

1 Technical Specification

DESIGN, MANUFACTURING, INSTALLATION AND TESTING OF THE "NEW HIGH PRESSURE TURBINE" KRŠKO NUCLEAR POWER PLANT

SP-ES1297

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1 BACKGROUND AND DESCRIPTION OF PROBLEM

1.1 Background

NPP Krško has installed Westinghouse HP turbine, two Mitsubishi LP turbines and Siemens generator as a tandem compound flow unit with reheat. Turbine consists of H.P. Turbine S.O.13A5461 **BB296**, L.P. Turbine #1 Serial No.: 6-366203 and L.P. Turbine #2 Serial No.: 6-366204. The high pressure turbine is a double flow element with rateau control stage followed by reaction blading in each end of the element. The steam enters the HP turbine through four MS pipes and associated flow stop-control valves (control valves type BB96, size 19,5") assemblies installed at the turbine deck, two located on each side regarding the direction of the HP turbine axis. The steam flows to the nozzle blocks through the control stage and axially in both directions to the four openings (two at each end) in the casing base, then through the crossunder piping to the moisture separator reheaters. Crossover pipes return the steam through the reheat stop and interceptor valves to the low pressure turbine.

1.2 Description of Problem

After steam generators replacement in the year 2000 (which corresponds to NSSS output of 2000 MW thermal) NPP Krško has had licensed »Operating Window« concept. Heat balances were created to model operation at three different steam pressures (887, 919 and 952 psia at RSG outlet corresponding to 839, 871 and 904 psia at turbine inlet). After the LP turbines replacement in the year 2006, the turbine-generator has been rated at up to approximately 730 MWe gross with six stages of feedwater heaters in service, a condenser vacuum of 3.81 cm HgA (1.5 inches Hg, abs.) and zero makeup. Steam conditions at the turbine inlet are 6.23 MPa (904psia), 278.0 °C (532.4 °F) and 0.47 percent moisture and final feedwater temperature is 219.8 °C (427.6 °F) of the maximum calculated heat balance of USAR Figure 10.1-8, which corresponds to 726.8 MWe. After the new LP turbine replacement, the five stages of feedwater heaters, moisture separator reheater, DEH system and main generator were replaced. The generator uprated rating was changed up to approximately 850 MVA.

The HP turbine is still the original one, now more than 35 years in operation. New HP designs offer several areas of improvement like 3D profile blades with improved seals. Significant MWe gain is achievable.

Control valves are affected by flow induced vibration and because of that the muffler lifting problem has been recognized. New control valves shall be ruggedized design with less pressure drop and improved efficiency.

2 ABBREVIATIONS AND DEFINITIONS

2.1 Abbreviations

ADP	Administrative Procedure
ASME	American Society of Mechanical Engineers
ANSI	American National Standard Institute
ASTM	American Society for Testing Materials
ATC	Automatic Turbine Control
AWS	American Welding Society
BOM	Bill of Material
B.O.P.	Balance of Plant
CDP	Conceptual Design Package
CER	Comprehensive Engineering Review
CFR	Code of Federal Regulations
CMTR	Certified Material Test Report
COI	Certificate of Inspection
CWP	Construction Work Procedure
CY	Condensate System
DMP	Design Modification Package
DEH	Digital Electro Hydraulic
DECTS	Design Extension Conditions Technical Specification
DP	Documentation Package
DSR	Design Summary Report
E/C	Erosion/Corrosion
EAM-MECL	Master Equipment Component List
ESD	Engineering Service Division
EH	Electro-Hydraulic
EHC	Electro Hydraulic Control
EPRI	Electric Power Research Institute
ESP	Engineering Service Procedure
EX	Extraction Steam System
FAT	Factory Acceptance Test
FATT	Fracture Appearance Transition Temperature
FDCR	Field Design Change Request
FME	Foreign Material Exclusion
FMEA	Failure Modes and Effects Analysis
FIR	Fully Integrated Ruggedized
FP	Fire Protection
FSAR	Final Safety Analysis Report
FW	Feedwater System
HD	Heater Drain System
HP	High Pressure
ID	Identification Number
ING	Engineering Department
IP	Installation Procedure
ISB	Integral Shroud Blades
LCO	Limiting Conditions for Operation
LO	Lube Oil System
LP	Low Pressure
LVDT	Linear Variable Differential Transformer

MS	Main Steam System
MSDS	Materials Safety Data Sheet
MT	Magnetic Testing
NCR	Nonconformance Report
NDE	Non Destructive Examination
NEK	Nuklearna Elektrarna Krško
NPP	Nuclear Power Plant
NSSS	Nuclear Steam Supply System
NSR	Non Safety Related
OBE	Operating Basis Earthquake
OPR	Owner's Project Representative
OSP	Operating Surveillance Procedure
OQAR	Owner's Quality Assurance Representative
PCSCDB	Process Computer Signal Configuration Database
PDEH	Programmable Digital Electro Hydraulic Control System
PIS	Process Information System
PMM	Project Management Manual
PQP	Project Quality Plan
PQR	Procedure Qualification Record
PT	Penetrant Testing
PWHT	Post Welding Heat Treatment
QA	Quality Assurance
QC	Quality Control
QSD	Quality System Division
RETS	Radiological Effluent Technical Specification
RG	Regulatory Guide
RSG	Replacement Steam Generator
RTD	Resistance Temperature Detector
SAT	Site Acceptance Test
SCC	Stress Corrosion Cracking
SE	Safety Evaluation
SES	Safety Evaluation Screening
SG	Steam Generator
SGTP	Steam Generator Tube Plugging
SNSA	Slovenian Nuclear Safety Administration
SSC	System, Structure and Component
SSE	Safe Shutdown Earthquake
SUP	Start-up Procedure
TD	Turbine Drain System
TG	Turbine-Generator or Turbine Gland System
TOP	Turn-Over Package
TR	Technical Report
TS	NEK Technical Specification
TSI	Turbine Supervisory Instrumentation
TU	Main Turbine
URSVJ	Uprava Republike Slovenije za jedrsko varnost (Slovenian Nuclear Safety Administration)
USAR	Updated Safety Analysis Report
USNRC	United States Nuclear Regulatory Commission
VWO	Valves wide open

WBS	Work Breakdown Structure
WOI	Waiver of Inspection
WPS	Welding Procedure Specification
ZVISJV	Zakon o varstvu pred ionizirajočimi sevanji in jedrski varnosti (Ionising Radiation Protection and Nuclear Safety Act)

2.2 Definitions

Bidder - one who offers execution of the scope of work and supply under defined terms&conditions including price)

Contract - shall mean the agreement between the Purchaser and the Seller, the including General Terms and Conditions, Technical Specifications for »New HP Turbine«, and Attachments; the Purchaser approved manuals, drawings, plans and procedures; the Request for Quotations; all Revisions and Addenda issued by the Purchaser to any of the foregoing; the Seller's proposal as accepted by the Purchaser; and all related data in connection with the Work to be performed.

Contractor - shall mean the successful Bidder who shall undertake the performance of the Work required by the Contract. The use of the words "Seller", "Bidder", and "Contractor" in this Specification is interchangeable.

Equipment- means all equipment, materials, documents, components and parts to be furnished by the Contractor to the Purchaser under this Specification for "New HP Turbine".

FIR - means Fully Integrated Ruggedized HP rotor monoblock type where discs are integrated with shaft.

