS | 34 |
| 44 | NEK PROPRIETARY DATA | 36 |
| 45 | APPENDICES | 37 |

1 BACKGROUND AND SYSTEM DESCRIPTION

1.1 Background

NPP Krsko is a Westinghouse two-loop PWR plant, located in Slovenia, 100 km away from the capital city Ljubljana (direction SE). Initial criticality was achieved in 1981, is currently in its 35th operating cycle. After each cycle, that is approximately 18 months, half of all the FAs are replaced with new fuel. During the outage, all FAs are transferred and temporarily stored in the Spent Fuel Pit. There are altogether 121 FAs in the core.

Since 1999, NPP Krško has performed In Mast Sipping inspection of all partially burned FA during the fuel unloading from the Reactor vessel without increasing the total time of the optimal defueling time. The system in use was supplied by former ABB Sweden (now Westinghouse).

NPP Krsko intention is to establish long term relationship with the supplier regarding inspection performance, experience, improvements, etc.

1.2 Purpose

NPP Krsko intends to upgrade the In Mast Sipping Failed Fuel Detection System (in the document recognized as IMS). The main goal is to achieve a very accurate system for used Fuel assemblies (FA) inspection and leak detection. The supplied system shall be very reliable with high leak detection accuracy.

This specification covers the design, manufacturing, testing, inspection, delivering, installation and startup of NPP Krsko IMS system. IMS will be installed on the NPP Krsko refueling machine produced by former Stearns-Rogers, now part of Raytheon Nuclear Inc. Equipment & Services, which is meant to be upgraded concurrently with IMS upgrade.

This specification represents technical requirements and basic data for NPP Krsko In Mast Sipping technical and commercial proposal.

The whole system is non safety related, but shall be seismically qualified in accordance with SP-S702 to prevent major IMS components detachment from the trolley and prevent objects from falling to reactor vessel.

1.3 General Notes

The Supplier shall be responsible for compliance with all the detailed requirements of this Specification, 677055A (which provides general design, fabrication, installation, shipping, marking, etc. requirements for refueling machine and its features) and its relevant referenced documents. There shall be no deviation from this specification and 677055A, nor deviation of without prior written approval by the NEK. Review and approval of any drawings, and/or specifications, and/or tests by the NEK shall in no way relieve the Supplier from these responsibilities. The Supplier shall perform the necessary reviews to ensure that the supplied items will comply with the existing plant systems, as mentioned in this Specification.

All potential technical solutions required for a safe, reliable, and efficient operation of the IMS shall be considered, and an optimum design shall be proposed and provided.

The Supplier shall ensure that the installation and start-up are implemented on schedule while meeting quality and safety targets. Nothing shall relieve the Supplier of the responsibility to perform, in addition to the established scope, analyses, tests, inspections, and other activities that through the process become necessary to ensure that the design and materials, as well as the product quality, shall be satisfactory for the intended service, or as may be required by common usage or good practice.

All engineering, design work, purchasing, manufacturing, installation and start-up work and planning shall be scheduled in accordance with the overall Project Schedule (see chapter 34), as adjusted and agreed by both parties before contract award.

1.4 Description of existing IMS

When a fuel assembly is raised and drawn into the mast of the refueling machine, the ambient pressure drops, resulting in an outflow of fission products from damaged fuel rods. To detect these fission products, water samples are drawn on-line ("sipped") from the immediate vicinity of the fuel assembly.

The water samples are drawn to the process unit and a water/gas separator by means of a centrifugal pump connected to a suction hose with mouthpieces on the grapple.

When the sipping is started, the air within the circuit is forced out and is replaced by the mixture of inactive gasses and fission gasses that are separated from the water samples. A gas pump conveys the separated gas to a gas detector chamber where it is measured for radioactivity, and then back to the water/gas separator.

The content of the fission gases dissolved in the water is constant and low when non-leaking fuel assemblies are tested. Because of the constant and low background in the on-line gas detection loop, leaking assemblies are easily detected with a high degree of sensitivity. The signal from the gas detector is displayed on a monitor and stored on a computer. It is recognizable from this signal whether there is a leak in the fuel assembly tested or not.

2 ABBREVIATIONS AND DEFINITIONS

2.1 Abbreviations

| | |
|----------|--|
| ADP | Administrative Procedure |
| ANSI | American National Standards Institute |
| BOM | Bill of Materials |
| CFR | Code of Federal Regulations |
| CoC | Certificate of Conformity |
| DCM | Document Control Module |
| DMP | Design Modification Package |
| DSFS | Detailed Software Functional Specification |
| EMC | Electromagnetic Compatibility |
| EOL, BOL | End of Life/Beginning of Life |
| ESD | Engineering Service Division |
| FA | Fuel assembly |
| FAT | Factory Acceptance Test |
| FDCR | Field Design Change Request |
| FME | Foreign Material Exclusion |
| FSAR | Final Safety Analysis Report |
| HOP | Hand-Over Protocol |

| | |
|--------------------------|---|
| H&S | Health and Safety |
| ID | Identification Number |
| IMS | In Mast Sipping (system) – a name used in this specification for the detection of fission products released from a failed fuel assembly. There are several commercial names available for the same/similar products, like Telescope Sipping system, ... |
| IP | Installation Package |
| MECL | Master Equipment Component List |
| M&IP | Manufacturing and Inspection Plan |
| NEK | Nuklearna Elektrarna Krško (NPP Krško) |
| NCR | Non-Conformance Reports |
| NSR | Non-Safety Related |
| NPP | Nuclear Power Plant |
| OBE | Operating Basis Earthquake |
| QA | Quality Assurance |
| PMM | Project Management Manual |
| RFI | Radio frequency Interference |
| RCMC | Reactor Cavity Manipulator Crane |
| RE | Responsible Engineer |
| RG | Regulatory Guide |
| SNSA | Slovenian Nuclear Safety Administration |
| SAT | Site Acceptance Test |
| SE | Safety Evaluation |
| SES | Safety Evaluation Screening |
| SSC | System, Structures and Components |
| SSE | Safe Shutdown Earthquake |
| TOP | Turn-Over Package |
| TS | NEK Technical Specification |
| URSJV Administration) | Uprava Republike Slovenije za jedrsko varnost (Slovenian Nuclear Safety Administration) |
| USAR | Currently valid NEK Updated Safety Analysis Report |
| USNRC | United States Nuclear Regulatory Commission |
| WSIP | Work Sequence and Inspection Plan |

2.2 Definitions

- 2.2.1 Equipment – means all equipment, materials, components and parts to be furnished by the Supplier to the NEK to fulfill requirements of this specification.
- 2.2.2 Service – means all activities performed to fulfill requirements of this specification.

- 2.2.3 Project shall mean modification 1302–FH-L, RCMC Upgrade
- 2.2.4 Specification shall mean SP-ES1493, IMS System Upgrade document, together with all relevant attached and not attached references and listed codes and standards in chapter 7 or documents referenced elsewhere in this specification.
- 2.2.5 Bidder shall mean organization, that meets requirements of and replied to Request for Quotation with submittal of a Bid in accordance with Bid instructions provided within RFQ.
- 2.2.6 NEK shall mean Nuklearna Elektrarna Krško, Nuclear Power Plant Krško or Purchaser
- 2.2.7 Supplier as used in this specification shall mean the party with whom Contract for supply of IMS has been signed.

3 SCOPE OF SERVICES AND DELIVERY

3.1 In Mast Sipping system, typically consisting of:

3.1.1 Suction Unit

- 3.1.1.1 Suction tube from refueling machine mast to Process unit

3.1.2 Process Unit

- 3.1.2.1 Water Pump
- 3.1.2.2 Gas Separator
- 3.1.2.3 Valves
- 3.1.2.4 Gas Pump
- 3.1.2.5 Gas dryer
- 3.1.2.6 Flow meters (gas and water)
- 3.1.2.7 Sampling points for water and gas
- 3.1.2.8 View glass for water level monitoring in gas separator
- 3.1.2.9 Purging system
- 3.1.2.10 Automatic condensate drains
- 3.1.2.11 Moisture separators
- 3.1.2.12 Water inlet piping with quick connector to existing suction hose
- 3.1.2.13 Water return piping with quick connector
- 3.1.2.14 Electrical dryer eliminating a need for silica gel

3.1.3 Electronic Unit

- 3.1.3.1 Computer system
- 3.1.3.2 Activity measurement system
- 3.1.3.3 Mains Power Transformer

3.1.4 System enclosure with interfaces to reactor building polar crane and refueling machine floor

3.2 Installation of on hand inlet and outlet connections

Permanent stainless steel suction tube shall be installed from the hose reel to the bottom of the mast truss and outlet tube from beneath the trolley to the upper trolley section to mitigate a health and safety risk to fasten the suction and outlet hoses. Ends shall be equipped with quick connectors matching the hoses.

3.3 All tools required to operate, handle and maintain IMS

3.4 Necessary spare parts for 10 years of operation including at least:

- 3.4.1 Spare water pump
- 3.4.2 Spare gas pump
- 3.4.3 Spare valves (each type one)
- 3.4.4 Spare flow meters (each type one)
- 3.4.5 Spare computer system
- 3.4.6 Spare activity measurement system (detector, signal conditioning, amplifier,...)
- 3.4.7 Spare mains power transformer
- 3.4.8 Spare quick connectors for water suction and return hoses
- 3.4.9 Spare set of required gaskets

3.5 Software

The system shall be supported by software for controlling the process and evaluating the service results. All results shall be printed as PDF and saved on disk for further analysis. An expert system for leaking FA detection will be integrated into the program and also submitted as a study and reference material for the fuel engineers.

