



Technical Specification

Reactor Cavity Manipulator Crane Upgrade

KRŠKO NUCLEAR POWER PLANT

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1 BACKGROUND AND SYSTEM DESCRIPTION

1.1 Background

Nuklearna elektrarna Krško (Nuclear Power Plant Krško) is Westinghouse designed two loops pressurized water reactor plant, built in late 1970's and is in commercial operation since 1983. Beginning with 2024, NPP Krško started extended plant lifetime operation.

Over the 40 years of use, even with regular preventive maintenance, reactor cavity manipulator crane has become aged. There have been many events in the past (drive unit failures, control cameras defects, many spare parts no longer available on market) that call for upgrade. Reactor cavity manipulator crane is essential equipment for successful execution of plant outages in terms of safety and economic.

1.2 Purpose

NPP Krško, hereafter referred to as "NEK" intends to upgrade reactor cavity manipulator crane (also named as nuclear fuel handling machine or refueling machine). Modification is planned for plant outage in October 2028.

This specification provides information on existing reactor cavity manipulator crane and together with attachment 677055A [1] defines scope and inputs for manipulator crane upgrade. Refueling Machine specification 677055A provides information about complete manipulator crane regardless of the scope of upgrade. Therefore, it should be read as partly applicable for the scope of upgrade defined in SP-ES1454.

1.3 General Notes

The Supplier shall be responsible for compliance with all the detailed requirements of this Specification and its referenced documents. There shall be no deviation from this specification, nor any deviation of RM functionality as described in 677055A (in terms of operation and safety features) 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 RCMC shall be considered and optimum design shall be proposed and provided.

The Supplier shall ensure that the installation and start-up is 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 Refueling Machine

The manipulator crane is a rectilinear bridge and trolley crane with a vertical mast extending down into the refueling water. The bridge spans the refueling cavity and runs on rails set into the edge of the refueling cavity. The bridge and trolley motions are used to position the vertical mast over a fuel assembly in the core. A long mast with a pneumatic gripper on the end is lowered down out of the

mast to grip the fuel assembly. The gripper assembly is long enough so that the upper end is still contained in the mast when the gripper end contacts the fuel. A winch mounted on the trolley raises the gripper assembly and fuel assembly up into the mast tube. The fuel is transported while inside the mast tube to its new position.

Existing manipulator crane uses a frequency inverter speed control. This is an AC control device that give stepless variable speeds from zero to full speed. All controls for the manipulator crane are mounted on a console on the trolley. The bridge is positioned on a coordinate system laid on one rail, and an electrical readout system on the console indicates the position of the bridge. The trolley is positioned on the bridge structure with the aid of a scale, which is read directly by the operator at the console. The drives for the bridge, trolley, and winch are variable speed and include a separate jog (low speed) control for each drive.

The auxiliary monorail hoist on the manipulator crane has variable frequency control of lift speed.

Electrical interlocks and limit switches on the bridge and trolley drives prevent damage to the fuel assemblies and protect people. Electrical interlocks prevent damage to fuel assemblies by stopping upward hoist travel when an overload occurs and by preventing downward hoist travel when an underload occurs. Lite or heavy load settings are selectable on the operating console. Lite load settings correspond to fuel assembly weight without an RCC and heavy load settings correspond to fuel assembly weight with an RCC. The winch is also provided with redundant limit switches to prevent a fuel assembly from being raised above a safe shielding depth should the limit switch fail. In an emergency, the bridge, trolley, and winch can be operated manually using a handwheel on the motor shaft. The manipulator crane meets the intent of October 1972 OSHA requirement.

2 ABBREVIATIONS AND DEFINITIONS

2.1 Abbreviations

ADP	Administrative Procedure
ANSI	American National Standards Institute
BOM	Bill of Material
CFR	Code of Federal Regulations
CoC	Certificate of Conformity
DCM	Document Control Module
DMP	Design Modification Package
DSFS	Detailed Software Functional Specification
ESD	Engineering Service Division
EMC	Electromagnetic Compatibility
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
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
PQP	Project Quality Plan
PLC	Programmable Logic Controller
RFI	Radio Frequency Interference
RCMC	Reactor Cavity Manipulator Crane
RG	Regulatory Guide
SNSA	Slovenian Nuclear Safety Administration
SAT	Site Acceptance Test
SSC	System, Structures and Components
SSE	Safe Shutdown Earthquake
TOP	Turn-Over Package
TS	NEK Technical Specification
URSJV	Uprava Republike Slovenije za jedrsko varnost (Slovenian Nuclear Safety Administration)
USAR	Currently valid NEK Updated Safety Analysis Report
USNRC	United States Nuclear Regulatory Commission
VFD	Variable Frequency Drive
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-ES1454, RCMC Upgrade document together with all attached (including 677055A) 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, who meet requirements of and replied to Request for Quotation with submittal of 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 refueling machine has been signed.