New HP Turbine – means the project which has to ensure:

- a. replacement of degraded HP Turbine with "New HP Turbine" in the outage 2021
- b. replacement of the four (4) control valves
- c. at least 7 MWe more total gross power through better efficiency of replacements HP turbine and control valves in SINGLE and/or SEQUENTIAL mode of valve control operation for NEK operating window (appendix J, USAR Fig. 5.1-3A) for:
 - i. Upper limit (appendix J)
 - ii. Intermediate point (appendix J)
 - iii. Lower limit (appendix J)
- d. resistance of materials to erosion/corrosion and stress corrosion cracking and 12-years maintenance period
- e. replacement (removal and installation) in 21 days during the April 2021 outage in accordance with attachment K,
- f. successfully completed Start-up Test on 28th day of the outage in April 2021
- g. successfully completed Site Acceptance Test in April 2021

- h. compatibility of new HP turbine with the existing equipment and systems (LP Turbines, GN, CO, LO, TC, TD, TG, EX, EH, PDEH, ...) in NPP Krško
- i. one new fully bladed high pressure turbine rotor, stators and outer casing with all necessary changes, attachments, equipment, spare parts, materials, services and engineering necessary to perform installation, testing, licensing and operate NPP Krško under power uprated conditions.

Operating window – The OPERATING WINDOW is the range of full power reactor coolant average temperatures and steam generator tube plugging levels in which the operating point of a fuel cycle can be selected (appendix J, USAR Fig. 5.1-3A).

Physical Delivery - shall mean delivery of all manufacturing documentation, pieces of equipment and materials as per this Specification SP-ES1297 item 3.2 Scope of hardware and services (supply, transportation and replacement ...).

Purchaser or NEK or NPP Krško - shall mean Nuklearna elektrarna Krško

URSJV - means Slovenian Nuclear Safety Authority (SNSA).

Work - shall mean all equipment and services (including all labour, supervision and management) and all other requirements set forth in or necessary to perform the Contract.

Commissioning - The process by means of which SSC of facilities and activities, having been constructed, are made operational and verified to be in accordance with the design and meet the required performance criteria.

Design - shall mean documentation preparation in accordance with NEK ESP 2.602 and all other relevant procedures of the ESP 2.602 under item 2.0

Design Documents - specifications and drawings derived from regulatory requirements and/or design, quality assurance, and process requirements for use in the procurement, fabrication, installation, examination and testing; and analyses and reports that substantiate design characteristics or evaluate item performance.

Design Basis - is a set of information, regulatory requirements and postulated accident scenarios (gathered in USAR) for which nuclear power plant SSC were originally designed. Information identifies the specific functions to be performed by a structure, system or component of a facility, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design. These values may be (1) restraints derived from generally accepted state-of-the art practices for achieving functional goals or (2) requirements derived from the analysis (based on calculation and/or experiments) of the effects of the postulated accident for which a structure, system, or component must meet its functional goals. They may also result from the regulatory requirements or applicable codes and standards.

Engineering - shall mean the profession of applying scientific principles to the design, construction, maintenance, and of operation of buildings, equipment and systems

Installation - shall mean all the activities and measures taken to successfully install the projects in accordance with the requirements of the NEK procedure ESP 2.619.

Procurement - shall mean the provision of all personnel, techniques, services and tools/equipment necessary or appropriate to successfully complete the Project

Project - shall mean modification 1098 – TU – L: HP turbine replacement

Specification - shall mean SP- ES1297, Rev. 2 Design, Manufacturing, Installation and Testing of the New High Pressure Turbine.

Start-up - shall mean testing to validate system functionality and performance while operating new equipment

SINGLE - The governor valves mode of operation where all the governor valves open or close in unison to change the amount of flow passage area

SEQUENTIAL - The governor valves mode of operation where multiple governor valves are sequenced to open or close in a predetermined order

Turnover package - shall mean all finalizing activities and documentation submission signifying that the work required by the plant modification packages has been performed, installed and tested in accordance with requirements of the design modification package.

Turnkey principle - means that any scope needed to meet the requirements from Technical Specification and to make the subject of the contracted project physically and functionally complete, shall be considered as Contractor's scope of Services and Delivery,

Turnkey project consists of:

- Preparation of design documentation (DMP, documentation according to the Slovenian Construction Code)
- Project documentation (PMM, PQP, etc.)
- Manufacturing or/and purchasing of equipment
- Transportation on Site
- Installation
- Start-up
- Preparation of Project turnover and closeout documentation.

3 SCOPE OF SERVICES

Summarized scope of New HP Turbine work and supply as “turn-key” project on turn-key principle is:

- Project documentation (PMM, PQP, etc)
- Preparation of design documentation (DMP, documentation according to NEK procedures)
- Manufacturing and purchasing of Hardware (HP Turbine, control valves and associated equipment/material)
- Hardware delivery on Site
- Supply of recommended spare parts and consumables
- Performance of Reference Performance Testing (pre/post installation testing, determination of gross MWe generator output before HP Turbine replacement)
- Disassembly of the existing turbine and transport to NEK warehouse
- Installation of new Hardware
- Supervision of Start-up and execution of SAT (including performance of post installation/replacement Performance Testing- determination of gross MWe generator increase at 100% reactor power)
- Preparation of Project turnover and closeout documentation according to NEK procedures

3.1 General

The scope of work presented in this specification shall include all required engineering, design, materials, manufacturing, construction, labor and supply of documentation and new hardware, including revisions of existing original documentation in NEK archives and assistance to Purchaser to license this design and licensing change in front of SNSA for the “New HP turbine” as “turn-key” project on Turn-key principle.

The Contractor shall be responsible for compliance with all of the detailed requirements presented in this Specification. There shall be no deviation from this Specification or its references without prior written authorization by Purchaser. The Contractor Scope of Service shall be:

- Overall project management, planning, scheduling and reporting
 - Site walk-down, acquisition of data and preparation of walk-down report
 - The Contractor shall ensure that the Project is implemented on schedule and within budget, while meeting quality and safety aspects
 - Preparation of detailed documentation including design modification package, all necessary FDCRs, changes to licensing documents, installation package, turn over package, as built documentation, etc., based on NEK ESD procedures
 - Preparation of QA documentation package
 - Preparation of documents necessary to support NEK required licensing in front of SNSA (URSJV) as detailed in section 3.5
 - Active participation in licensing meetings with SNSA
 - Creation and revision of affected maintenance and operation procedures
 - Preparation of equipment environmental qualification reports
 - Material/Equipment procurement, manufacturing, inspection and testing (including Factory and Site Acceptance Tests)
-

- Modification implementation
- Training of NEK maintenance and operation personnel
- Integrating all Project documents into NEK plant databases (DCM, MECL)
- Project turn over and close out

Nothing shall relieve the Contractor 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.

In accordance with NPP Krško requirements the Contractor shall replace old degraded HP Turbine with "New HP Turbine", to provide the same functional connection between »New HP Turbine« and existing system as "turn-key" job.

The Scope of Work shall be delivered physically and functionally complete and in a state which will achieve and meet all performance criteria and other requirements of this Specification including transportation of "New HP Turbine" from Manufacturer's facility till NEK turbine deck el.115,5, preparation of "New HP Turbine" for installation with the development of installation package with all documentation requested by this Specification, removal of the existing "Old HP Turbine" and attachments and transportation in warehouse, putting old rotor on the existing (old) rotor stand, steel construction for supports, restraints, platforms, insulation, assembly and installation, welding, non-destructive testing, removal of scaffolding & cleaning of working area.

Any hardware, software or engineering services not specifically included in this Specification shall be deemed to be included in Contractor's undertaking if their inclusion is required to make the Scope of Work physically or functionally complete.