3.6 Engineering and Design work

- 1) Overall project management
 - a) Management of interfaces between NEK, equipment Suppliers, and other sub-Suppliers for the project completion. This involves assistance to assure the flow of information is timely to support schedule requirements.
 - b) Management of schedule, all resources, risks, budget...
 - c) Coordination of all other activities under the scope of this supply & service.
- 2) Quality Control & Quality Assurance in accordance with chapter 43
- 3) Mandatory walkdown in April 27 outage
 - a) Detailed walk-down shall be performed by Supplier. The main purpose of the walk-down is to verify design inputs and to confirm that the as-built status in the plant is same as it is shown in provided NEK documentation (DCM items). If during that walk-down or during the DMP development any discrepancies are found between actual status in the field and the existing NEK documentation or if appropriate as-built documentation does not exist at all, it is the Supplier's obligation to prepare inputs for documentation for known purposes. As a consequence of walk-down process and possible discrepancies found, Supplier is requested to report found discrepancies to NEK, but they are not requested to correct NEK

DCM documents and drawings. All findings shall be reported in the walk-down report issued. Formal walk-down report should be submitted to the NEK for review and approval.

- 4) Design per ESP-2.602; Plant Design Modification – preparation of DMP.
 - a) Technical overview of design and review of engineering documents for consistency with the project documents requirements.
 - b) All the necessary design calculations necessary to develop the detail design modification package.
 - c) Detailed mechanical, structural, electrical and I&C drawings per NEK ESP-2.613.
- 5) Equipment Qualification (including EMC qualification certificate) and Seismic Qualification.
- 6) Licensing support (10CFR50.59)
- 7) Equipment manufacturing, inspections, purchasing, assembly, set up, packing, handling and shipment.
- 8) Material, equipment, parts procurement
- 9) Factory acceptance testing shall consist of a full scope In-Mast Sipping inspection sequence with water supply and discharge with the exception that fuel assembly will not be present in the mast. During the testing emphasis shall be on operability of all components, water/gas leak detection, data processing, and operator interfaces. Solid isotope like Sr-90 shall be used to check response of the detector unit.
- 10) Training of 6 (six) NPP Krsko nuclear fuel engineers for leakage detection theory and manipulation of IMS equipment + training materials
- 11) Training of 4 (four) NPP Krsko maintenance engineers + training materials
- 12) Complete installation work – demolition of existing and installation of new equipment in outage 2028, supervision of transportation of new and removed equipment in NEK, and disassembly (including cutting) of disposed parts to reduce necessary disposal space.
- 13) Preparation and processing of potential FDCR per NEK ESP-2.609, as applicable for the necessary changes identified during installation and testing requiring additions to existing design or corrections of DMP, and execution of all necessary fieldwork related to these changes.
- 14) Site acceptance testing shall consist full scope In-Mast Sipping inspection sequence. During the testing emphasis shall be on testing of items that were not tested during FAT.
- 15) Complete DCM and MECL update of new or by modification affected equipment and documents.
- 16) Preventative IMS maintenance and system check every 18 months, approximately three months before NEK regular outages, in the period from 2030 to 2040 in accordance with the Supplier's maintenance manual.
- 17) IMS inspection every 18 months, during NEK regular outages in the period from 2030 to 2040.

All activities shall be documented as listed in chapter 11. Engineering and Design include all the activities required for preparation of necessary project documentation following NEK ESP Procedures, QS 610, USAR and Codes and Standards specified by the NEK or proposed by the Supplier and approved for use by NEK. The codes and standards are specified under chapter 7 in this specification.

4 SAFETY CLASSIFICATION OF CONTRACTED WORK

IMS is classified as Non-Safety Related. Activities related to upgrade of IMS are classified as Augmented Quality due to elevated requirements with regards to design control, seismic anti fall down protection, cyber security, cleanness, and other requirements as specified in this document.

5 DESIGN INPUTS

5.1 General Notes

There is an existing In-Mast sipping system installed on the refueling machine trolley. It is assumed by this specification that the existing suction unit inside the mast, up to and including hose reel will be reused.

New IMS shall be placed on the same spot on the trolley as the existing one, using existing or similar attachment features.

380 V AC, 3 phases, 50 Hz electrical power supply is available.

All original design documents available at NEK along with the information provided or referenced in this specification will be put at Suppliers disposal for review and use with respect to the proprietary policy.

The development of the design inputs is within the scope of Suppliers work. The design input document shall be prepared in accordance with NEK procedure ESP-2.604. As a prerequisite for DMPs development a design input document shall be reviewed and approved by Supplier and by NEK.

The standards referenced in chapter 7 of this specification shall provide the basis for the design and construction.

The design shall ensure maximum reliability and performance for operation and the shortest and most effective maintenance with the engagement minimum maintenance crew.

Seismic design: The design of equipment installed on the refueling machine shall be Seismic Class II (anti-fall-down assurance).

Upgraded IMS shall eliminate the use of Xenon isotope for regular calibration and functional testing of IMS.

5.2 Design Life

The design life of IMS delivered to this specification shall be forty (40) years and 5000 operation hours. Design life is defined as the expected length of time that IMS will provide compliance with its specified functional requirements.

Design life pertains only to metal parts. For non-metallic parts, Supplier shall identify the service and replacement life based on meeting the functional requirements identified in this specification. Supplier shall identify the replacement interval for these parts in the qualification documentation and Instruction Manual.

Supplier shall warrant 10 years of IMS operation without any failure (up to and including year 2040).

Supplier shall assure availability of IMS spare parts/component (or alternative replacement products of the same quality) for 10 years after IMS installation (up to and including year 2040).

5.3 Verification of existing equipment

The design of upgraded IMS shall enable Supplier to requalify existing components and structures (bridge and trolley components, mast, rails, rails foundations, floor slab,...) by comparison and evaluation methods, with the assumption that original structural analyses and loads (of bridge, rails, floor slab) are no longer available. Otherwise, Supplier shall perform additional analyses of existing components and structures as proposed within the Bid and include its cost in the overall project cost.

6 APPLICABLE NEK-SUPPLIER DESIGN CONTROL PROGRAM

Design shall be executed and controlled in accordance with NQA-1-2008, Ad.2009/2011, Part I, mandatory Requirement 3 and Part III, implementing guidance Subpart 3.1-3.1. Software design shall be in accordance with NQA-1-2008, Ad.2009/2011, Part II, Subpart 2.7.

Design shall include generation of Design Inputs.

Important design milestone between Supplier and NEK will be after completed conceptual design, upon which Supplier shall provide to NEK assembly drawings, functional drawings, plant interface drawings and BOM's. At that time Supplier shall organize design review meeting to present conceptual design accompanying Suppliers experts and NEK operators and maintenance staff.

After conceptual design will be approved, Supplier shall proceed to DMP development.

Design review shall be performed in accordance with NEK ESP-2.607.

Any deviation from conceptual design at any stage of project shall be immediately reported to NEK.

7 APPLICABLE CODES, STANDARDS AND DESIGN CRITERIA FOR THE WORK

The design criteria, regulations, codes and standards listed below are to be considered during the course of this project.

A later version of some of the dated documents may be mandatory under regulations that have jurisdiction. If this occurs, Supplier shall inform NEK about it and obtain NEK approval. If there is a conflict between this Specification and a referenced document, the Supplier shall refer the matter in writing to the NEK to inform him of the conflict and to provide a proposal to resolve the conflict for NEK's approval.

The Supplier, unless otherwise stated by the NEK, shall use the appropriate codes and standards listed in this chapter in effect at the time of Contract signed.

Bidder shall review listed codes and standards for applicability for the project. Alternatives to the required codes and standards shall be identified and justified within Bid.

7.1 Applicable Slovenian Legislation

1. Rules on the use of radiation sources and on activities involving radiation (JV2/SV2), Ur.l. RS, No. 27/2006
2. "Pravilnik o dejavnikih sevalne in jedrske varnosti" (JV5), (Rules on radiation and nuclear safety factors (JV5), Ur.l. RS, No. 92/2009 and 9/2010)
3. "Pravilnik o zagotavljanju varnosti po začetku obratovanja sevalnih ali jedrskih objektov" (JV9), Ur.l. RS 85/09, 9/10, 87/11 (Rules on the safety of radiation and nuclear facilities)

4. Zakon o varstvu pred ionizirajočimi sevanji in jedrski varnosti (ZVISJV), (Ionising Radiation Protection And Nuclear Safety Act, Official Gazette of the Republic of Slovenia (ZVISJV), Ur.l. RS, No. 102/2004-UPB2, 70/2008-ZVO-1B, 60/2011 and ZVISJV-D,74/15)
5. Pravilnik o fizičnem varovanju jedrskih snovi, jedrskih objektov in sevalnih objektov, Ur.l. RS 31/05 (Rules on physical protection of nuclear materials, nuclear facilities and radiation facilities)
6. Uredba o zagotavljanju varnosti in zdravja pri delu na začasnih in premičnih gradbiščih, Ur- l. RS 83/05 (Decree on safety and health at work at temporary or mobile construction sites)
7. Zakon o varnosti in zdravju pri delu (ZVZD-1), Ur. l. RS 43/11 (Law on Safety and Health at Work)
8. Odredba o varnosti strojev (Ur. l. RS št. 52/00 in 57/00, Decree on machinery safety)
9. Konvencija o jedrski varnosti, UL RS-MP, št. 16/1996 (Nuclear Safety Convention)

7.2 Applicable US Legislation

1. 10 CFR 50, Appendix A, General Design Criteria
2. 10 CFR 73.54, Physical Protection of Plants and Materials
3. RG 1.29, Revision 1, Seismic Design Classification
4. RG 1.100, Revision 2, Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants
5. RG 1.180, Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems
6. RG 5.71, Cyber Security Programs for Nuclear Facilities
7. NUREG-0700, Human-System Interface Design Review Guidelines, July 2020