3 SCOPE OF SERVICES AND DELIVERY

3.1 Scope of Equipment Delivery

3.1.1 MC Control Console

- 3.1.1.1 Complete MC Control Console with electrical cabinet shall be replaced with the new scope of supply to accomplish all features, MC operation and safety functions as described 677055A.
- 3.1.1.2 Control console shall be designed to be removable and supplied with all handles, switches, pushbuttons, indicator lights, redundant position, load and video displays, and connector panel interface. The new control console shall be designed to meet the functional requirements of the existing operator control console and mount similarly to the existing orientation and locations, containing a similar control switch layout for ease of operation.
- 3.1.1.3 Siemens-based touchscreen computer and PLC-based control systems shall be provided within.
- 3.1.1.4 All necessary control components including transformers, motor drives, power supplies, EMC filters, circuit protection, wiring, cables, and climate control devices shall be provided.
- 3.1.1.5 The controls on the MC console shall be designed to fully satisfy the Updated Safety Analysis Report (USAR) with exception that new design allows simultaneous movement of trolley and bridge in automatic, semi-automatic and manual mode due to individual drive control of each traveling axis. In combination with secure zone / safe path this selectable functionality provides an acceptable level of safety. As a consequence, USAR shall be revised. In addition, if previously redundant circuits (as documented in the USAR) are handled in the PLC, the USAR may require additional changes.
- 3.1.1.6 Electrical sockets with circuit breakers shall be provided for single and three phase users.

3.1.2 Hoist Drive Assembly

- 3.1.2.1 One (1) main Hoist with integral motor and brakes, wire ropes, load weighting system, travel indicators (including dual position encoders and additional mechanical travel indicator like Z-Z tape), drums with sheaves, and limit switches for setting normal up limit, redundant up limit, and the full down lower limit. The drive assembly shall be provided with a handwheel, stowage proximity switch or equivalent, required miscellaneous hardware like EMC filters, circuit protection, wiring and cables interconnecting the motor and drive.
- 3.1.2.2 New dynamic brake resistors will be supplied to interface with the replacement motor drives. The new resistors will be mounted on the new enclosure assembly.

- 3.1.2.3 All drive components will be sized to meet the designed speed requirements and provided with components (motor controllers, handwheel, limit and control switches, drip pans, support structures, etc.) that meet or exceed the functionality of the existing design.

- 3.1.2.4 Mounting structures will be reused.

3.1.3 Bridge and Trolley Drive Assemblies

- 3.1.3.1 The Trolley Drive assembly shall be provided with a servo motor (preferably over the AC motor with VFD) and an electric brake coupled directly to a new gear reducer mounted to the existing pan. The trolley drive is coupled to the new drive shaft. Also provided shall be handwheel, stowage proximity switch or equivalent, and required mounting brackets for the trolley drive.

- 3.1.3.2 The Bridge Drive assembly shall be provided with a servo motor (preferably over the AC motor with VFD) and an electric brake coupled directly to a new gear reducer mounted on the existing pan. The bridge drive is coupled directly to the new drive shaft. Also provided shall be handwheel, stowage proximity switch, handwheel shaft cover, and required mounting brackets for the bridge drive.

- 3.1.3.3 All drive components will be sized to meet the designed speed requirements and provided with components (motor controllers, handwheels, limit switches and control switches, drip pans, bumpers, end travel system, support structures, etc.) that meet or exceed the functionality of the existing design.

- 3.1.3.4 Only wheels and rails will be reused.

3.1.4 Bridge and Trolley Positioning System

- 3.1.4.1 Bridge and Trolley shall be provided with laser positioning and a video camera system to monitor the pointer and index scale for operator information and operating zone control. The positioning system design consists of dual absolute position feedback control. The laser position assemblies are designed with connectors to be removed between outages.

- 3.1.4.2 End travel mechanical (or sensor) switches shall be provided for each axis.

- 3.1.4.3 Index plates to indicate the position shall be provided for each axis.

3.1.5 MC Simulator

- 3.1.5.1 Simulator will be used for operator training and to test the software and components of the manipulator crane console in a non-radioactive environment prior to an outage.

- 3.1.5.2 The simulator emulates the hardware on the RCMC that do not get removed from containment, such as motors, position assemblies, switches and other components. The simulator will be able to adjust the load between hoist loaded and unloaded, to enter a load, to override the current load, to choose a different load type, to simulate interlock faults, and other malfunctions. The control console HMI will allow the operator to use the operator screens, while connected to the simulator, including those used to inform the operator of any interlock condition.

3.1.6 Trolley Cable Track

- 3.1.6.1 A new cable track for the main trolley is provided that will contain all necessary interconnection cables to support the trolley and control console. The cable track is designed to permit replacement of individual sections or links without disconnection of the necessary air hose and cables for the machine.