This Specification covers the design, manufacture, installation and testing of a replacement turbine steam path using the latest engineering technology for the NPP Krško High Pressure (HP) steam turbine, including all related accessories and auxiliaries required for a complete and operable system. In this Specification, a new steam path shall be defined as including both the fully assembled rotating parts as well as the adjacent stationary parts (blades, blade/diaphragm rings, inner cylinders and flow guides, etc.).

Any modification, such as bearing replacement (if it should require redesign of bearing supports) or main oil system (all components shall be checked and improved/replaced if it is necessary), which shall be performed on the existing systems and equipment in NPP Krško because of »New HP Turbine« necessary to achieve goals of the Project or is required to allow NPP Krško safe and reliable operation with "New HP Turbine" is part of "Scope of Services and Delivery" under this Specification/Contract.

All engineering, design work and planning shall be scheduled in accordance with the overall Project Schedule (see Paragraph 34 SCHEDULE REQUIREMENTS) to fulfill requirements for execution of the "New HP Turbine" Project. The development of DMP shall run in parallel on the modification. Contractor is finally and ultimately responsible for the quality of the DMP and other contractual documentation developed for this Project.

The Contractor shall perform the necessary reviews to ensure that the supplied items will comply with all interface requirements of the existing plant systems, as mentioned in this Specification. If it is necessary to perform any field measurements the Bidder shall coordinate with Purchaser all the activities at least three (3) weeks before the measurement execution. NEK can grant limited time and access (up to three night shifts with the duration from 05.04.2018 8 pm to 08.04.2018 6 am) and up to four individuals per shift during the outage. All workers shall fulfil all NEK's requirements (Attachment L) which allowed to work as unescorted person. All technical solutions required for a safe, reliable and efficient operation of the new installed systems shall be considered and provided in the design.

Built status in the field NEK documentation or if appropriate As-Built documentation does not exist at all, It is the Contractor's obligation to perform a detailed walk-down/As-Built process and to prepare needed corrected As-Built mark-up documentation for known purposes. The Contractor is not requested to correct NEK DCM documents and drawings at this phase of the Project. The subject walk-down/As-Built mark-ups shall be performed prior to the development of the DMP.

3.2 Scope of Services and Delivery (Hardware supply, transportation, replacement,...)

The Scope of Services and Delivery under this Contract shall be based on the supply of »New HP Turbine« equipment and the provision of technical services to enable the engineering, procurement, commissioning and licensing to result in a complete TG-set forming part of a fully licensable plant at rated electrical and thermal output.

Within the Scope of Services and Delivery there is a complete »New HP Turbine«, which has to include all the necessary project documents, components, piping, valves, fittings, insulation, instrumentation, cables and control equipment and electrical equipment up to and including their terminal boxes.

The detailed Scope including transportation and replacement given in this Specification shall not necessarily be limited to the items mentioned below:

3.2.1 The "New HP Turbine" Project has to ensure:

- a. At least 7 MWe more total gross power through better efficiency of replacements HP turbine in SINGLE and/or SEQUENTIAL mode of control valve operation for NEK operating window (appendix J, USAR Fig. 5.1-3A):
 - i. Upper limit (Appendix J)
 - ii. Intermediate point (Appendix J)
 - iii. Lower limit (Appendix J)
- b. Flow induced vibration resistant control valves
- c. Resistance of materials to erosion/corrosion and stress corrosion cracking and 12-years maintenance period
- d. Compatibility of new HP turbine with the existing equipment and systems (LP Turbines, GN, CO, LO, TC, TD, TG, EH, EX, DEH ...) in NPP Krško,
- e. That all turbine supervisory parameters shall be the same or better than before the equipment replacement.

- f. That vibration levels of “New HP turbine” are lower than in the pre outage 2021 and not higher than the values for zone A in accordance with ISO 7919-2,
- g. Control valve operation in SINGLE and/or SEQUENTIAL mode of operation, valve surveillance testing (at least once per 184 days by cycling each control and stop valve through at least one complete cycle from the running position), maintenance, ...

3.2.2 The Contractor shall remove the existing HP turbine, existing control valves and other interfacing equipment and transport to NEK warehouse, disassemble all existing connections, prepare all for the installation and install the “New HP Turbine” and equipment. The work shall be performed within time frame, that does not in any way jeopardize the NEK outage duration:

- a. provide replacement (removal and installation) in 21 days during the April, 2021 outage in accordance with Appendix K,
- b. successfully complete Start-up Test on 28th day of April 2021 outage
- c. successfully complete Site Acceptance Test in April 2021

During the Project implementation the Contractor shall organize his activities on TB el. 107 and TB 115.5 in such a way that will allow the performing of other NEK outage activities (bearings inspections, lube oil circulation, turbine valves overhaul, generator works, ...).

3.2.3 One (1) Fully Bladed (3D blades) Advanced Design HP Rotor Monoblock type with partial or full arc design, with governor and generator end couplings compatible with existing design, factory balanced and overspeed tested for installation in the new NPP Krško HP Turbine Outer Cylinders. Recommended one (1) spare set of spindle and stationary steam stage seals shall be included. In case of swallowing capacity adaptation possibility, the Bidder shall provide all required replaceable constructions elements.

3.2.4 Stationary parts; One (1) fully bladed inner casing and/or blade rings carriers, shop assembled and with steam admission components (inlet steam deflector, blade rings, including internal components as elevation plates), fitted and aligned in the factory or equivalent. One (1) set of Diaphragm and Rotating Blade Seals shall be included. Recommended one (1) spare set of Diaphragm and Rotating Blade Seals shall also be included.

3.2.5 Two (2) sets of HP tilting pads, self-aligning type bearings together with adjusting liners, bearing supports, bearing housing, temperature measurement elements and additional two sets (2) spare bearings (self-aligning type bearings together with adjusting liners, tilting pads, bearing supports, bearing outer housing and temperature measurement elements). The “New HP Turbine” bearings shall be designed to match the existing bearing pedestal and support system.

3.2.6 One (1) New HP Outer Casing manufactured from erosion resistant low alloy steel, outside insulated with sprayed insulation. The insulation shall be partially removable on the new HP Outer Casing in the horizontal joint bolting area, balancing/inspection openings, flange connections ...The flange's seals of the steam supply lines after governor valves (to the upper half outer casing) are soft

iron design. The Bidder should provide improved flange seal design. The attachments for the overhaul temporary scaffolding in the horizontal bolting area shall be constructed and erected on the bottom half outer casing (bolted or welded supports installed during manufacturing or installation).