7.3 Applicable EU and US Codes and Standards

1. ISO 45001:2018, Occupational health & safety management system
2. EN 61000 series - Electromagnetic compatibility (EMC)
3. ISO 9001:2015 Requirements for a Quality Management System
4. ANSI/ASNT CP-189, ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel, 1995
5. ASME/ANSI B18.2.2-1987, Square and Hex Nuts
6. ASME NQA-1 2008, Ad.2009/2011, Quality Assurance Requirements for Nuclear Facility Applications
7. ASME Y14.5M, Geometric Dimensioning & Tolerance
8. ASTM A Specifications for Structural Steel
9. AISC ASD – 13th Edition, American Institute of Steel Construction, Allowable Stress Design
10. AWS D1.1:2020, Structural welding code – Steel
11. AWS D1.6:2017, Structural welding code – Stainless steel
12. AWS D14.1:2005, Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment

13. AWS QCI: 2016, Standard for AWS Certification of Welding Inspectors
14. EPRI TR-102323 R5, Guidelines for Electromagnetic Interference Testing in Power Plants
15. EPRI, Cyber Security Technical Assessment Methodology: Vulnerability Identification and Mitigation, 3002008023, Final Report, October 2016
16. MIL 461E Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment (Used within the Guidelines of EPRI TR-102323, Rev. 1)
17. IEEE-344, Recommended practice for seismic qualification of class 1E equipment for nuclear power generating stations
18. IEEE-383, 2015, Standard for Qualifying Electric Cables and Splices for Nuclear Facilities
19. IEEE-730:2002, Standard for Software Quality Assurance Plans
20. IEEE-828:2012, Standard for Software Configuration Management Plans
21. IEEE-830:1998, Recommended Practices for Software Requirements Specifications
22. IEEE-1012:2016, Software Verification and Validation
23. IEEE-1016:2009, Recommended Practice for Software Design Description
24. IEEE-1050:2004, Guide for Instrumentation and Control Equipment Grounding in Generation Plants
25. IEEE-1059:1993, Guide for Software Verification and Validation Plans
26. IEEE-1074:2006, Software Lifecycle Process
27. National Electric Code ANSI/NFPA 70 - 2020
28. NEI-08-09, Rev. 6, Cyber Security Plan for Nuclear Power Reactors
29. NEI 10-04, Rev. 2, Identifying Systems and Assets Subject to the Cyber Security Rule
30. OSHA 29CFR1910.29(b), Fall protection and falling object protection-criteria and practices

To the above listed, alternative EU codes and standards can be used based on justification by Supplier and approval by Purchaser.

7.4 NEK Documents

1. QS-600, Generic Software Quality Assurance Program Requirements
2. QS 610, Generic Quality Assurance Program Requirements
3. SP-S702, Seismic Analysis, Testing, and Documentation
4. EDC-4, Cable Tray, Cable & Conduit Separation Criteria
5. EDC-5, Grounding System Criteria
6. EDC-10, Cable Rating Criteria
7. ADP-1.0.131, Organizacija izvedbe modifikacije (Development of modifications)
8. ADP-1.0.500, Program protipožarne zaščite – Požarni red (Fire protection program)
9. ADP-1.1.033, Varnost in zdravje pri delu v NEK (Health and safety at work at NEK)
10. ADP-1.1.051, Vstop, izstop in gibanje v tehnološkem delu NEK (Entry, exit and move within the technological part of the NPP)
11. ADP-1.2.116, Nadzor dokumentov v NEK

12. ADP -1.101, Preprečitev vnosa tujkov (FME program)
13. ADP-1.1.105, Priročna skladišča in kontrolirano odložena oprema (Temporary storage and controlled deferred Equipment)
14. ADP-1.1.125, Izvedba delovnega naloga (Working order process)
15. ADP-1.2.003, Plant Design Modification and Control Process
16. ADP-1.4.022, Prevoz, skladiščenje, rokovanje in notranji transport (Storage, handling and internal transport)
17. ADP-1.14.202, Normativi osebnih zaščitnih sredstev (Personal protection norms)
18. ESP-2.111, EAM MECL Data Element Structure/Definition
19. ESP-2.113, EAM MECL equipment numbering system
20. ESP-2.302, Administration of Changes to the USAR
21. ESP-2.303, Authorization of Changes, Tests and Experiments (10CFR50.59)
22. ESP-2.602, Plant Design Modifications
23. ESP-2.604, Design Considerations, Basis and Input
24. ESP-2.605, Design Analysis and Calculations
25. ESP-2.607, Design Verification
26. ESP-2.609, Field design Change Request
27. ESP-2.611, Document Turnover and Closeout
28. ESP-2.613, CAD Drawing Control of Scanning, Conversion or Revision Process
29. ESP-2.617, Material and Equipment Specification
30. ESP-2.619, Preparation of Installation Packages
31. ESP-2.624, Design Impact Evaluation
32. ESP-2.631, EMC Program in Design Modification Process
33. ESP-2.913, Rules for Process Computer Systems Human Machine Interface
34. ESP-2.921, Cyber Security Assessment of Critical Digital Assets (CDA) in NEK
35. ESP-2.951, Process Computer Signal Configuration Database Control
36. FPP-3.7.002, Postopanje v primeru požara (Fire response)
37. FPP-3.7.004, Kontrola vnosa gorljivih snovi (Flammable items control)
38. EIP-17.044, Nudenje prve pomoči in prve medicinske pomoči v primeru nezgode v NEK (Medical first aid)
39. ADP-1.1.141, Ravnanje s težkimi bremenami v NEK
40. ADP-1.2.116, Nadzor dokumentov v NEK
41. ESP-2.615, Material Equivalency/Substitution
42. ESP-2.616, ALARA Implementation for ESD Activities
43. RFI-5.850, Fuel Assembly Inspection
44. 677055, Rev. 6, RCMC General Specification

45. 677072, Rev. 2, RCMC Addendum to Specification
46. P29110-1, Rev. 0, Substitutions of the Steel Materials According to the ASTM Standards with Materials According to the SIST EN Standards
47. NFH-5.814, Instructions, precautions and limitations for handling new and partially spent fuel assemblies
48. SP-ES1454, Technical specification Reactor Cavity Manipulator Crane Upgrade
49. 677055A, Rev. 1, Equipment Specification, Upgraded Reactor Cavity Manipulator Crane
50. 1451E29, Sh. 1, Rev. 10, 16 X 16 Fuel Assembly Interface Parameters
51. 22170-155: Inner Mast – Assembly Drawing,
52. 22650-155 Gripper Finger (16x16) - Assembly Drawing,
53. 22830-105: Control Console Panel Layout - Assembly Drawing,

8 AFFECTED SYSTEM(S)

Fuel Handling System (acronym FH).

9 IDENTIFICATION OF AFFECTED EQUIPMENT

| | |
|----------------|---------------------------------------|
| FHSCMC01 | Reactor Cavity Manipulator Crane |
| FHSCMC01-IMSEU | Refueling Machine IMS Electronic Unit |
| FHSCMC01-IMSHR | Refueling Machine IMS Hose Reel |
| FHSCMC01-IMSPU | Refueling Machine IMS Process Unit |

10 SUPPLEMENTAL DATA

Only the bids, which will provide all answers requested by this specification will be accepted in the evaluation process. The bidder shall specify each deviation from the requirements in this specification. The reasons for the deviations shall be explained.

During the development of documentation for the project, all design activities and deliverables specified in sections 3 to 5 shall comply to NPP Krsko procedures as follows:

- NFH-5.814 Instructions, precautions and limitations for handling new and partially spent fuel assemblies,
- REP-5.841, Accounting for and control of nuclear material,
- RFI-5.850, Fuel assembly inspection.

Bidder shall reference the similar projects implemented on other Nuclear Power Plants. All relevant data for evaluation of reliability and accuracy of the IMS shall be presented. Data shall be supported by simultaneous ultrasonic / eddy current measurements, coolant activity measurements of the applicable fuel cycle (reference EOL cycle coolant activity, next cycle BOL coolant specific activity of Iodine, Krypton, Xenon, Cesium, etc.). A list of advantages and disadvantages compared to other fuel detection methods and systems shall also be provided. Reliability shall be documented with the results from similar referenced services. Worldwide experience regarding agreement of the IMS services results with the analytical predictions shall also be described.

11 DOCUMENT SUBMITTAL

11.1 General Notes

All submitted documents shall bear at least following identification:

- Supplier's Name
- Date of issue
- Document number
- Revision number
- NEK's Purchase Order (Contract) Number
- NEK's Specification Number
- Supplier name, location and employee responsible for the preparation of the document
- Supplier's order number

All document deliverables shall be submitted in two versions as a minimum: PRELIMINARY for NEK review, and FINAL version to be approved by NEK. All documents for review shall be delivered to NEK in soft copy (pdf files structured with bookmarks and active cross reference links) reviewed and approved by Supplier first. All final documents shall be delivered as PDF files and also as one hard copy.

Hard copies shall be good-quality full-size, reproducible, sharp, direct-contact prints of the Supplier's original drawings. They shall be provided together with cover form (DIW) in accordance with NEK procedure ADP-1.2.116.

Final drawings shall be prepared in a form required by NEK procedure ESP-2.613. Supplier shall utilize the existing NEK numbering system and structure for NEK documents. NEK series drawings shall be provided in editable form (*.dwg).

A submittal drawing title block shall be defined by Supplier and two drawing numbers shall be shown in the submittal drawing title block. One drawing number shall be provided by NEK, and the other drawing number shall be provided by Supplier.

The outline drawings shall provide sufficient outline dimensions to permit arranging space in the plant to accommodate the installation and maintenance of the new equipment. As a minimum, the outline drawings shall provide overall dimensions, sizes, orientation, tolerances, and all other interfaces that will require connecting in the field. These physical outlines must clearly indicate any differences in size and space requirements as compared to the as-installed equipment.