3.1.7 Underdeck Video Camera System

- 3.1.7.1 Underdeck pan tilt zoom video camera system shall be installed beneath the trolley deck. A multiplexer/camera control shall be provided in the area of the MC control console to allow the operator to monitor and control the underdeck camera or switch to the index cameras. The selected camera view(s) shall be visible by operator on the trolley.

3.1.8 Pneumatic Air Supply System

- 3.1.8.1 The pneumatic air supply system shall be replaced by Festo or equivalent components. The scope of replacement consists of stainless-steel piping, valves, filters, actuators and controls. No quick connectors shall be used.

3.1.9 In-Mast Sipping System

- 3.1.9.1 Electrical socket with a circuit breaker shall be provided for the three-phase power supply serving In-Mast Sipping (IMS) system. Power to the IMS shall be available even with RCMC shut down.
- 3.1.9.2 A stainless-steel tube shall be provided from the existing hose reel on top of the mast to approximately 12 inches above the trolley floor for IMS interface.

3.1.10 Refurbishment Scope of Supply

- 3.1.10.1 Within the scope of refurbishment, a thorough inspection of the mast assembly (including internal components) shall be performed including replacement of mast guides and rollers.

3.1.11 Spare Parts

As a minimum following spare parts shall be delivered within the main scope of supply:

- 3.1.11.1 One (1) Bridge drive assembly (servo motor with drive or VFD with motor)
- 3.1.11.2 One (1) Hoist drive assembly (servo motor with drive or VFD with motor)
- 3.1.11.3 One (1) Trolley drive assembly (servo motor with drive or VFD with motor)
- 3.1.11.4 Two (2) Bridge/trolley laser sensors or two (2) Bridge/trolley motor encoder sensors
- 3.1.11.5 One (1) PLC, one (1) I/O card of each type used, one (1) power supply and one (1) HMI
- 3.1.11.6 Indicator lights (for each part number one spare)
- 3.1.11.7 Control Panel Switches (for each part number one spare)
- 3.1.11.8 Pneumatic filter
- 3.1.11.9 Limit switches (for each part number one spare)
- 3.1.11.10 Spare hoist drum encoder
- 3.1.11.11 Spare hoist load sensor and load meter
- 3.1.11.12 One position camera
- 3.1.11.13 One underdeck camera

Final spare parts list shall be proposed in the bid as applicable.

3.2 Reused Equipment

The following RCMC equipment shall be reused:

- a) Bridge structure with trolley rails;
- b) Bridge wheels and building rails;
- c) Monorail hoist with monorail trolley, wire rope, hook, power center, and control pendant;
- d) Trolley and mast structure including gripper, handrails, underwater camera and telescope camera mast and controls. The existing IMS system components installed on the mast, which includes the existing suction unit inside the mast, up to and including hose reel, will be reused.

Reused equipment shall be inspected by Supplier and confirmed to be ready for continuous operation and be compatible with new equipment. If needed (based on walkdown observations) reused equipment (other than 3.1.10) shall be refurbished as added scope.

3.3 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 ensure 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 2027 outage
 - a) Detailed walk-down shall be performed by Supplier. The main purpose of the walk-down is to finalize 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. The level of information provided on the drawings by Supplier and Sub-suppliers (Vendors) shall be equal to the level of existing NEK IMS drawings and shall enable NEK to operate, maintain and troubleshoot the equipment. Provided drawings shall support design, removal of the old equipment, and installation of new.
 - d) Detailed Software Functional Specifications in accordance with ESP-2.912 Documentation of New Applications for Process Computer Systems

- 5) Equipment analyses and testing results, including (but not limited to) 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
- 10) Complete installation work – demolition of existing and installation of new equipment, supervision of transportation of new and removed equipment in NEK and disassembly (including cutting) of disposed parts to reduce necessary storage space.
- 11) 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.
- 12) Site acceptance testing
- 13) Complete DCM and MECL update of new or modified equipment and documents.
- 14) Support of RCMC specialist during fuel reloading (fall 2028) and unloading (fall 2030).
- 15) Mast overall inspection and replacement of guides and rollers

All activities shall be documented as required by 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 listed in chapter 7 of this specification.

4 SAFETY CLASSIFICATION OF CONTRACTED WORK

RCMC is classified as Non-Safety Related. Activities related to upgrade of RCMC are classified as Augmented Quality due to elevated requirements with regards to design control, seismic strength, cyber security, cleanliness, and other requirements as specified in following sections.

5 DESIGN INPUTS

5.1 General Notes

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.

Preliminary design inputs are prepared by NEK and attached to this specification [9]. The development of the final 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 DMP development a design input document shall be reviewed and approved by Supplier and by NEK.

Design inputs shall be checked and verified by Supplier to comply with equipment specifications 677055A [1]. 677055A shall be revised by Supplier following design inputs finalization and/or certified as complying with the upgraded RCMC.