- 3.2.7 One (1) set of horizontal joint bolting for inner casing and/or blade rings of the tensioning or Hytorc, or equivalent design that does not require thermal stretching. Recommended spare bolts quantity shall be included.
- 3.2.8 One (1) set of horizontal joint bolting for outer casing of the stud tensioner or Hytorc, or equivalent design that does not require thermal stretching. Recommended spare bolts quantity shall be included.
- 3.2.9 Two (2) sets (one set per shaft end) of HP Inner and Outer Gland Seals with associated packing seal segments, springs, etc. The Contractor shall provide an engineering evaluation of the existing gland steam regulating system with recommendations for improvements and implement all necessary changes for a successful execution of the Project. Recommended spare two (2) sets of inner and two (2) sets outer gland seal segments shall be included.
- 3.2.10 Four (4) control valve subassemblies – removable part (muffler, bonnet, plug, stem, bushing, seal ring, seal, nuts, washers, bolts), (spring & linkage support, limit switches, new actuators with LVDT if the design is modified too, ...) or whole control valve, flow induced vibration proof design, position interchangeable, compatible with existing DEH system, fitted in the existing valve body with or without additional machining and one (1) spare control valve subassembly with new actuator, limit switches, LVDT, ... New actuators shall be equipped with two AC type of LVDT with more rugged (LVDT with larger diameter of LVDT body and core) version than the existing ones being Macro Sensors HSAR-750-10000. The mounting of new LVDT shall include easy removal during the outage or replacement (LVDT mounting plate or so).
Valves shall be controlled (I/P transmitter) with servo valves produced by MOOG or equivalent of the existing one (existing servo valve is MOOG mod A076-185). New control valves shall allow the performance of valve testing function at least at existing power level (96% turbine power) or higher power level to avoid valves to operation in the range of small delta flow/high valve travel.
Control valves and HP turbine shall be designed with at least 0,5% additional throttle reserve at Low Tavg and 5% steam generator tube plugging.
- 3.2.11 Evaluation and all required changes of the existing impulse pressure (first stage) instrumentation loops P-505 and P-506, which provide turbine power and T_{ref} signal used for control and protection systems. Bidder shall identify the means for measurement of the turbine power identical or equivalent to the existing channels, and provide all necessary evaluations, calculations and testing requirements for implementation of these channels into Purchaser's control and protection systems.
The Bidder shall design and implement the measurement of the turbine load signal (i.e. equivalent of the first stage impulse pressure signal that is used currently) such that it shall not be adversely affected by closing of individual turbine governor and/or stop valve, or by operation in SINGLE/SEQUENTIAL regular operating or testing modes of operation.
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3.2.12 One (1) Coupling Spacer for LP turbine connection.

3.2.13 Validation, identification and implementation of the necessary changes to the existing instrumentation (temperature, pressure, differential expansion, eccentricity, speed, vibration, etc.) which is affected by the HP turbine replacement.

3.2.14 Contractor shall perform analysis/calculation of influence of turbine replacement to all existing adjacent and affected systems, structures and components, which includes but is not limited to the main steam system, extraction steam system, auxiliary steam system, feedwater heaters, MSRs, lubricating oil system, EH high pressure fluid control system, turbine gland system, turbine drain system, heater drain system, condensate and feedwater system, etc. Any impact to the existing systems, structures and components shall be resolved by the Contractor.

3.2.15 Contractor shall implement all necessary changes (tubing cutting, welding..) into EH system due to replacement of control valves actuators. After EH system works completion is required to perform system flushing.

3.2.16 Contractor shall provide evaluation of the existing PDEH connections, an engineering evaluation, analysis, calculation, and detailed instructions of the control valve operation to permit the simultaneous operation of the valves in accordance with partial or full arc design:

- a. Influence of new HP turbine to PDEH: Validation and definition of the new control curve of the turbine valves for all the power ranges with the valve opening rate as function of the pressure/load/flow; flow versus lift coefficients for governor valves in SINGLE and/or SEQUENTIAL valve modes.
- b. IMPULSE pressure currently represents turbine power and is used for closed loop control. New/updated method of measuring turbine power shall be introduced and implemented in PDEH system to allow closed loop control with the existing method of three independent transmitters (existing transmitters XD/IP1, XD/IP2 and XD/IP3).
- c. HP turbine ROTOR STRESS calculations in PDEH system should be updated to reflect limitations of new turbine in order to allow PDEH ATC mode of operation.
- d. Existing /new HP turbine protection system (existing WATER DETECTION function controlling HP turbine DRAIN valves) which actuates protective equipment shall introduce triple redundant measurement system for reliable sensing and reduce unwanted actuation (for example existing 3 transmitters for IMPULSE pressure).
- e. New measuring system shall be designed to be accessible during normal power operation for maintenance
- f. Accessibility of the existing measurement systems shall not be adversely affected for maintenance during normal power operation.
- g. Rescaling PDEH rated values.
- h. Because of mandatory periodic testing of the control valves, the design of the first wheel of the turbine shall take into account the operation in partial arch for each closure test of a control valve.

- 3.2.17 Contractor shall implement all necessary changes of the existing impulse pressure (first stage) instrumentation loops P-505 and P-506 into reactor control system.
- 3.2.18 Contractor shall implement all necessary changes into PDEH system. This shall include, but not be limited to:
- Updating of all existing PDEH system modes of operation and test capabilities (SPEED control, SPEED control with house load, AUTO SYNCH mode, LOAD control with IMP, MW and SPEED feedback loops, VALVE TEST mode and ATC mode of operation Rescaling PDEH rated values
 - Rescaling PDEH rated and limiting values
 - Updating PDEH specific documentation (DSFS, SDD, SDS, 816 series of drawings)
 - Updating PCSCDB list for PDEH and PIS systems
 - New/updated control valve controlling system which will allow operation in SINGLE and/or SEQUENTIAL mode
 - New/updated method of measuring turbine power shall be implemented in PDEH system to allow closed loop control with existing method of three independent transmitters (existing transmitters XD/IP1, XD/IP2 and XD/IP3).
 - HP turbine ROTOR STRESS calculations should be updated to reflect limitations of new turbine
 - New/updated HP turbine controlling system
 - New/updated HP turbine protection system
 - New/updated HP turbine monitoring system
 - New/updated Water DETECTION control
 - Implement all PDEH changes into NEK plant simulator

The PDEH turbine control system is built around redundant Emerson Ovation 3.0.4 platform and application software development is provided by WEC – Westinghouse Electric Corporation. In order to adequately monitor, control, alarm, protect, trend or analyze new HP turbine all provided signals shall be processed to the existing NEK programmable digital system (i.e. PDEH), which already has appropriate HMI devices installed in MCR (on MCB and on MCR operators' desks). As a consequence of the HP turbine replacement the new signal shall be presented on PDEH in the MCR. Due to proprietary nature of the PDEH System the Contractor shall involve original supplier of the system (Westinghouse Electric Corporation).

- 3.2.19 Contractor shall implement all necessary changes into PIS system.
- 3.2.20 Evaluation of the existing Turbine Water Induction Protection System and implementation of proposed improvements. The modification of the HP turbine shall be designed in such a way that all internal recesses in which condensation may collect shall be properly drained. The design shall provide the means for moisture separation and removal from the stages in the wet region.
- 3.2.21 One (1) set of rigging and lifting fixtures (or modifications to the existing ones). This includes: 1 Lifting gear, including slings and new lifting beam (or
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modification design and analysis for re-rating of existing lifting beam) for rotor picks and sized wire cables for cylinder lifts. All lifting devices shall be delivered with appropriate certificates.

3.2.22 One (1) set of special tools and one (1) set of balance weights.

3.2.23 One (1) rotor stand for installation and maintenance purpose

3.2.24 The Scope of Services and shall also include:

- a. All auxiliary structures and/or structural materials, components, and appurtenances as required (permanent or temporary for erection and transportation) including all structural connections (platforms), studies, calculations, certificates ...
- b. All consumable materials (welding, NDE, testing, etc..), components, and appurtenances as required for erection and transportation of "New HP Turbine" including all mentioned components and services mainly described in this Specification.
- c. All equipment, tools, materials, manpower, testing and inspection and other services necessary for the completion of the Scope of Services and Delivery, even if not expressly included in the Installation Package, except to the extent specifically included in NEK's Scope.
- d. All transportation equipment and appropriate devices, tools and ropes for handling with heavy pieces of Project "New HP Turbine"

3.2.25 One (1) set of Jack Shaft standard coupling bolts for HP turbine and Jack Shaft connection and one (1) set of hydraulic bolt sleeves for Jack shaft X to LP TU connection

3.2.26 New insulation on the all four (4) sets of Valve Stop and Control valves (Appendix D: Figure 1 I.L. 1250-3786 and Appendix D: Figure 1 I.L 1250-3785-A) and steam supply lines from control valve to the HP turbine, TG, TD lines around HP turbine. The insulation shall be partially removable on the stop and control valves for maintenance works. The stop and control valve insulation shall be from spray-applied thermal insulation. Insulation of the valves removable part shall be removable too.