Assembly and detail drawings shall be submitted before start of manufacturing or procurement of related items. The level of information provided on the drawings by Supplier and Sub-suppliers (Vendors) shall be equal to the level of existing IMS drawings and shall enable NEK to operate, maintain and troubleshoot the provided equipment.

Detail drawings shall contain information as to welding procedures, materials and process specifications, materials ordering and procurement specifications.

Documents will be reviewed by NEK within 10 working days after receipt, with exception of DMP, for which review time will be 20 working days, unless otherwise agreed between Supplier and NEK.

Approval of documents by NEK shall constitute acceptance of general design and interface dimensions only and shall not relieve the Supplier from the entire responsibility for correctness of design details or dimensions.

11.2 BID Phase

The bidding documentation shall consist of the following chapters:

1. Technical Approach describes how the scope is understood and how specification requirements will be accomplished
2. Explanation of technical solutions for design, installation, and operation of IMS
3. Project schedule and installation schedule considering boundaries presented in section 34.2.
4. Draft Project Management Manual and Project Quality Plan
5. List of applicable codes and standards
6. QA Manual in acc. with the chapter 43 of this specification
7. Identification of key personnel including project manager, main design engineer(s), main installation engineer(s), IMS operation supervisor and QA representative
8. Identification of major equipment Suppliers

Specifications with attachments shall be studied line by line by Bidder. Bid shall include a list of items that are not in compliance with specifications requirements and proposed rewording by Bidder.

Detailed instructions about the preparation of the Bid is described in the document “Instructions to Bidders”.

11.3 Project Documentation

Following documentation is to be provided by Supplier:

11.3.1 Project Management Manual (see ESP-2.617, App. 6.13 for guideline)

- 11.3.1.1 PDR - Project Deficiency Report form shall be established within Project Management Manual. Project Deficiency Reports will be issued by Supplier or NEK to identify deviation from project requirements and process problem resolution.
- 11.3.1.2 SPWAR – System Performance/Warranty Action Request serves as a formal form by which NEK request Supplier’s corrective action during warranty period.

11.3.2 Project Schedule

11.3.3 Project Organization Chart

11.3.4 Project Quality Plan

- 11.3.4.1 PQP shall generally describe Supplier's QA approach, provide specific information concerning the interfaces between various Supplier departments/facilities and describes application of the Supplier's QA Manual to the activities included in the scope of work (including design and procurement control, control of fabrication, treatment of non-conformance's, reporting of deficiencies, corrective actions implementation, site installation control,...).
- 11.3.4.2 PQP shall identify subtier documents such as all procedures related to the project, design control documents, manufacturing and inspection plans, documents handling deviations, non-conformance process,...

11.3.5 Design Inputs

- a) The design input document shall be prepared by Supplier in accordance NEK procedure ESP-2.604 including:
 - i. Identifying applicable project standards.
 - ii. Identify all design information that will be used during the project and ensure that engineering activities are performed with a consistent set of assumptions and data.

11.3.6 Design Modification Package (DMP) shall be prepared in accordance with the requirements of ESP-2.602 and all other applicable ESD procedures referenced therein.

11.3.6.1 Calculations / Analysis Reports in accordance with NEK procedure ESP-2.605 or equivalent Supplier procedure.

Supplier shall submit calculations showing that equipment meets design requirements.

Reports shall be provided in sufficient details, providing all inputs and assumptions, supporting calculations, spreadsheets, data bases, etc. to enable NEK engineers to perform an independent line by line review. In case of missing data, NEK will reject such report and reset review cycle.

11.3.6.2 A list of MECL equipment, new or affected by modification with all attributes as required by ESP-2.111 (in excel table, table structure will be provided by NEK).

11.3.6.3 A list of affected (void, new, revised) documents to be entered into NEK database (DCM) with markups

11.3.6.4 Interim (mechanical, electrical, structural) drawings, including new and revision of existing/NEK drawings.

11.3.6.5 Vendor components drawings

11.3.6.6 Detailed Software Functional Specification (DSFS) shall be prepared for PLC developed software as part of DMP package – section I, where software functionalities, program logic, inputs/outputs to program logics and HMI displays are explained in detail.

11.3.6.7 Basic cyber evaluations and protection for all new digital components shall be performed and submitted as part of ESP-2.921, Cyber Security Assessment of Critical Digital Assets (CDA) requirements.

11.3.6.8 Detailed software and hardware user and maintenance (including administration) manuals shall be prepared and included into project to provide detailed usage instructions and basic maintenance instructions such as load or backup of software in case of failed PLC or HMI display equipment replacement.

11.3.6.9 Software Criticality Analysis

11.3.6.10 Failure Modes and Effects Analysis

11.3.7 USAR changes (10CFR50.59)

Supplier shall prepare necessary technical documentation according to NEK procedures ESP–2.302, Administration of Changes to the Updated Safety Analysis Report (USAR) and ESP–2.303, Evaluation of changes in NEK to apply for SNSA license.

11.3.8 Detailed Equipment Procurement Specifications (ESP-2.617)

- a) Supplier shall transmit to procurement specifications all the requirements from this specification.

- b) Supplier shall review Sub-Supplier (Vendor) drawings and documents for compliance with these specifications and contract documents requirements. Assure that the appropriate parameters and design information are being used by all the parties.

- c) Price and general terms and conditions may be omitted from transmittal.

11.3.9 Fabrication procedures for activities such as material receipt, manufacturing (welding), assembly, testing, inspection, cleaning, shipment, transportation, coating, etc.

11.3.10 Manufacturing Work Sequence and Inspection Plan

11.3.11 Non-Conformance Reports

11.3.12 Waste Handling and Minimization Plan providing drawing and instructions for minimization of waste volume, disposal locations, etc.

11.3.13 Factory Acceptance Test (FAT) procedure

Supplier shall prepare a Factory Acceptance Test procedure to execute maximum scope of equipment functional and performance testing at Supplier's facilities.

11.3.14 End of Manufacturing Report

The documentation about manufacturing shall comprise the following as a minimum:

- a) Index
- b) The last revision of the Manufacturing WSIP showing the identification number of all records
- c) Records of all the manufacturing and inspection operations chronologically scheduled per the Manufacturing WSIP
- d) All manufacturing procedures
- e) Bills of materials
- f) Certificates of Compliance (CoC)
- g) Non-Conformance reports
- h) All certificates required by materials specifications
- i) All certificates required by filler materials specifications
- j) Personnel certificates
- k) Equipment and measuring equipment certificates.
- l) Software certificates
- m) Welders qualification records
- n) Welders and Inspectors certificates
- o) Welding reports
- p) Welding procedure qualification records
- q) Heat treatment certificates
- r) Repair reports

- s) Seismic Qualification Documentation Package (SQDP). The Supplier shall submit a formal qualification report with seismic design analysis or seismic test results, which will demonstrate the seismic (category II) qualification of the equipment.
- t) Electromagnetic and Radiofrequency Equipment Qualification/Justification Documentation Package (EMQDP)
- u) As-built parts lists
- v) All NDE records, including radiographs (originals)
- w) Packing Specifications
- x) Transportation Specifications
- y) Vendor drawings
- z) Manufacturing drawings

11.3.15 Site Installation Packages for mechanical, electrical/I&C scope of works in accordance with NEK ESP-2.619, including:

- 11.3.15.1 Schedule and Organization Plan
- 11.3.15.2 Lifting Plans
- 11.3.15.3 Welding travelers, WPS's, PQR's
- 11.3.15.4 Installation Procedures
- 11.3.15.5 Installation WSIP
- 11.3.15.6 Installation and demolition drawings
- 11.3.15.7 Foreign Material Exclusion Plan
- 11.3.15.8 Safety Plan
- 11.3.15.9 Supplier inputs for ALARA plan

11.3.16 The need for expeditious changes of the "Approved for implementation" DMP shall be handled by FDCR (Field Design Change Request) document prepared in accordance with NEK procedure ESP-2.609.

11.3.17 Site Acceptance Test (SAT) procedure

Supplier shall prepare SAT procedures to exercise the scope of functional and performance testing, including testing, which may not have been possible during FAT. Scope of these procedures shall envelope full scope of FAT already performed at equipment Suppliers facilities with the differences related to the full project configuration and all equipment manipulation needed to start the system in designed configuration. Tests performed within FAT may not be repeated during SAT.

11.3.18 Instruction (operation, safety, maintenance) manuals (see chapter 31)

11.3.19 Installation report

Installation report shall be prepared after installation completion to document installation process and final as built situation. It shall be prepared on a basis of Installation Package and shall comprise the following as a minimum:

- Distribution and revision list
- General description of the work and scope
- Organization chart

- Closed out WSIP with Inspection Reports
- Personnel with certificates
- List of tools and measurement equipment with certificates
- Bill of materials with all certificates for installed materials
- QC records (NDE, dimensional reports, as build data)
- FME reports
- Photos
- Mark-up of drawings
- Non-Conformance reports and FDCR's
- List of used documents/procedures
- Other documentation related to the installation (see chapter 11.3.15)

11.3.20 Essential drawings (NEK will define them) shall be furnished by Supplier to NEK as soon as possible, but not later than when the systems are ready for operability declaration.

11.3.21 As Built drawings include all existing affected and new drawings reflecting as built configuration. They shall be provided in *.pdf and *.dwg format.

11.3.22 Turn Over Package (TOP)

Maximum 3 months after the installation completion, the Supplier shall prepare TOP according to NEK procedure ESP-2.611, Document Turnover and Closeout.