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

The design of the modified system (equipment) shall ensure maximum reliability and performance for operation and the shortest and most effective maintenance with the engagement minimum maintenance crew.

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

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

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

5.2 Design Life

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

Design life pertains only to new 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 Maintenance Manual.

5.3 Verification of existing equipment

The design of components of upgraded RCMC shall enable Supplier to requalify existing components and structures (remaining bridge and trolley components, mast, rails, rails foundations, floor slab, etc.) 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 of RCMC 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 of RCMC shall include generation of Design Inputs and revision of equipment specification 677055A. Both shall be subject of NEK review and approval.

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, NEK design, 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 the 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 proposed 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 dejavnih 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)
10. Pravilnik o splošnih ukrepih in normativih za varstvo pri delu z dvigali (žerjavi), Ur. l. SFRJ št. 30/69. (Regulations on general measures and standards for protection at work with cranes)

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 1.25, Revision 0, Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors

4. RG 1.29, Revision 1, Seismic Design Classification
5. RG 1.100, Revision 2, Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants
6. RG 1.180, Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems
7. RG 5.71, Cyber Security Programs for Nuclear Facilities
8. NUREG-0554, Single Failure-Proof Cranes for Nuclear Power Plants, 1979
9. NUREG-0700, Human-System Interface Design Review Guidelines, July 2020 *

* This standard may be used for guidance only. Proven operator interfaces may be used as the basis for the design, but should follow generally accepted practices.

7.3 Applicable EU and US Codes and Standards

1. ISO 45001:2018, Occupational health & safety management system
2. ISO 9001:2015 Requirements for a Quality Management System
3. ANSI/ASNT CP-189, ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel, 1995
4. ANSI 57.1:1992, Design Requirements for LWR Fuel Handling Systems
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. ASME B30.7:2016, Base Mounted Drum Hoists
9. ASME B30.10:2019, Hooks – Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings.
10. ASME B30.26:2015, Rigging Hardware
11. ASTM material specifications
12. CMAA 70-2020, Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes
13. AISC ASD – 13th Edition, American Institute of Steel Construction, Allowable Stress Design
14. PA1:2016, Shop, Field, and Maintenance Painting of Steel – (SSPC) Society for Protective Coatings
15. PA2:2018, Procedure for Determining Conformance to Dry Coating thickness requirements – (SSPC) Society for Protective Coatings
16. AWS D1.1:2020, Structural welding code – Steel
17. AWS D1.6:2017, Structural welding code – Stainless steel
18. AWS D14.1:2005, Specification for Welding of Industrial and Mill Cranes and Other Material Handling Equipment
19. AWS QCI: 2016, Standard for AWS Certification of Welding Inspectors
20. EPRI TR-102323 R5, Guidelines for Electromagnetic Interference Testing in Power Plants

21. EPRI, Cyber Security Technical Assessment Methodology: Vulnerability Identification and Mitigation, 3002008023, Final Report, October 2016
22. MIL 461E Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment (Used within the Guidelines of EPRI TR-102323, Rev. 1)
23. IEEE-308, Standard Criteria for Class 1E, Power Systems for Nuclear Power Generating Stations
24. IEEE-323, IEEE standard for qualifying class 1E equipment for nuclear power generating stations
25. IEEE-344, Recommended practice for seismic qualification of class 1E equipment for nuclear power generating stations
26. IEEE-352:1987, Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Systems and Other Nuclear Facilities
27. IEEE-383, 2015, Standard for Qualifying Electric Cables and Splices for Nuclear Facilities
28. IEEE-730:2002, Standard for Software Quality Assurance Plans
29. IEEE-828:2012, Standard for Software Configuration Management Plans
30. IEEE-830:1998, Recommended Practices for Software Requirements Specifications
31. IEEE-1012:2016, Software Verification and Validation
32. IEEE-1016:2009, Recommended Practice for Software Design Description
33. IEEE-1050:2004, Guide for Instrumentation and Control Equipment Grounding in Generation Plants
34. IEEE-1059:1993, Guide for Software Verification and Validation Plans
35. IEEE-1074:2006, Software Lifecycle Process
36. National Electric Code ANSI/NFPA 70 - 2020
37. NEI-08-09, Rev. 6, Cyber Security Plan for Nuclear Power Reactors
38. NEI 10-04, Rev. 2, Identifying Systems and Assets Subject to the Cyber Security Rule
39. OSHA 29CFR1910.29(b), Fall protection and falling object protection-criteria and practices
40. OSHA 29CFR1910.269, Electric Power Generation, Transmission, and Distribution

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

IEEE standards may be used as guidance only (as related to applicable software requirements, and non-safety-related, non-Class 1E equipment) provided supplier procedures are followed that are based on the concepts of these standards and governed by the supplier Quality Assurance Manual.