3.2.27 New removable insulation (metal reflective or encapsulated as preferable) on all four (4) Interceptor valves and on all four (4) reheat stop valves (Appendix D: Figure 1 I.L. 1250-4153 and Appendix D: Figure 1 I.L 1250-4267) and four (4) flanges of the crossover piping.

3.2.28 Replacement of the Turbine Drain and Turbine Gland piping and associated elements like orifices, strainers valves, test connections etc., below the HP turbine (up to valve TGS2, shown on D-302-141, Appendix C) which are shown but not limited to the Picture 1, 2, 3, 4 and 5: PPG STM & GLD AB (see Appendix D, green line). The Contactor must perform a detailed walk down on the Turbine Drain and Turbine Gland system and prepare As-Built documentation during the outage 2019.

- 3.2.29 The Contractor shall perform Pre- Performance Test in accordance with SUP-16.061 in SEQUENTIAL governor valve mode of operation at two operating points (different Tav_g). The test shall be done in accordance with section 12.6.
- 3.2.30 The Contractor shall perform Post performance test in accordance to SUP-16.061 in SINGLE and/or SEQUENTIAL governor valve mode of operation at two operating points (different Tav_g). The test shall be done in accordance with section 12.7.
- 3.2.31 The Contractor shall prepare and deliver documents in accordance with section 11 and other requirements from this Specification.
- 3.2.32 The Contractor shall perform Post-Installation Torsional Test. NEK takes the right to concurrently perform independent torsional test.

3.3 Optional/Additional Scope

Not applicable.

3.4 Design

New HP Turbine and new control valves shall be designed for the minimum **design life of 40 years**.

All new built-in parts and assemblies shall be designed and manufactured according to the latest available practice and technology with the goal to provide a service life of forty (40) years or more. The Contractor shall provide all necessary features to ensure New HP Turbine design life of forty (40) years.

The Contractor shall ensure that modification packages are designed in accordance with specified requirements. The design documentation has to be prepared according to the NEK ESD procedures.

Contractor shall prepare documentation according to NEK procedures defined in Paragraph 7.6. These procedures are prepared in accordance with ZVISJV.

At least the following list of document shall be prepared and submitted for the Project:

- Project Management Manual (PMM)
- Integrated Project Schedule
- Project Quality Plan (PQP)
- Design Input Document (DI) in accordance to ESP-2.604 NEK Procedure
- Equipment Specifications
- Procurement Specifications without prices
- Analysis Report for equipment generic features
- Design calculations specific to the NEK Site, including the revision of the applicable existing NEK calculation (Thermal kit T4-A6341, ...)
- Design Modification Package in accordance with ESP-2.602 NEK procedure
- Safety Evaluation and USAR/TS/changes (10CFR50.59) in accordance with ESP-2.301, ESP-2.302, ESP-2.303, and ESP-2.306 NEK procedures
- Factory testing reports for equipment
- SAT procedures
- Installation Package (IP) in accordance with ESP-2.619 NEK procedure

- Turnover package (TOP) in accordance with ESP-2.611 NEK procedure
- Drawings (preliminary, construction, as-built)
- Equipment Data Report
- Technical manuals
- FME Plan in accordance with NEK procedures

Design documentation is prepared within DMP packages.

3.5 Licensing according to the Slovenian Nuclear Code

NEK operational license is based on the following documentation: USAR, TS, DECTS and RETS, which contains vital information regarding nuclear safety. In general, plant modifications may potentially have an impact on the former. Therefore, the effect on nuclear safety and the documentation, which is the basis for the plant license, is evaluated through 10CFR50.59 process for any modification on SSC.

For the New HP Turbine modification the Contractor shall perform 10CFR50.59 evaluation of the modification using NEK plant procedure ESP-2.303. This includes the preparation of Safety Evaluation Screening (SES), Safety Evaluation (SE) if required and supporting analyses. Within the 10CFR50.59 evaluation the Contractor shall review USAR, TS, and RETS and if required prepare change packages for these documents according to NEK plant procedures ESP-2.301, ESP-2.302 and ESP-2.306. All mentioned licensing documents (SES, SE and change packages) are a part of standard DMP. The required schedule for the completion of the licensing documents (including KOC and KSC Review) is defined in the plant procedure ESP-2.602, requiring the completion of the licensing documents 90 days before the desired approval by the URSJV.

The Contractor shall also provide necessary support during the licensing process at URSJV. This includes providing iterative answers on questions raised by either regulator or Expert Reviewer (if applicable), attend meetings and presentation as requested by the Purchaser and provide overall technical support for the licensing activities. The Purchaser will be responsible for arranging and conducting any management, regulatory, licensing or other presentations.

To summarize, the Contractor shall prepare the following documents within its scope of licensing activities:

- SES according the plant procedure ESP-2.303
- SE according the plant procedure ESP-2.303 (if applicable)
- USAR Change Package according the plant procedure ESP-2.302 (if applicable)
- TS Change Package according the plant procedure ESP-2.301 (if applicable)
- RETS Change Package according the plant procedure ESP-2.306 (if applicable)
- documented analyses necessary to support the above mentioned licensing documentation

3.6 Procurement Manufacturing and Supply

Procurement and manufacturing shall consist of fabrication and delivery of the New HP turbine and ancillary equipment. It is the Contractor's responsibility to supply all ancillary equipment required to implement the modification.

Procurement/supply consists of at least the following activities:

1. Preparation of material/equipment specification for the procurement of required material/equipment
2. Review and approval of drawings, tests and qualification reports
3. Informing Purchaser of Factory Acceptance Tests
4. Witness at Factory Acceptance Tests
5. Preparation and transfer of manufacturers documentation to NEK
6. Verification that contracted test requirements are met and tests demonstrate equipment & component capabilities performance requirements.
7. Ensuring that suppliers compile properly the required reports and manufacturing certificates.
8. Contractor/Purchaser will participate at the inspections and testing during the equipment manufacturing.
9. All ancillary equipment required to manipulate, install and maintain new HP Turbine
10. The Contractor's Scope shall include all testing and inspection requirements to be performed by the Contractor pursuant to the component design requirements and Purchaser heavy load license commitments
11. Inspections, examinations, and testing as required
12. Documentation as required.
13. All components and ancillary equipment shall be shipped in necessary racks, cradles, frames, containers, etc. furnished by the Contractor. Shipping configurations shall be provided in accordance with standard industry practice, specified quality assurance requirements (Section 30 herein) and Certificate of Compliance. Appropriate working facilities shall be provided for the Purchaser's Resident Inspector at any fabrication facility employed by the Contractor. Facilities shall include a standard desk, chair, locking file cabinet, free access to internet and private telephone circuit.