11.3.23 Status/progress reports

11.3.24 Documentation Index

11.3.25 Daily reports during the installation phase

11.3.26 IMS regular preventive maintenance instructions harmonized with NEK procedures

11.3.27 IMS operation instructions harmonized with NEK procedures

11.3.28 Recommended spare parts list

All documentation listed above shall be provided in a preliminary version, previously reviewed and approved by Supplier, to NEK for review and approval.

11.4 Software tools

Supplier shall, in its project management manual, in detail describe which software tools will be used for the design and for reproduction of the drawings and how it will maintain NEK equipment numbering system including cable and wire numbering, use of NEK drawings symbols, drawings format (headers) and series (206, 207, 208, 302, 816, 911, 912, etc.). If the Supplier is using its own software tools, its outputs (calculations, drawings ...) shall be compatible with NEK software and in accordance with NEK requirements for drawings.

All software used shall comply with the requirements of ASME NQA-1 2008, Ad.2009/2011, Requirement 3.

11.4.1 Mechanical design area

Standard tools used by NEK for modification processes:

- a) Classical drafting: AutoCad Map 3D + Raster Design

b) Modeling of mech. elements: Inventor Professional

11.4.2 Software for Electrical and I&C design area

NEK uses PC-CKS software database for conduits, cables and cable trays design. Supplier's chosen software for raceways and cable systems shall enable easy transfer from the new database into the existing PC-CKS database.

12 PERFORMANCE REQUIREMENTS

The IMS services will be implemented during NPP Krsko plant mode 6 (refueling). The temperature of the water during service will be approximately 60 degrees Celsius.

One of the main requirements for the IMS system service is that it will not increase the total time of the FA in the mast tube during the unloading from Rx cavity. The IMS must have an automatic and manual mode of operation. In auto mode licensed operator should have only limited control over the sipping process. In mast sipping inspection shall be completed during fuel lifting from the Reactor vessel and fuel transportation to the transfer canal. Potential leaking FA shall be immediately identified. Purging sequence duration time shall also be stated with the intention of determining the delay time for fuel handling.

13 MATERIAL REQUIREMENTS

Material requirements are specified in 677055A. In the case of the ASTM material substitution with material according to the EN, NEK procedure ESP-2.615 "Material equivalency/Substitution" shall be implemented.

Stainless steel material type 304 or 316 (including bolting) shall be used wherever physically possible - mandatory for structural steel, enclosures, and steel in contact with refueling water.

All materials used on this system shall be identified with its applicable code or industry standard and shall be in compliance with requirements of documents described in Section 7.

14 FABRICATION AND ASSEMBLY

14.1 General

- 14.1.1 Fabrication shall start upon approved Manufacturing WSIP with all related documents (drawings, procedures, etc.). If fabrication will be started prior to DMP approved by NEK, risks associated with redesign shall be borne by Supplier. Fabrication documents shall be stamped with 'approved for fabrication'.
- 14.1.2 Components shall be fabricated and assembled in the shop to the greatest extent possible.
- 14.1.3 Shearing, flame cutting, and chipping shall be done carefully and accurately, finished surfaces shall be clean and smooth. Rough edges shall be removed.
- 14.1.4 Burrs and shavings produced by punching and reaming operations shall be removed before assembling.
- 14.1.5 Parts not completely assembled in the shop shall be secured by bolts, in so far as or wherever practical, to prevent damage during shipment and handling.
- 14.1.6 Holes shall not be made or enlarged by burning. Holes for bolts shall be punched or drilled.
- 14.1.7 Thermal cutting of steel is not allowed.

14.1.8 Tolerances shall be defined in accordance with an ANSI/ASME Y-14.5M.

14.2 Bolts

14.2.1 Stainless steel bolts shall be used as much as possible.

14.2.2 Stainless steel bolts shall be anti-seize protected.

14.2.3 All bolts intended to be used for regular outage installation/transportation shall be at least of ½" (12 mm) diameter.

14.2.4 Washers shall be installed under the driven bolt element.

14.2.5 A minimum of two bolts per connection shall be used.

14.2.6 One sided or other type of eccentric connections shall not be permitted, unless indicated on the Construction Drawings.

14.3 Welding

14.3.1 Welding, welding procedures, welders, and welding operator qualifications shall conform to AWS D1.1 (D1.6). Written welding procedures shall be submitted for approval. Welder's certification shall be submitted for approval.

14.3.2 All flux coated welds shall be chipped and wire brushed.

14.3.3 Electrodes shall be protected from moisture. Handling, storage, heating, reheating, and duration of exposure shall be in accordance with Section 5 of AWS D1.1 (D1.6) or the manufacturer's instruction whichever is more conservative.

14.3.4 Shielding gases shall be welding grade with dewpoints of -68° C for inert gases and -51 ° C for carbon dioxide and nitrogen.

14.3.5 Parts that are to be joined by welding shall be fitted, aligned and retained in position by use of bars, jacks, clamps or other mechanical means, or by welding sequence; the use of temporary attachments for fixing shall be avoided.

14.3.6 If it is necessary to use temporary attachments, they shall be of a compatible material as the base material to which they are attached, or base metal match-up may be achieved by buttering.

15 INSPECTIONS AND TESTS

15.1 Scope

15.1.1 Testing, inspections and related acceptance criteria shall conform to the applicable codes and standards as specified in chapter 7. If not listed therein, the Supplier shall use codes and standards proposed with the Bid and accepted by NEK.

15.1.2 Inspection of all structural steel welding shall be performed in accordance with the provisions of AWS D1.1/D1.6, Section 6.

15.1.3 The structural steel welding inspections shall include visual examination of preparations, welding processes, and post welding operations.

15.1.4 Weld repairs necessitated by visual or nondestructive test examinations shall be made in accordance with the procedure used to perform the original weld or a qualified repair procedure, and shall be reinspected by the same method, which disclosed the repaired defect.

16 QUALIFICATION, PARTS CLASSIFICATION & DOCUMENT TRACEABILITY

16.1 Seismic and Dynamic Equipment Qualification

The new electrical, I&C and mechanical equipment shall not dislodge from the manipulator crane and fall into the reactor cavity. Qualification requirements shall also be applied to the existing equipment and interconnections affected. Existing equipment and interconnections that are Safety-Related or Class 1E components are already qualified to meet SP-S702 Technical Specification "Seismic Analysis, Testing and Documentation", Rev.10, respecting Regulatory Guide 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants." Note that no Safety-Related or Class 1E components will be required as part of this upgrade and therefore would not require additional qualification beyond the structural analysis to determine that Seismic Category II is met. It is assumed that existing equipment and interconnections that are Safety-Related or Class 1E components are already qualified and will not be affected by any new electrical, I&C, and mechanical equipment.

16.2 Electromagnetic and Radiofrequency Equipment Qualification

Supplier shall perform equipment function and location assessment, and based on it, define equipment EMC/RFI requirements (applicability or classification) related to RG-1.180 and ESP-2.631, EMC Program in Design Modification Process. New electrical and I&C equipment shall be tested in accordance with EPRI TR-102323, with test results or EMC/RFI justification letter provided to NEK.

16.3 Cyber Security

In general, the Supplier's security policies should follow guidance provided in NEI 08-09 Rev. 6 and NEI 10-04 Rev. 2 and include the following:

- a) Software is developed in a secure environment where only properly authenticated and authorized personnel are allowed access to the target software and hardware.
- b) Media shall be ensured to be free from any malicious code before being connected to the target hardware. Routine virus scans are performed on applicable equipment/media.
- c) Third-party software integrated into the system products shall be assessed and mitigated for security vulnerabilities.
- d) Software not needed to support system operation, maintenance, troubleshooting or diagnostics shall be removed prior to the FAT.
- e) An assessment shall be performed prior to the FAT to ensure unauthorized software or hardware is not contained in the system.
- f) Passwords shall be used to access different user/maintenance areas with the application.
- g) No connection to the internet or any other network at any time (air-gap protection) is allowed.
- h) Unused communication ports are blocked.
- i) Cabinet, where OT equipment will be mounted, must be locked with key.
- j) Provide a patch / upgrade policy for IMS software, OS and detector firmware.
- k) Coordinate patch testing with NEK prior to deployment.

- l) Document an end-of-support policy to avoid running out-of-support OS/hardware without a plan.
- m) Require a cyber asset list for IMS that classifies: Process unit, pumps, detectors, electronic unit/PC, communication links, any IMS-specific PLC/HMI, as CDA or non-CDA with justification, and associated control sets documented in the cyber assessment.
- n) Explicitly state that IMS hardware and software share the same cyber zoning and boundary protections as the RCMC control system, and that IMS is included in the common cyber assessment/network architecture documentation produced for the overall RCMC upgrade.

The drive freezing software shall be installed on all PC's provided as part of the proposed modifications. For the included drive freezing software, the hard drive is frozen to prevent any viruses or malicious threats from taking control of the operating system, registry, software, Master Boot Record (MBR), and files that are located on the hard drive. If a malicious threat successfully penetrates any barriers, the freezing software reverts to the last frozen secure state, negating the effect of the threat(s). This reversion occurs when the computer is powered down and rebooted or upon request by the operator. The system shall provide immediate immunity from many of the problems that plague similar computers. These include configuration drift, accidental system miss-configuration, malicious activity, and system degradation.

Supplier shall provide NEK with licenses for all software and licenses for the software upgrade. Additionally, all passwords will be provided as applicable, so that NEK can maintain required administrative and management rights for the software. NEK shall be able to load software to PLC in case of its failure without Supplier's physical presence and support. In the same manner, NEK shall be able to load Human Machine Interface to HMI display computer in case of its failure. NEK does not request rights to perform software or HMI modifications.