7.4 NEK Documents

1. QS-600, Generic Software Quality Assurance Program Requirements
2. QS 610, Generic Quality Assurance Program Requirements
3. SP-A501A, Painting of Equipment in Containment
4. SP-S702, Seismic Analysis, Testing, and Documentation

5. EDC-4, Cable Tray, Cable & Conduit Separation Criteria
6. EDC-5, Grounding System Criteria
7. EDC-10, Cable Rating Criteria
8. ADP-1.0.131, Organizacija izvedbe modifikacije (Development of modifications)
9. ADP-1.0.500, Program protipožarne zaščite – Požarni red (Fire protection program)
10. ADP-1.1.033, Varnost in zdravje pri delu v NEK (Health and safety at work at NEK)
11. ADP-1.1.051, Vstop, izstop in gibanje v tehnološkem delu NEK (Entry, exit and move within the technological part of the NPP)
12. ADP-1.2.116, Nadzor dokumentov v NEK
13. ADP -1.101, Preprečitev vnosa tujkov (FME program)
14. ADP-1.1.105, Priročna skladišča in kontrolirano odložena oprema (Temporary storage and controlled deferred Equipment)
15. ADP-1.1.125, Izvedba delovnega naloga (Working order process)
16. ADP-1.2.003, Plant Design Modification and Control Process
17. ADP-1.3.004, Osamitev in označevanje sistemov / naprav (Tagging)
18. ADP-1.4.022, Prevoz, skladiščenje, rokovanje in notranji transport (Storage, handling and internal transport)
19. ADP-1.14.202, Normativi osebnih zaščitnih sredstev (Personal protection norms)
20. ESP-2.111, EAM MECL Data Element Structure/Definition
21. ESP-2.113, EAM MECL equipment numbering system
22. ESP-2.302, Administration of Changes to the USAR
23. ESP-2.303, Authorization of Changes, Tests and Experiments (10CFR50.59)
24. ESP–2.602, Plant Design Modifications
25. ESP–2.604, Design Considerations, Basis and Input
26. ESP–2.605, Design Analysis and Calculations
27. ESP–2.607, Design Verification
28. ESP-2.609, Field design Change Request
29. ESP–2.611, Document Turnover and Closeout
30. ESP–2.613, CAD Drawing Control of Scanning, Conversion or Revision Process
31. ESP–2.617, Material and Equipment Specification
32. ESP–2.618, System Design Description
33. ESP–2.619, Preparation of Installation Packages
34. ESP–2.624, Design Impact Evaluation
35. ESP-2.631, EMC Program in Design Modification Process
36. ESP-2.912, Documentation of New Applications for Process Computer Systems
37. ESP-2.913, Rules for Process Computer Systems Human Machine Interface

- 38. ESP-2.921, Cyber Security Assessment of Critical Digital Assets (CDA) in NEK
- 39. ESP-2.951, Process Computer Signal Configuration Database Control
- 40. FPP-3.7.002, Postopanje v primeru požara (Fire response)
- 41. FPP-3.7.004, Kontrola vnosa gorljivih snovi (Flamable items control)
- 42. FPP-3.7.005, Naloge požarne straže (Fire watch)
- 43. FPP-3.7.006, Dovolilnica za dela s toplotnimi učinki (Permission to work with heat generating tools)
- 44. FPP-3.7.007, Ravnanje z vnetljivimi plini in tekočinami (Flammable gases and liquids)
- 45. EIP-17.044, Nudenje prve pomoči in prve medicinske pomoči v primeru nezgode v NEK (Medical first aid)
- 46. ROP-3.8.301, Refueling Machine Test Procedure
- 47. ROP-3.8.303, Refueling Machine Operability Test
- 48. 677055, Rev. 6, RCMC General Specification
- 49. 677072, Rev. 2, RCMC Addendum to Specification
- 50. P29110-1, Rev. 0, Substitutions of the Steel Materials According to the ASTM Standards with Materials According to the SIST EN Standards
- 51. SP-G377, Rev. 1, Technical Specification, Fuel Handling Machine Upgrades, 1993
- 52. SP- ES1493, Rev. 0, Technical Specification, In Mast Sipping System Upgrade

8 AFFECTED SYSTEM(S)

Fuel Handling System (acronym FH).