3.7 Construction, Installation, Commissioning and Loading

FAT, SAT and Start-Up Plans are developed based on design - transfer of the mentioned plans into executable procedures after the completion of fabrication/procurement phase. Major tasks in the Construction, Installation, Commissioning and Start-up process shall include:

1. Preparation of all necessary Field Design Change Requests (FDCRs).
 2. Performance of constructability analyses, providing opinion on best options.
 3. SAT (Site Acceptance Test) at NEK Site. Contractor shall prepare a SAT procedures that shall be reviewed, commented and approved by NEK. Scope of Site Acceptance Testing shall envelope full scope of FAT already performed at equipment supplier's facilities witnessed by NEK. SAT shall exercise full scope of individual modification functional and performance testing, including performance testing, which may not have been possible during FAT.
 4. Tests and inspections shall be performed in accordance with written procedures which have been reviewed and approved by the Purchaser.
 5. Existing plant procedures shall be adapted or modified as necessary for the project start up test.
 6. Contractor shall prepare Start-up Procedures (SUP's) which shall be reviewed, commented and approved by NEK. Scope of Start Up Procedures shall envelope all equipment manipulation needed to start the systems in all
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designed configurations, system start-up activities by preparing correct startup program with related test procedures in order to ensure a safe operation testing, and checkout of the equipment. Field technical services to correct manufacturing and design errors/deficiencies shall be the Contractor's Scope, but with the Purchaser's final approval of the techniques, equipment and methods used. Contractor's field personnel shall be capable, qualified, and able to perform the duties required to the satisfaction of the Purchaser and shall be vested with authority to make decisions binding on the Contractor.

7. Lighting
8. Commonly available tools
9. Temporary container (for offices or temporary storage location at Turbine deck TB elevation 115)
10. Calibration service for the additionally installed equipment/instrumentation, except for the equipment/instruments normally used at the plant
11. Provide any gasses for welding purging etc.
12. Contractor shall provide for any plan activity work leader familiar with NEK processes and qualified as a work leader. To be able to interface with the plant processes and personnel he/she should speak Slovenian/Croatian.
13. For the FME zones a FME monitor shall be provided by the Contractor. The Contractor shall also provide FME protection equipment. For fire risk activities Contractor has to assign fire watch person.
14. The Contractor shall provide Start up support Team for balancing the HP turbine with tools and equipment for balancing.

Nothing in this Specification shall relieve the Contractor from performing, such analyses, tests, inspections and other activities considers necessary to ensure that the design, material and workmanship are satisfactory for the service intended, or as may be required by common usage or good practice.

Preparatory work and New HP Turbine construction must be developed according to the corresponding design Modification Package

3.8 New HP Turbine Replacement/Installation Performed by Contractor

The Contractor will be responsible for repair of any damage incurred to any plant structures, components, equipment, etc. during the performance of installation and services if he can be held responsible for the damage.

Equipment installation shall include the following activities:

1. Scaffolding requirements for service
2. FME Control (Foreign Material Exclusion)
3. Cleaning of working area, Final clean-up.
4. Insulation removal/ installation

All equipment, tools, materials, manpower, testing and inspection and other services necessary for the completion of the Scope of Services and Delivery, even if not expressly included in the Installation Package are part of the Contractor's Scope of the supply, except to the extent specifically included in NEK's Scope.

3.9 Commissioning

3.9.1 Loading Service

1. The Contractor shall provide all needed equipment for new HP turbine parts manipulation to/from turbine deck
2. The Contractor shall provide Project management, supervision, labor and equipment specified herein to perform preparation, installation, startup, and testing services at the Plant.
3. The Contractor crew shall perform the following activities:
 - a. Participate in the Project meetings and Readiness Reviews.
 - b. Work with Purchaser's personnel on planning and scheduling activities.
4. Contractor shall provide a crew made up of a Project Manager, Shift Supervisors, technicians, craft, welders, and NDE test personnel to implement the respective works as required. Project Manager and Shift Supervisors shall be designated as Key Personnel, and shall be subject to Contractor and Purchaser review.
5. Contractor shall possess computer-based project management tool (e.g., PX, Primavera or equivalent) capable of integration with the Purchaser's integrated Project schedule.
6. Contractor shall conduct appropriate pre-job briefs.
7. The Contractor shall immediately report to the Purchaser any non-conforming condition, identified during New HP Turbine works process, for entry into the Purchaser Corrective Action Program.
8. Contractor shall attend daily schedule meetings.
9. Contractor personnel responsible for Site work coordination and completion shall maintain logs and records of problems encountered, delays, etc., having an effect on cost and/or schedule. The logs shall be available to Purchaser for review at any time.
10. Contractor will be responsible for coordination and timely in-processing of all personnel; in-processing will be performed by Purchaser. Contractor will be responsible for providing information to Purchaser for background investigations as necessary.

3.9.2 Onsite Preparation

1. Pre operational checkout of loading equipment
2. Preventive and corrective maintenance activities for applicable New HP Turbine equipment, as required

3. Setting up of the New HP turbine work area including staging of support equipment, routing of service air and electrical power lines and storage stands; auxiliary equipment such as lift yokes, exhaust vent manifold, welding equipment, gases and consumables.
4. The Contractor shall provide weld wire. All materials will be processed through the Purchaser's material warehouse.

3.10 Preparation of Turn-over Package and Project Closure

Contractor and/or its subcontractor shall provide needed activities to close the Project according to the requirements of NEK procedures. Project closure for modification shall include the following activities:

- a) Preparation of As-Built essential drawings (before Turbine system start-up)
- b) As-Built update of DCM
- c) As-Built update of EAM-MECL (EBS asset)
- d) Signing of Handover Protocol
- e) Preparation of all other As-Built drawings
- f) Preparation of TOP per NEK procedure ESP-2.611

3.11 Spare parts

Contractor shall supply recommended spare parts and provide a list (Itemized and priced) for the purchased equipment. At least the following recommended spare parts shall be listed in the table:

1. HP turbine spare parts
 - One (1) set of inner casing and/or blade rings horizontal joint bolting
 - One (1) set of outer casing joint bolting
 - One (1) set of Diaphragm and Rotating Blade Seals
 - Two (2) sets of inner and two (2) sets outer shaft gland seal segments
 - Two (2) sets of High Pressure Turbine Bearings (self-aligning type bearings together with adjusting liners, tilting pads, bearing supports, bearing outer housing and temperature measurement elements)
2. Control valves spare parts
 - One (1) control valve subassembly – removable part (muffler, bonnet, plug, stem, bushing, seal ring, seal, nuts, washers, bolts, ..), (spring & linkage support and new actuator with LVDT, limit switches, servo valve, if the design is modified, too), flow induced vibration proof design, position interchangeable, compatible with existing DEH system, fitted in the existing valve body with or without additional machining
 - Two (2) Sets new LVDT

3.12 Project Management

3.12.1 General

Project management should include all personnel and other resources necessary to plan, organize, direct, and control the New HP Turbine Project. They shall be responsible for:

- a) Engineering and Design of New HP Turbine Project
- b) Developing the Project plan & schedule
- c) Working with NEK to approve the plan & schedule
- d) Coordinating all main subprojects of the New HP Turbine Project

The Contractor shall provide the necessary personnel and equipment to successfully design and manage the New HP Turbine Project as identified and described elsewhere in this Specification. The Contractor shall be responsible for the selection and supervision of all personnel within the project organization under the Contractor's control. Various elements to be included in the Contractor's Project management are described herein.

As a part of the proposal the Contractor 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 Services and Delivery. The Contractor shall also identify the executive who will have the responsibility and authority for the completion of the work Scope.