The criteria for classifying a digital system as a CS (critical system) in the nuclear power plants are based on 10CFR54.73, Protection of digital computer and communication systems and networks (SSEP) and NRC RG 5.71, Cyber Security Programs for Nuclear Facilities. Based on the definition of the ITS (Importance to Safety) function, NEK assesses that the MC is declared as ITS, based among others on USAR section 15.7.4 Design Basis Fuel Handling Accidents in the Containment and Spent Fuel Storage Buildings. If it is possible for a DA (Digital Asset) to rule out a possible impact on the design accident of the treatment (for the frequency of the event or in general), the DA can be treated as non-critical DA.

IMS DA can affect outage duration, which can directly increase costs (effect of lower power generation) and outage time (fuel unloading and refueling). For this reason, all security measurements must be included in the design of the entire system, and the cyber assessment must be performed in accordance with the ESP-2.921 procedure and the EPRI Cyber Security Technical Assessment Methodology: Vulnerability Identification and Mitigation.

The provider must identify which computer subsystems are added or modified within the modification. For each computer subsystem, it is necessary to determine whether it is critical to cyber security. NEK also evaluates the isolated computer subsystem in the same way. For each computer subsystem (regardless of whether it is critical or not), the provider must prepare a cyber security analysis using the NEK ESP-2.921 procedure. With the analysis according to the NEK ESP-2.921 procedure, the security controls that need to be implemented will be selected. A successful analysis (signed by NEK) is a prerequisite for completing the DMP package.

17 OTHER REQUIREMENTS

17.1 Suppliers Responsibility

Should the Supplier propose to purchase from other Suppliers any equipment, material, or service specified herein, the Supplier shall identify to the NEK the sub-Supplier and the specific components/scope they need to provide. If the proposed sub-Supplier will manufacture any of the items covered by the specification completely or perform sufficient fabrication of the items that require presence of the NEK's representative in the sub-Supplier's shop, the Supplier shall identify the sub-Supplier to the NEK.

The Supplier or its agent shall perform inspections and/or witness tests at the sub-Supplier facilities. The presence of NEK representative does not relieve the Supplier of his responsibilities to meet the requirements of this specification.

The Supplier shall be completely responsible for the design, manufacturing and installation of the new system components. The Supplier shall be fully responsible to ensure that his work, and the work of any sub-Supplier, is of high quality in every respect of workmanship throughout and fully complies with this specification. If any requirement of this specification is determined by the Supplier to be technically incorrect or technically unsuitable, or that conformance would diminish the Suppliers responsibility or the product performance after installation; then the Supplier shall transmit such objections with the Bid or as soon as possible later in the project.

In all respects, equipment supplied in response to this specification shall incorporate normally accepted industry practice of engineering, design, and workmanship. It is not the intent of this specification to specify all details of design and construction. The equipment shall be constructed and equipped with accessories in accordance with this specification and with Supplier's standard practices, when such practices do not conflict with this specification.

17.2 Health and Safety

The Supplier shall manage and be responsible for the performance of the H&S services for all the work performed within the project.

The NEK shall be provided with unrestricted access to the Supplier's facilities and H&S records for the purpose of auditing the Supplier's health and safety program.

All persons employed by the Supplier, agents, sub-Suppliers, or other persons for which the Supplier has responsibility shall perform work under the direction of the Supplier's H&S program that is in compliance with OSHA or equivalent regulations. All people shall be instructed in and be familiar with H&S rules and regulations applicable to the work being performed.

The Supplier shall have responsibility for ensuring that safe work practices are followed.

The Supplier shall designate a qualified H&S representative. The representative shall attend all project safety meetings and participate fully in all activities outlined in Supplier's H&S program. The Supplier's H&S representative shall have stop-work authority for unsafe acts or conditions, shall be considered a key person, and shall be on site when work is performed. The Supplier's occupational H&S staff shall be adequate to respond to the administrative aspects of any emergency or medical situation resulting from the installation work. The Supplier shall maintain reports of all accidents and injuries. The Supplier, once mobilized, shall hold regularly scheduled meetings to instruct its personnel on safety practices and the requirements of the H&S program. The Supplier shall furnish safety equipment and enforce the use of this equipment by its personnel.

Within the Installation Package, the Supplier shall submit the H&S Program to the NEK for approval. Program shall contain a statement, which industrial H&S standards were used in

preparation of installation activities. Approval of Supplier's Program by the NEK does not relieve the Supplier of any Supplier's H&S responsibilities.

17.3 Foreign Material Exclusion

IMS upgrade activities on the refueling machine is highly critical from FME perspective, therefore strict adherence to the respective NEK procedure ADP-1.101 (FME program) and standard industry practices is required. FME policy applies already at the design stage, where design solutions shall be adopted to prevent or minimize possibilities for FME events during installation, operation and maintenance. Supplier shall consult with NEK on the applicable FME level based on installation operations. During the installation phase at NEK site, Supplier shall delegate individual responsible for FME.

17.4 Radiological Protection

- 17.4.1 Instructions provided in ESP-2.616 shall be followed to provide design and features that will result in radiation dose savings in accordance with ALARA policy.
- 17.4.2 Supplier undertakes to plan and perform the Construction and implement radiation protection measures in the manner and to the extent required by the ALARA (As Low As Reasonably Achievable) principle.
- 17.4.3 ALARA Plan for installation shall be prepared by the Supplier and reviewed and accepted by the NEK.
- 17.4.4 Radiation protection includes provision of qualified personnel (being trained and having a certificate for work within radiation controlled area), tools, equipment, instruments, expendables, and services as required supporting the RCMC upgrade project in accordance with the ALARA Plan.
- 17.4.5 The Supplier shall be responsible to provide personnel, including sub-Suppliers, and comply with all radiological protection requirements, including:
 - a) Providing to NEK active Radiological Work Permit Certificate;
 - b) Providing to NEK active Medical Record;
 - c) Providing to NEK Dose History Record;
 - d) Following Radiation Protection's posted, written, and verbal radiological instructions;
 - e) Actively participating in the station ALARA Program;
 - f) Implementing the ALARA Plan;
 - g) Observing Radiation Protection Job Guidelines.
- 17.4.6 The Supplier shall designate a qualified Radiation Protection representative, who will actively assist designers in preparation phase and installers in installation phase of the project. The representative shall be present on site and support the work during installation phase.

17.5 Radwaste Handling & Minimization Plan

- 17.5.1 The Supplier shall be responsible for establishing methods to reduce the amount of radwaste generated in association with the Supplier's scope of work.
- 17.5.2 Storage plan with volume optimization for existing IMS parts shall be provided within the DMP.

- 17.5.3 Waste items (including disposed IMS parts) expected to arise shall be specified and volume projection by items estimated during design phase. Segregation of waste items is required prior to packaging into waste containers and handing over to NEK. Techniques to reduce waste shall be specified as well as NEK's support needed. NEK will provide 55 gal drums, licensed for storage in Solid Radwaste Storage Facility. Expected number of drums needed shall be specified by Supplier. Hazardous materials and PVC are not accepted in Radwaste.
- 17.5.4 The draft Waste Handling and Minimization Plan will be prepared by the Supplier and submitted a minimum of 12 months in advance of the scheduled start of the IMS upgrade for review and comment, and shall be based on radiological surveys performed in outage 27.

17.6 Loads handling at the site

Hoisting, rigging and transporting of items at Supplier's facilities and at NEK site shall be in accordance with ANSI NQA-1-2008, Ad.2009/2011, Part II, Subpart 2.15. For all load lifting operations at NEK site, NEK procedure ADP-1.1.141 shall be respected. This procedure requires special load lifting plans to be prepared in advance of lifting (within the Installation Package).

18 CLEANING

Cleaning requirements are specified in 677055A.

19 CORROSION PROTECTION / COATING

Corrosion protection / coating requirements are specified in 677055A.

Selection of materials and coatings shall ensure lifetime corrosion protection of all components.

Coatings that are damaged in handling shall be repaired. Coated members shall not be loaded for shipment or shipped until dry. Coated members shall be handled, stacked, and transported in a manner that does not damage the coating.

If during installation, coating on the reused parts of the refueling machine is damaged, it shall be restored by local sanding and touch-up coating.

20 MARKING AND IDENTIFICATION

The Supplier shall establish and maintain a system for the identification and traceability of materials, parts, components and partially fabricated assemblies through drawings. These measures shall ensure that identification of the item is maintained by heat number, lot number, part number, serial number, or other appropriate means, either on the item or on records traceable to the item throughout installation, shipment, and use of the item.

21 PACKAGING, HANDLING & STORAGE

For packaging, handling and storage, requirements of NQA-1-2008, Ad.2009/2011, Part II, Subpart 2.2 shall be respected. For electronic equipment, Level B requirements are mandatory, for other equipment, Level C requirements are mandatory. Protective measures level shall be clearly labeled on each package.

The Supplier shall provide, for NEK's review and approval, procedures for packaging, shipping, site receiving, site storage, handling, and cleaning as well as procedure for periodic handling to

and from containment and storage outside containment. The packaging procedure shall take into account methods of transportation to be used, as well as the possible storage duration and storage environment.

Supplier is responsible for equipment up to customs area in the vicinity of NEK. Truck unloading will be done by NEK based on Supplier's instructions and supervision.

Transportation from customs into reactor building will be done by NEK. Introduction of equipment through equipment hatch by mobile crane shall be supervised by Supplier's representative. Equipment shall be packed to allow transportation with truck, forklift of capacity 8000 kg and mobile crane. Any other special transportation and lifting devices shall be provided by Supplier.

Wrapping shall be done with non-transparent material suitable for decontamination. Wood is not allowed in containment.

Handling shall be done in a manner to minimize damage to the primer or materials. If necessary, critical equipment shall be shipped with accelerometers. Pieces showing the effect of rough handling or damage shall be rejected.

The Supplier shall verify the site storage and/or specify additional requirements necessary to maintain equipment warranties. Available storage locations are ANSI Level C and ANSI Level B with limited storage capacity.