9 IDENTIFICATION OF AFFECTED EQUIPMENT

FHSCMC01	Reactor Cavity Manipulator Crane
FHSCMC01-BRKR	Single Phase Circuit Breaker
FHSCMC01-BRK2	Refueling Machine Bridge Brake
FHSCMC01-BRK3	Refueling Machine Trolley Brake
FHSCMC01-CCU1	Refueling Machine Camera Control
FHSCMC01-CMR1	Ref Bridge Positioning Camera
FHSCMC01-CMR2	Fuel and Rx Inspection Color Camera
FHSCMC01-CMR3	Fuel and Rx Inspection B&W Camera Assy
FHSCMC01-CON/VM	Video Mast Control Unit
FHSCMC01-DRV1	Refueling Machine Main Hoist Gear
FHSCMC01-DRV2	Refueling Machine Bridge Gear
FHSCMC01-DRV3	Refueling Machine Trolley Gear
FHSCMC01-FLT	FHSCMC01 Inl Air Dust Filter
FHSCMC01-FRN	Frequency Inverter

FHSCMC01-HST	Refuel Machine Monorail Hoist Assy
FHSCMC01-HST/FRN	Refuel Machine Monorail Hoist Inverter
FHSCMC01-IMSEU	Refueling Machine IMS Electronic Unit
FHSCMC01-IMSHR	Refueling Machine IMS Hose Reel
FHSCMC01-IMSPU	Refueling Machine IMS Process Unit
FHSCMC01-LS14	Refuel Mach Trolley Forward Stud Limit Lsw
FHSCMC01-LS18	Refuel Mach Trolley Rev Stop Xfer Area Lsw
FHSCMC01-LS4	Refuel Mach Gripper Tube Up 2 Limit Lsw
FHSCMC01-MON1	Ref Bridge Positioning Monitor
FHSCMC01-MTR1	Manipulator Crane Hoist Motor
FHSCMC01-MTR2	Manipulator Crane Bridge Motor
FHSCMC01-MTR3	Manipulator Crane Trolley Motor
FHSCMC01-TRD	Refueling Machine Pneumatic Transducer
FHSCMC01-VCR1	Refueling Machine VCR
FHSCMC01-VMST	Refueling Machine Video Mast
FHSCMC01-VRCK	Refueling Machine Video Rack
EE104SWGLD21	400 VAC Switchgear
EE106PNLL701	Refuel Canal Sply Fan Local Control Panel
EE103MCCD212	400 VAC Motor Control Center Train X
1EPK187X	Cbl to Pen Canister

10 SUPPLEMENTAL DATA

Not applicable.

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 in addition to pdf files also as one hard copy.

Hard copies shall be good qualities 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.

For maintenance purposes, the access for repair and inspection shall be indicated.

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.

Design documentation 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, except for 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 RCMC
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) and QA representative

8. Identification of major equipment Suppliers (cameras, PLC, control console, cables, hoses, motor drives)

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, etc.). The PQP may be included within the overall Project Plan.

11.3.4.2 PQP shall identify sub tier documents such as all procedures related to the project, design control documents, manufacturing and inspection plans, documents handling deviations, non-conformance process, etc.

11.3.5 Design Inputs

a) The design input document shall be reviewed and amended 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.

b) Equipment specification 677055A shall be revised by Supplier based on updated design inputs.

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 requirements of the specifications. Calculations shall be submitted showing acceptable stresses in sheave mountings, rope anchors and any other critical parts involved in lifting the fuel.

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 drawings. Existing NEK drawings shall be reviewed and revised.

11.3.6.5 Detailed Software Functional Specification (DSFS), or equivalent document(s), 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.

11.3.6.6 Basic cyber evaluations and protection for all new digital components (PLC, display computer, cameras, etc.) shall be performed and submitted as part of ESP-2.921, Cyber Security Assessment of Critical Digital Assets (CDA) requirements including:

- Cyber asset inventory and CDA / non-CDA classification for all digital subsystems,
- Network architecture diagrams (zones, conduits, boundary defenses),
- Cyber security design description mapping controls to NEI 08-09 / RG 5.71,
- Cyber security test plan and test results.

11.3.6.7 Detailed software and hardware user and maintenance (including administration) manuals shall be prepared and included in the 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.

11.3.6.8 Software Criticality Analysis

11.3.6.9 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 project procurement specifications all the requirements from this specification and equipment specification 677055A, including any clarifications, as agreed to by both parties.
- 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, ...as applicable.

11.3.10 Manufacturing Work Sequence and Inspection Plan, as applicable.

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 (input provided by NEK), as applicable. NEK is responsible for all disposal of old equipment and remains the owner of all removed equipment.

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, (as applicable):

- 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 relevant 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 (including measuring) 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 qualification of the equipment.
- t) Electromagnetic and Radiofrequency Equipment justification letter or EMC/RFI test results

- u) As-built parts lists
- v) All NDE records including radiographs (originals)
- w) Packing Specifications
- x) Transportation Specifications
- y) Vendor drawings
- z) Assembly and Sub-Assembly Manufacturing drawings

* Any procedures that are intellectual property of the supplier or their sub-suppliers shall be made available at their facility and may not be provided as attachments to the End of Manufacturing Report.

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

- 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, as applicable
- List of tools and measurement equipment with certificates
- Bill of materials with certificates, as applicable
- QC records (NDE, dimensional reports, as build data), as applicable
- FME reports with 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 identify 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. NEK drawings, revised for As-Built conditions, shall be provided in *.dwg format.