The Contractor shall provide a competent Project management staff capable of managing the implementation and completion of the Scope of Services and Delivery. The Contractor shall provide home office and site project organization charts (including subcontractors) that correspond to the following phases of the Project:

- b) Engineering and management prior to the Site mobilization
- c) Site mobilization in the year 2021

The Contractor shall provide technical staff with specifically defined duties, responsibilities, and authorities to support timely resolution of all design and other deficiencies in the design documentation identified during the installation phase of the Project and prepare all necessary FDCRs. The personnel shall be defined as key personnel. The key personnel shall be assigned full-time to the Project, and their names and titles shall be clearly depicted on any and all organization charts when applicable. The Contractor will not change personnel assigned to key positions without the prior approval by the Purchaser.

The Contractor shall designate an Authorized Representative to act on behalf of the Contractor for all matters related to the Contract, including:

- a) Receiving all communications from the Purchaser
- b) Providing all approvals, consents, authorizations, and proposals
- c) Transmitting all communications to the Purchaser
- d) Acting for and committing for Contractor

During the course of the New HP Turbine Project, regularly scheduled and special meetings will be required between the Purchaser and the Contractor to review progress, establish and review schedule requirements, and discuss other items (modification) concerning the status of the New HP Turbine Project work. These meetings will be scheduled at the Purchaser's facilities and will be attended by the appropriate Purchaser and Contractor personnel. Meeting minutes may be taken by the Purchaser at his discretion.

3.12.2 Planning, Scheduling and Reporting – Project Management Manual

The NEK New HP Turbine Project is scheduled to be completed till the end of the outage 2021.

After the Contract award, the Contractor shall finalize Project Management Manual with integrated detailed schedule with milestones and reports for Purchaser's approval of overall schedule (design, fabrication and delivery of major equipment).

The Contractor shall be responsible to prepare and submit to the Purchaser for approval the Project Management Manual (PMM) defined in Appendix E. The purpose of this document is to establish guidelines for conducting business and to provide reference to specific administrative procedures that affect work activities between the Contractor and the Purchaser. The PMM will define Project level interfaces, as well as the overall Project operation. The PMM is intended to establish the basis for effective communication and responsive actions between the contracting parties. The PMM shall also include existing NEK communication infrastructure using Microsoft SharePoint 2010 application on NEK Portal "Projektne mape").

The PMM will address the issues such as Project organization and interfaces between the Purchaser, Contractor, Subcontractors and Major Equipment Suppliers. Correspondence and communication control and their record keeping will also be addressed within the PMM. The PMM will further describe the process required to permit the Contractor to utilize the existing Purchaser procedures during the performance of work.

Due to the nature of the PMM, it is intended to be a "living document", and the Contractor will be required to maintain and revise it as the Project progresses. All PMM revisions will require approval by the Purchaser.

The PMM shall be the plant lifetime document and shall be properly treated through NEK's document control program.

Within the PMM the simple process for the classification of certain set of the documentation as safeguard information shall be defined. Such sets of documentation shall be recognized based on the content of the included information and shall be recognized as soon as possible but definitely before the issue of such set of documentation. Required process shall recognize the classification of the information and define the way and persons who will take care about such kind of documents.

Project Control includes provision of personnel, supplies, software, and equipment necessary to perform all planning and schedule functions for the Project. The objectives of the Project Control functions are:

- a) Overall Project control from the Contract award to the TOP handover to NEK.
- b) All project scheduling shall be performed on Project management software (PRIMAVERA P-6 or equivalent).

The Contractor's Project Controls scope shall include provisions of personnel, supplies, software, and equipment necessary to perform all schedule functions for the Contractor's Scope of supply and to integrate suppliers and construction sub-contractors activities into a master schedule with the following major provisions:

- a) Develop and maintain integrated Project Schedule based on schedules provided by the Contractors and the Purchaser
- b) Provide requirements for schedule to contractors (schedule software, template coding structure, etc.)
- c) Provide schedule updates
- d) Perform critical path analyses and what-if scenarios
- e) Recommend planning corrective actions

4 SAFETY CLASSIFICATION OF CONTRACTED WORK

The contracted Scope of Services and Delivery is classified as Augmented Quality in accordance with Krško NPP classification. The equipment is important for stable and reliable plant operation. For the work on such components the Contractor shall be familiar with original technical regulations for the design.

5 DESIGN INPUTS

5.1 Design & Functional Requirements

5.1.1 Maximum Design Conditions

The new steam path shall be capable of continuous operation in the entire NEK operating window (Appendix J) with Partial/Full Arc Admission, inlet guide ring, all extractions in operation, and cross-around steam being supplied to the auxiliary feed pump turbine.

The turbine (HP and LP) shall be capable of continuous operation without de-rating up to an exhaust back pressure of 8 in. Hg Abs. The turbine shall be capable of operation at 100% of rated NSSS steam flows and rated conditions with condenser vacuums as low as 1 in Hg Abs and for range of Steam Generator pressure as defined in Appendix J. The Contractor shall analyze all cases of operation with »New HP Turbine« based on data about steam inlet parameters, Sava river cooling temperature over the last three years, connecting condenser pressures and exit steam velocities from the last stage of LP Turbine. The Contractor shall provide acceptable region for turbine operation in the form of diagram and recommend the optimum regime for operation with »New HP Turbine« taking into account all specifics of NPP Krško (Existing CW Pumps, condensers, tube cleaning system, river water temperature and cleanliness as a function of condenser vacuum and other valid variables).

5.1.2 Objectives

The following objectives shall apply to the design of the new HP turbine steam path:

- a. To provide a state-of-the-art design that will improve efficiency of HP Turbine and consequently **increase the Krško NPP total gross electrical output for 7 MWe or more**, and eliminate any current reliability concerns.
- b. To contribute to maximum overall availability and efficiency for the NSSS-turbine-generator combination.
- c. Control valves design shall be flow-induced vibration proof to eliminate the muffler lifting problem and less pressure drop whilst producing improved efficiency.
- d. To provide replacement (removal and installation) in 21 days during the April, 2021 outage in accordance with Appendix K
- e. To successfully completed Start-up Test on 28th day of the outage in April 2021 with no influence on outage critical path.
- f. To successfully completed Site Acceptance Test in April 2021
- g. To ensure the resistance of materials to erosion/corrosion and stress corrosion cracking and 12-years maintenance period
- h. Compatibility of new HP turbine with existing equipment and systems (LP Turbines, GN, TC, TD, TG, EX, EH, MS, LO, PDEH, HD ...) in NPP Krško
- i. One new fully bladed high pressure turbine rotor, stators and outer casing with all necessary changes, attachments, equipment, spare parts, materials, services and engineering necessary to perform installation, testing, licensing and operate NPP Krško under power uprated conditions.
- j. To provide ease of maintenance (such as providing quick disconnect couplings) and inspection (such as no rotor bore) over a 40 year design life.
- k. To address Stress Corrosion Cracking (SCC) as a maintenance issue. This shall include all areas subject to SCC such as rotor blade root radii, inner cylinder, etc.
- l. To eliminate or severely reduce the wear due to moisture erosion.
- m. To minimize both the possibility and consequences of missile generation.

The rotor and all other parts shall be designed for 40 years of life by minimizing stress concentration effects. As large radii as practical shall be used and stress risers and crevices eliminated, in order to minimize material stress corrosion effects.

In order to support the 40 years design life, the Contractor shall furnish documentation that substantiates the design bases. This should be in the form of a comparison at the 100% design operating condition of his rotating and stationary parts design (i.e., allowable stress/actual stress) using ASME Code equivalent material allowable stresses.