22 SOURCE INSPECTION/SURVEILLANCE NOTIFICATION

Supplier shall perform source inspections of material/products and services provided by its sub-Suppliers based on requirements in this Specification.

The Supplier shall officially notify of inspection "hold" and "witness" points according to the manufacturing and inspection plan. Notification time shall be at least 10 calendar days ahead of anticipated occurrence, except if resident NEK representative is present at inspection location. In such cases minimum notification time shall be agreed between parties.

23 NONCONFORMING MATERIALS

Control of non-conforming items shall be based on ANSI NQA-1-2008, Ad.2009/2011, requirement 15. Any deviations or design changes that are not fully in accordance with the technical or quality assurance requirements of the procurement documents and which the Supplier desires to accept must be accepted by the NEK. Any such deviation request must be made in writing by means of a Non-Conformance report submitted to the NEK for acceptance prior to continuing work. For better understanding, a sketch shall be made or a picture taken in order to show non-conformance. Further engineering and/or manufacturing after the detection of non-conformances, prior to NEK's approval, shall be at Supplier's risk.

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

Supplier shall:

- a) Make the Non-Conformance report available to the NEK for review to assure the non-conformance is completely identified and accurately stated, and
- b) Properly dispose and transmit the report to NEK by the most expeditious means. The Supplier shall provide technical justification if recommended disposition is "Accept-As-Is" or "Repair".

- c) Manage corrective actions in accordance with requirement 16 of ANSI NQA-1-2008, Ad.2009/2011.

24 SPECIAL HANDLING

See chapter 21.

25 SHELF LIFE

Supplier shall provide shelf life data by expiration date and storage conditions for each spare part and consumable supplied.

26 10CFR21 REPORTING

10CFR21 reporting is not applicable to this modification.

27 COMMERCIAL GRADE ITEM DEDICATION

Commercial grade dedication is not applicable to this modification.

28 SUPPLIER DOCUMENTATION REQUIREMENTS

See chapter 11.

29 REPAIR RECORDS

Major defect repair records that require Non-Conformance reports shall be delivered to the NEK.

30 SHIPPING REQUIREMENTS

The NEK's representative has the right to hold shipment if the specification requirements are not met. Supplier is responsible for getting all permissions for transportation of the equipment.

Prior to the shipment, the Supplier shall contact NEK to confirm shipping arrangements. All pieces of equipment, boxes, cartons, etc., shall have a waterproof identification label attached with the following information:

Nuklearna Elektrarna Krško

Vrbina 12, 8270 Krško

SLOVENIA

In Mast Shipping System

Attn: Robert Planinc, ING.MOD

CONTENTS: Packing list identifying each item or assembly shipped.

31 VENDOR TECHNICAL MANUAL AND REGISTERED UPDATES

The Supplier shall furnish one (1) hard-copy and an electronic copy of the final technical manual with all necessary information for operation, safety and maintenance, updated specific data and drawings for all equipment. Supplier is responsible for sending applicable manual updates to NEK until warranty period expiration.

Manual shall include operation instructions, routine maintenance procedures, spare parts list, complete drawing list and a trouble shooting procedure to aid in rapid location of trouble. Standard instructions and data sheets shall be obtained from Suppliers of purchased components, and included in manual. A draft of the manual shall be submitted for approval at least three months prior to shipment. Detailed erection instructions for use of Suppliers field engineers shall be included in manual or provided as separate documents.

Content of manual shall be per ESP-2.617 Appendix 6.10, Vendor Manual Guideline.

32 TRAINING PROGRAM

The Supplier must prepare training for the operation and maintenance of the newly installed equipment and systems. The extent and manner of training should be timely coordinated with NEK. Basic training shall be performed in Supplier's facilities. Complete functionality of IMS shall be physically trained at Supplier's facilities. All necessary mockups and training simulators shall be included in the scope of supply.

Approximate training duration should be 2 full working days for IMS operators and 2 full working days for maintenance. Training should be performed in parallel with FAT.

33 REVIEW & VERIFICATION OF WORK

Supplier is required to perform a detailed verification of all phases of work, starting from initial walkdown, design and ending with TOP preparation. All documentation shall be reviewed and approved by Supplier before sending to review to NEK. In order to NEK to contribute to quality of documentation, Supplier's proprietary documents that are classified as non-releasable may be made available for consultation by NEK and Slovenian regulatory authorities on a case-by-case basis.

34 SCHEDULE REQUIREMENTS

34.1 Project Schedule

To comply with the objective of IMS upgrade in outage October 2028, activities shall be completed as required in the following table.

Table 1: Schedule requirements

| Item | Description | Delivery schedule |
|------|--|-------------------|
| 1 | PMM and PQP | June, 2026 |
| 2 | Design inputs | September, 2026 |
| 3 | DMP with 10CFR50.59 package | May, 2027 |
| 4 | Procurement specifications for major equipment | May, 2027 |

| | | |
|-----------|--|----------------|
| 5 | Manufacturing WSIP ready for fabrication | May, 2027 |
| 6 | Outage 2027 walkdown | April, 2027 |
| 7 | Site installation package | April, 2028 |
| 8 | Factory acceptance test | July, 2028 |
| 9 | Instruction manuals | August, 2028 |
| 10 | IMS (with all parts) delivered to NEK | August, 2028 |
| 11 | Installation of new IMS, SAT | October, 2028 |
| 12 | Installation report | November, 2028 |
| 13 | Turn over package | January, 2029 |
| 14 | 1 st IMS campaign after upgrade | April, 2030 |

34.2 Installation Schedule

IMS upgrade activities will be performed within H9 phase of outage (from end of fuel unloading from reactor vessel to start of fuel loading to reactor vessel), which ordinarily lasts around 10 days. Within this time frame, activities on upgrade shall be completed, including site acceptance testing/commissioning. Even though no other major activities are planned for outage 28 to be performed on refueling deck (taking into account parallel Refueling machine upgrade), note that not a complete time window is available for the RCMC/IMS project from the point of working/laydown area occupation and polar crane use.

35 STATUS REPORTING REQUIREMENTS

Following tools shall be used by Supplier for status reporting:

- a) Progress monthly (Teams) meetings with participation of Suppliers and NEK project managers, QA representatives, main design and production engineers and main sub-Suppliers representatives as applicable based on meeting agenda,
- b) Regular project Steering Committee meetings (three months period),
- c) On-line Action Items List, which is managed by Supplier and identifies all activities with ID, description, due date, responsible person and status from all parties involved,
- d) Monthly reports that integrate monthly meetings, Action Items List and status of project activities,
- e) Monthly updated Documentation Index that lists all project documents (including all sub tier Suppliers documents) with status (in preparation, in review, approved,...),
- f) Outage installation daily meetings (shift progress meetings will be held in parallel with mandatory pre job briefings),
- g) Site daily reports delivered to NEK by 7AM each morning containing:
 - i. 24 hours activities progress report,
 - ii. Required support from NEK,
 - iii. Deviations (technical, safety, ...),
 - iv. Schedule updates.

36 WORK OR INFORMATION TO BE PROVIDED BY NEK

In addition to the documentation provided with this technical specification, NEK will provide to Supplier upon request all NEK specific documents/information needed to perform the scope of work. The usage of this information by the Supplier will be restricted according to specific instructions provided by NEK.

In addition, NEK will:

- a) Revise the specification following the completion of the technical part of the Bid process, if necessary.
- b) Designate a Project Manager, QA responsible engineer and other project team members who will serve as interface with the Supplier.
- c) Perform revision of all affected NEK procedures based on markups provided by Supplier.
- d) Provide licensing interface with SNSA.
- e) Provide all interface information with any other plant activities related to this project.
- f) Provide general outage schedules and integrate agreed Suppliers interface activities into an overall outage schedule.
- g) Provide access to all the areas where new systems, major equipment and accessories will be located.
- h) Provide an on-site training to all Supplier's and his sub-Supplier's employees as needed to meet requirements for an unescorted access to perform the on-site activities.
- i) Provide access to NEK workshops.
- j) Provide office for installation crew with internet connection.
- k) Provide all in processing services for installation, operation and maintenance personnel.

Whenever NEK approval is required in this specification for submittals, procedures, methodologies, approaches or options, such approval shall be provided in writing or, if provided orally, shall be confirmed in writing.

37 CHANGES OF WORK SCOPE

The Supplier shall notify the NEK in each case when the change of work or plan will affect the quality of work, schedule or cost of contracted activities. Any such deviation must be made in writing by means of a form submitted to the NEK for approval prior to continuing work.

38 RECORDS

A records system shall be established and maintained by the Supplier to provide documentary evidence of the quality of items and activities affecting quality. Records management shall be in accordance with NQA-1-2008, Ad.2009/2011, Part I, Requirement 17 and Subpart 3.1-17.1 and 3.1-17.2. The Supplier shall turn over all records applicable to this project to NEK.

All records shall have a unique identification number with a revision number and need to be sorted into groups and subgroups.

If a record is not legible, one of the following methods shall be used:

- a) The illegible area of the record shall be enhanced by tracing or writing the information clearly on the record or by submitting additional information for clarification of the illegible area. The Supplier person authorized to perform this function shall initial and date the area enhanced or clarified.
- b) If the record cannot be enhanced, the records shall be marked "Best Copy Available", and the marked record shall be initialed and dated by the responsible organization's supervisor or designee.

39 ORGANIZATIONAL CONTACT

Supplier shall co-ordinate all technical matters with:

Name: Robert Planinc
Phone: 00 386 74 802 148
E-mail: robert.planinc@nek.si

Supplier shall co-ordinate all commercial matters with:

Name: Vesna Deak
Phone: 00 386 74 802 436
E-mail: vesna.deak@nek.si

40 SUPPLIER'S TECHNICAL APPROACH TO THE WORK

Preliminary Project Management Manual and Project Quality Plan (PQP) provided within the Bid outline how and where the work will be performed and indicate how the Supplier understands their scope of work. The Supplier shall particularly describe how IMS project will be coordinated with RCMC project in terms of installation activities. The Bid should also indicate similar project applications that have been performed by the Supplier.