11.3.22 System design description document in accordance with ESP-2.618 procedure.

11.3.23 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.

11.3.24 Project status/progress reports

11.3.25 Documentation Index

11.3.26 Daily reports during installation phase

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) applicable for NEK 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 engineering and analysis 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

Performance requirements are specified in 677055A.

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 bolts) shall be used wherever physically possible.

14 FABRICATION AND ASSEMBLY

14.1 General

- 14.1.1 Fabrication shall start upon approved Manufacturing WSIP with all related deliverable documents (drawings, procedures,...). 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 machine 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 machine shop shall be secured by bolts, in so far as or wherever practical, to prevent damage in shipment and handling.
- 14.1.6 Tolerances shall be defined in accordance with an ANSI/ASME Y-14.5M.

14.2 Bolts

- 14.2.1 Unless shown otherwise on the Construction Drawings, shop assembly connections may be bolted or welded.
- 14.2.2 Hardened washers shall be installed under the driven bolt element of each high strength bolt.
- 14.2.3 Unless otherwise noted on the Construction Drawings, all high strength bolted connections shall be designed, detailed, and fabricated as "friction-type" connections, and be tightened by the "turn-of-the-nut" or calibrated-wrench method in accordance with the specification for Research Council on Structural Connections Specification for "Structural Joints Using High-Strength Bolts". Shop painting in areas of high strength bolts shall be blocked out.
- 14.2.4 Bolted beam connections shall develop a minimum of one bolt value greater than the reaction, as given on the Construction Drawings or the maximum reaction allowable for a

uniformly loaded beam of the given size and span. A minimum of two bolts per connection shall be used.

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

14.2.6 Stainless steel bolt connection shall be made with anti-seize protection.

14.3 Welding

14.3.1 Welding, welding procedures, welders, and welding operator qualifications shall conform to AWS D1.1/D1.6, Section 6 or AWS D14.1, Section 10 or equivalent. Written welding procedures shall be submitted for approval.

14.3.2 Welding starts and stops in continuous welds shall be held to a minimum. Each such stop shall be properly conditioned before continuing the welding. The use of runoff plates, where possible, is recommended.

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

14.3.4 Welded studs shall be secured with the manufacturer's authorized stud welding equipment and shall be in accordance with AWS D1.1/D1.6, Section 6 or AWS D14.1, Section 10.

14.3.5 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, Section 6 or AWS D14.1, Section 10 or the manufacturer's instruction, whichever is more conservative.

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

14.3.7 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.

14.3.8 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. The temporary attachments shall be removed by grinding or thermal cutting. If thermal cutting is used, the attachment shall be cut no closer than ¼ inch from the member and the balance removed by grinding. After removal, the area shall be MT or PT inspected. In all cases, the method or alignment shall not result in deformation of the component.

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 or AWS D14.1, Section 10.

15.1.3 Materials, procedures, or workmanship not conforming to the provisions of this Specification shall be rejected at any time non-conformances are found during the progress of the work. Rejected material and workmanship shall be corrected at no additional cost to NEK.

- 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 repair 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. 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 per SP-S702.

Supplier shall prepare Seismic Qualification Documentation Package (SQDP) for subject equipment. SQDP should provide sufficient level of details supported with test reports, calculations or analyses that confirm equipment seismic qualification for subject seismic load.

16.2 Electromagnetic and Radiofrequency Equipment Qualification (EMC/RFI)

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 non-NEK-controlled external networks is allowed. Any connection to other plant systems shall be via NEK-approved, security-hardened interfaces in accordance with ESP-2.921 and the site Cyber Security Plan.
- h) No unnecessary software is installed.
- i) Unused communication ports external to cabinets and enclosures are blocked.
- j) Cabinet, where OT equipment will be mounted, must be locked with key.

- k) Custom software is developed and used in secure environments both at the factory and at the plant.
- l) The system shall implement security event logging (logins, failed logins, configuration changes, mode changes, etc.),
- m) Logs shall be reviewable by NEK and integrated into NEK's cyber monitoring processes where applicable.

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 mis-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 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.

RCMC 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 MC 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, as applicable, 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, at an agreed upon scheduled time.

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

Old RCMC parts demolition, transportation, storage, and installation of new equipment 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 solution shall be adopted to prevent or minimize possibilities for FME events during installation, operation and maintenance. Supplier shall consult with NEK 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 Instruction 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 replacement 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 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 for existing RCMC parts shall be provided within the DMP, with locations provided by NEK.

- 17.5.3 Waste items (including disposed RCMC 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. NEK shall be responsible for disposal of all 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 RCMC replacement for review and comment, and shall be based on radiological surveys performed in outage 27.

17.6 Loads handling at 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 supplied 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, as applicable to codes and standards for non-safety related equipment. If required for specific equipment, 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 refueling 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. 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. Wooden materials are 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 or equivalent. 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, as applicable.

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 which 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 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 with specification requirements, approved drawings, and applicable federal, state, and local 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 disposition 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 for 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 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

Reactor Cavity Manipulator Crane Upgrade

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 final technical manual with all necessary information for operation 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 a 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, operation instructions, and routine maintenance procedures (or maintenance manual), shall be included in manual.

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

32 TRAINING PROGRAM

The Supplier is obliged to 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 refueling machine shall be physically trained at supplier's facilities on a test bridge and trolley. All necessary mockups and training simulators shall be included in the scope of supply.

Training shall be comprised of classroom training and physical training. Approximate training duration should be 5 full working days for RCMC operators and 5 full working days for maintenance. Training should be performed directly post-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 and as agreed to by involved parties, and with the proper non-disclosure agreements in place.

34 SCHEDULE REQUIREMENTS

34.1 Project Schedule

To comply with the objective of full implementation of the modification in outage October 2028, activities shall be completed as required in 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	Refuelling machine (with all parts) delivered to NEK	August, 2028
11	Demolition of RCMC, installation of new RCMC, SAT	October, 2028
12	Installation report	November, 2028
13	Turn over package	January, 2029

34.2 Installation Schedule

RCMC replacement 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 replacement 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, note that not a complete time window is available for the RCMC project from the point of working/laydown area occupation and polar crane use. Polar crane will be available approximately 50% of this time window (cumulatively 120 hours).

35 STATUS REPORTING REQUIREMENTS

Following tools shall be used by Supplier for status reporting:

- d) Progress bi-weekly (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,
- a) Regular project Steering Committee meetings (three months period),
- b) 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,
- c) Monthly report that integrates weekly meetings, Action Items List and status of project activities,
- d) Bi-weekly updated Documentation Index that lists all project deliverable documents (including all sub tier Suppliers documents) with status (in preparation, in review, approved, etc.),
- e) Outage installation daily meetings (shift progress meetings will be held in parallel with mandatory pre job briefings),
- f) Site daily reports delivered to NEK by 7AM each morning, during installation activities, containing:
 - i. 24 hours activities progress report,
 - ii. Required support from NEK,
 - iii. Deviations (technical, safety, etc.),

- iv. Schedule updates.

36 WORK OR INFORMATION TO BE PROVIDED BY NEK

In addition to 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 2027 and 2028 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 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 deliverable 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 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 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 requirements of this specification, Supplier shall delegate to this project a team of engineers experienced in reactor cavity manipulator crane upgrades. Supplier shall get familiar with existing fuel system 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 identified during the

installation phase of the project. 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 shall also assume 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, and 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/procedure according to which operation, test, measurement, inspection, etc. shall be performed;
- d) Reference procedure 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. All provided documents must be in English. 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 will be repeated in accordance with Supplier quality program requirements.

44 NEK PROPRIETARY DATA

Some references are restricted for use due to supplier's proprietary policy. Such documents, necessary for project to be executed, will be disclosed to a third party upon special agreement or disclosed for review only at NEK premises. No pictures may be taken of any portion of third party proprietary documents or drawings. For further instructions, please note the General Terms and Conditions proprietary-related paragraph.

45 APPENDICES

1. 677055A, Rev. 1, Equipment Specification, Upgraded Reactor Cavity Manipulator Crane
2. 1209E82, Sh. 1 - Reactor Plant Arrangement Containment Plan
3. 1209E82, Sh. 2 - Reactor Plant Arrangement - Elevation
4. 1459F99, Sh. 1, Rev. 3, Krsko Nuclear Plant - Refueling Machine
5. L-22830, Sh. 1 Rev. 3, General Arrangement Refueling Machine
6. L22650, Sh. 101, Rev. 2, Upper Structure Assembly, Refueling Machine
7. 22830-6, Sh. /, Rev. E, R.H. Trolley Ass'y Refueling Machine
8. 1451E29, Sh. 1, Rev. 10, 16 X 16 Fuel Assembly Interface Parameters
9. CDP-1302-FH-L, Preliminary Design Inputs (ESP-2.604)
10. MECL-RB-04: MECL Plant Layout Drawing - Reactor Building,
11. 205796; Sh. 1, 2, 3: Manipulator Crane - Schematic Drawing,
12. 22170-155: Inner Mast – Assembly Drawing,
13. 22170-170: In Mast Sipping System - Assembly Drawing,
14. 22650-155 Gripper Finger (16x16) - Assembly Drawing,
15. 22830-101; Sh. 1, 2, 3: Electrical Schematic Drawings,
16. 22830-103; Sh. 1, 3: Wiring and Connection Diagram,
17. 22830-105: Control Console Panel Layout - Assembly Drawing,
18. SP-S702, Rev. 11, Seismic Analysis, Testing, and Documentation (Short Version)
19. QS 610, Rev. 2, Quality Specification QS 610 - Generic Quality Assurance Program Requirements