The Supplier shall be responsible for:

- a) All labor required to physically perform the work. This labor force shall be certified to possess skills to perform the work on the Project.
- b) Supplier's field personnel shall be capable, qualified, and able to perform the duties required for the satisfactory resolution of field problems.

To fulfill the requirements of this specification, Supplier shall delegate to this project a team of engineers and experts experienced in IMS upgrades, IMS operation and IMS maintenance. Supplier shall get familiar with existing configuration and operator practices in NEK to adopt optimum solutions to a specific need.

The Supplier shall be responsible for the selection and supervision of all personnel within the project organization under the Supplier's control.

As a part of the Bid, Bidder shall identify and describe the organization under which the work will be performed, identify the resources (number and types of personnel with their background and experience on similar projects) available to carry out the work associated with the scope of supply.

The Supplier shall provide technical staff with specifically defined duties, responsibilities, and authorities to support timely resolution of all design and other deficiencies. These personnel shall be defined as key personnel. The key personnel shall be assigned full-time to the work, and their

names and titles shall be clearly depicted in organization charts. The Supplier will not change personnel assigned to key positions without the prior approval of the NEK.

The Supplier shall designate Project Manager to act on behalf of the Supplier for all matters related to the Contract, including:

- a) Receiving and transmitting all communications from and to NEK;
- b) Providing all approvals, consents, authorizations, and proposals;
- c) Acting for and committing for Supplier.

41 ACCESS TO SUPPLIER FACILITY AND DOCUMENTS

The Supplier will provide access to the Supplier's and authorized sub-Supplier's facilities to the NEK personnel (including NEK Representatives) who are engaged in the work for the purpose of reviewing the quality and the progress of the work being performed.

42 SUBCONTRACTED WORK

Based on law of ZVISJV and based on "Pravilnik o dejavnikih sevalne in jedrske varnosti" (JV 5) Article 60, (nadzor podizvajalcev in dobaviteljev), NEK is responsible for establishing surveillance on Supplier and its sub-Suppliers to ensure high quality of services and nuclear safety for the public.

Supplier personnel working under Supplier's direct responsibility are not considered as sub-Suppliers in this context.

All sub-Suppliers shall be listed in the Bid. If, after Contract signature, Supplier wants to change or select a new sub-Supplier, this is subject to NEK approval.

The Supplier shall impose on its sub-Suppliers the requirements of this Specification. The Supplier shall ensure that all sub-Suppliers meet the requirements of this Specification.

Since the Supplier retains full responsibility for all aspects of sub-Suppliers' performance (including quality and schedule), the Supplier shall ensure that adequate and periodic audit and surveillance of the sub-Supplier is maintained. NEK's right of access to the Supplier's sub-Suppliers' facilities for the purpose of inspection or audit shall be imposed by the Supplier's documents.

All sub-Suppliers need to be qualified by the Supplier and have to be included on its Approved Supplier List (ASL). They shall also have experience/references on same or similar work performed on nuclear power plant(s).

The Supplier or its sub-Supplier shall not subcontract any portion of the Work without the written approval of the NEK.

43 QUALITY ASSURANCE REQUIREMENTS

43.1 General

43.1.1 The Supplier shall have an established quality assurance (QA) Program that complies with the requirements of ISO-9001 and the requirements of the enclosed specification QS-610, Rev. 2, Generic Quality Assurance Program Requirements.

- 43.1.2 All work shall be carried out in compliance with the Supplier's QA Manual and with the approved PQP. In accordance with this specification, the Supplier has the responsibility to require any sub-Suppliers to comply with the quality requirements, technical, commercial requirements, and schedules in accordance with this specification.
- 43.1.3 The Supplier has the responsibility for QA activities for all work pursuant to this Specification. All technical and quality requirements shall be met.
- 43.1.4 The supplier's software development lifecycle shall be described in its Software Quality Assurance Program, which shall be harmonized with NEK QA Specification QS 610 requirements, QS 600 Generic Software Quality Assurance Program Requirements. Supplier's procedures for software development lifecycle activities shall be submitted to NEK for review and acceptance before implementation.

43.2 Quality Manual

- 43.2.1 One (1) controlled copy of the Supplier's QA Manual of the latest revision shall be submitted to NEK with the Bid, if not previously submitted to NEK.
- 43.2.2 The Supplier's Quality Manual and referenced company standards shall apply to all practices employed on the work performed pending review and concurrence by the NEK.
- 43.2.3 The relevance and effectiveness of the Supplier's QA Manual shall be provided with the Bid and reviewed and accepted by NEK prior to the Contract award. The same shall apply to any subsequent changes to the manual proposed by the Supplier during the project progress.

43.3 Supplier's Responsibilities for Sub-Suppliers

The Supplier has following responsibilities regarding its sub-Suppliers:

- a) The Specification requirements for documents submittals shall apply to sub-Suppliers for services not performed by the Supplier. The Supplier shall first review sub-Supplier's documents to ensure compliance with the Specification requirements, submit these documents, and obtain the NEK's approval in writing prior to performance of sub-Supplier's work. The Supplier's documents may be used at the sub-Supplier's facilities if necessary.
- b) The Supplier shall ensure that the sub-Supplier is aware of all activities that the sub-Supplier will be required to perform and shall identify activities that require the presence of the NEK Representative. The Supplier shall ensure that NEK Representative has the right of access to sub-Supplier's facilities and documents needed to perform audits, inspections or witness tests.
- c) The Supplier shall retain full responsibility of the sub-Supplier work, supervise quality, and document such facts in the End of Manufacturing Report and Final Installation Report.

43.4 Quality Control and Inspection Plans

The Supplier shall provide manufacturing, testing, transportation, installation WSIP's for review prior to the start of each phase of the Project. Those plans shall cover all relevant steps and sequence in work, inspection requirements and specific preplanned Supplier inspections that are required to be performed. Based on the above information, NEK will determine record (R), witness (W) and hold (H) points which will be mutually agreed with the Supplier. The Supplier shall update the plans and submit copies thereof to the NEK after changes have been approved by NEK.

For each step in the WSIP, the following shall be specified:

- a) Subject component (i.e. material/part/assembly/complete set);
- b) Type of test, activity and method (e.g. assembling, welding, cutting, forming, cleaning, coating, destructive/non-destructive inspection, visual, liquid dye-penetrant, magnetic particle, X-ray, ultrasonic, probes, analysis for chemical composition, etc.);
- c) Standards and supporting documentation according to which material, equipment, part shall be purchased, or standards/procedures according to which operation, test, measurement, inspection,... shall be performed;
- d) Reference procedures with acceptance criteria according to the applicable standard.

If there is a Witness or Hold point, and the acceptance criteria or testing procedure is established according to the manufacturer's standard, such a standard and reference testing procedure must be made available to NEK for inspection at least ten (10) days before test execution. The standard shall be included in the list of all applicable standards with the Bid as specified in chapter 11.2 of this Specification.

43.5 Inspections

NEK inspection and audit visits related to this project are not expected to be limited to a specific number. Also, NEK is not expected to cover additional costs due to inspection and audit performance.

43.6 Notification Points

NEK shall have the right to establish notification points (through WSIP's) for which the Supplier shall give prior notification to NEK. NEK may require that activities performed without proper notification be repeated for NEK Representative observation at the Supplier's expense.

NEK Representative will witness the event or will authorize the Supplier to proceed without NEK's witnessing of the event.

43.7 STOP/Hold Points

Hold points are those tests, inspections, or operations that require witnessing by the NEK Representative and beyond which operations shall not proceed without written consent of the NEK.

The Supplier's failure to stop at a hold point will be a cause for rejection of those activities for which notification was not provided or which were not held.

When Supplier or NEK Representative has any concern about some non-confirming condition found by the test and inspection specified herein, the Representative shall have the right to call for an appropriate supplementary test. Acceptance criteria for any supplementary testing will be defined and agreed prior to performing tests and inspections. Non-acceptable results will be dispositioned and corrected, and the subject test repeated in accordance with Supplier quality program requirements.

44 NEK PROPRIETARY DATA

Some references may be restricted for use due to a supplier's proprietary policy. Such documents, necessary for project execution, will be disclosed to a third party upon special non-disclosure agreement or disclosed for review only at NEK premises. For further instructions, please note General Terms and Conditions proprietary-related paragraph.

45 APPENDICES

1. 1209E82, Sh. 1 - Reactor Plant Arrangement Containment Plan
2. 1209E82, Sh. 2 - Reactor Plant Arrangement - Elevation
3. 1459F99, Sh. 1, Rev. 3, Krsko Nuclear Plant - Refueling Machine
4. L-22830, Sh. 1 Rev. 3, General Arrangement Refueling Machine
5. L22650, Sh. 101, Rev. 2, Upper Structure Assembly, Refueling Machine
6. 22830-6, Sh. /, Rev. E, R.H. Trolley Ass'y Refueling Machine
7. MECL-RB-04: MECL Plant Layout Drawing - Reactor Building,
8. 205796; Sh. 1, 2, 3: Manipulator Crane - Schematic Drawing,
9. 22170-170: In Mast Sipping System - Assembly Drawing,
10. 22830-101; Sh. 1, 2, 3: Electrical Schematic Drawings,
11. 22830-103; Sh. 1, 3: Wiring and Connection Diagram,
12. SP-S702, Rev. 11, Seismic Analysis, Testing, and Documentation (Short Version)
13. QS 610, Rev. 2, Quality Specification QS 610 - Generic Quality Assurance Program Requirements