A summary report shall be provided to briefly explain the Contractor's design approach to fulfill the goal for service life of 40 years

For all parts, including blade roots, the evaluation of SCC resistance will be per Contractor design methods and allowable.

5.2 Mechanical Requirements & Features

Turbine rotor shall be designed as fully integrated ruggedized (FIR) monoblock type and fabricated from new shaft with blades features and shroud blades, with redesign blade roots to have low stress factor etc. to make a complete rotors assembly compatible with 1500 rpm and without danger of mechanical damage, thermal distortion or excessive vibration.

Stator and rotor blading shall be designed for minimum leakage loss throughout the load range, without danger of internal rubbing and without the need for making adjustments or otherwise altering the clearances of the rotor relative to the stator.

The design shall take into account possible transportation limitations.

The detailed fabrication shall include:

- a. Manufacturing of »New HP Turbine« for NPP Krško. New HP rotor shall be monoblock type.
- b. Assembling of all blade stages, all blade shrouds and all blade locking devices for both ends of new rotor.
- c. Rotor couplings shall be equipped with replacement coupling bolts and must be fully compatible with the existing LP turbine rotors.
- d. Rotor shall have provisions for on-site balancing (i.e., balance holes, weights, etc.) without removing the rotor.
- e. Preparation for shipment (Section 30.0) and shipping of »New HP Turbine« and equipment DAT NPP Krško Site.

Contractor shall identify all additional parts such as bearings, seal rings, coupling bolts, oil rings, spacer plates, etc. that will require modification or replacement to accept the new equipment.

Turbine stationary parts shall be new fabricated outer casing, inner casing and/or blade rings, airfoils, covers, seals, etc. to make a complete stationary assembly with sufficient and effective drainage points. Hollow spaces where water may collect shall be avoided.

The detailed fabrication shall also include:

- a. New stationary assemblies that is compatible with the HP rotor. The Contractor will identify specific quantities for the HP's.
- b. Assemble all airfoils, all airfoil covers/seals and all stationary locking devices for the new stationary sections.
- c. Preparation for shipment (Section 30.0) and shipping of all new stationary parts to DAT NPP Krško Site.
- d. Fabrication and shipment of all other stationary parts not re-used because of the design, such as inlet and exhaust flow guides, outer or inner gland rings, cylinders and/or bearing assemblies, keys and shims for adjustment, and steam seals that are necessary to make up a complete steam path.

The design shall also maintain the current frequency of Overspeed Protection System testing, the 6-months Main Turbine Valve testing, and the Main Turbine Valve disassembly/inspection frequency.

The Contractor shall ensure the pre-alignment of the stationary parts so that they can be assembled as a complete assembly.

Critical speed calculations shall be carried out for the complete T-G set. In consideration of bearing and foundation elasticity, no critical speed shall occur for the combined rotor between 80 and 120% of the normal operating rotational speed (All critical speeds of HP rotor shall be outside of the 1200 - 1800 RPM range).

Torsional oscillatory phenomena at the coupling shall be overcome in every normal and emergency operating condition, including the most unfavorable case of generator short circuit.

A rotor train torsional analysis shall be performed that encompassing all torsional frequencies up to 110 Hz. It shall include the new HP and exciter (2018) rotors and existing LP turbines and Generator rotors. The analysis must show that the assembled shaft torsional frequencies, when taking into account both analytical and testing tolerances, is +/- 2 Hz away from either 100 Hz or 50 Hz forcing frequencies.

The final design shall support the Nuclear Regulatory Commission (NRC) approved 10 year inspection interval. The vendor shall not require any interim inspection which requires opening the unit prior to the specified 12 year inspection. The Contractor shall be responsible for furnishing all technical information to NPP Krško.

All parts of the turbine shall be designed to permit free thermal expansion and contraction without exceeding allowable stresses or disturbing the alignment. Balancing shall be possible without opening the respective cylinder.

5.3 System Inputs & System Configuration

Contractor shall provide a summary report of interfaces with the existing components, including design characteristics of the interface such as dimensions, bearing design loads, foundation loads and movements, flow rates of lubricating and/or cooling system, DEH, gland steam seal systems, extraction steam nozzle movements, supervisory instrumentation, instrumentation loops P-505 and P-506 and other interfaces. This shall include, but is not limited to, the items described in this section.

EQUIPMENT INTERFACE REQUIREMENTS

The new steam path shall be compatible with the existing design configurations of all the systems, accessories and auxiliaries at the NPP Krško unit. The Contractor shall be responsible for reviewing applicable design documentation within ninety (90) days after the applicable refueling outage during which adaptation measurements are taken (if required), and for taking sufficient measurements to verify that the new steam path is compatible with all turbine-generator systems. For refueling outage related items, the Contractor should identify its requirements to NE Krško three hundred and sixty (360) days prior to the refueling outage when equipment installation is anticipated to occur, to allow for adequate preparation.

The identification of any modification to the existing NPP Krško unit systems or components that are required to accommodate the new steam path is the responsibility of the Contractor.

Examples of systems/components requiring design interface evaluation for system interaction considerations are as follows:

- a. Existing journal bearing pedestals including foundation loads. Contractor shall furnish the foundation loads to NPP Krško.
- b. Complete lubricating oil pumping system compatibility with the existing NPP Krško unit oil viscosity and quality requirements and operating with the existing bearing lift pumps. The Contractor shall be responsible for the redesign and modification of any Contractor identified modifications.
- c. Turbine glands used in the steam gland sealing system.
- d. Supervisory instruments for the unit including, but not limited to, the following Vibration phase angle meter with pick-up selector switch, including shaft-mounted reference detector and required supervisory instrument circuitry. Shaft vibration pickups for bearings #1 through #6.
- e. RTD's as listed below:
 - i. For measurement of turbine metal temperatures for the purpose of controlled starting.
 - ii. For all main bearing metal.
 - iii. For all main bearing drains.
- f. HP Turbine exhaust interface including all crossunder and extraction piping.
- g. Shims and soleplates required to set and align the unit. Set of lifting beams/slings and special tools and wrenches as required by turbine design. Contractor shall perform an analysis and if necessary modify the NPP Krško lifting beams.
- h. Turbine rotor couplings at the following locations:
 - i. Shaft extension with main oil pump to HP turbine,
 - ii. HP to jack shaft "X" and jack shaft "X" to LP "1".
- i. Instrumentation loops P-505 and P-506
- j. PDEH System

The couplings in Item h. listed shall be furnished with replacement coupling bolting. This shall include bolts, sleeves and alignment pins as necessary. The Contractor shall provide any required in-line coupling boring or reaming during the installation.

5.4 System Outputs

- 5.4.1 The Contractor with Purchaser prior agreement will establish acceptance criteria for function operability under different plant conditions including vibration limits and noise limitations.
- 5.4.2 The Contractor shall review or furnish limiting parameters for operation and startup such as:
 - 5.4.2.1 Allowable deviations from design throttle pressure and temperature.
 - 5.4.2.2 Maximum permissible LP turbine back pressure and maximum permissible differential pressure between the condenser shells. This shall include both 100% power operation as well as operation below 50% power where blade stall/flutter is a concern. It shall also include both alarm limits and trip limits.
 - 5.4.2.3 Permissible limit on cooling water inlet temperature or resulting bearing oil, seal oil, hydraulic fluid.
 - 5.4.2.4 Bearing vibration alarm and trip limits for each bearing.
 - 5.4.2.5 Limitations on startup. This shall include, but not be limited to; blade vibration frequencies, rotor vibration frequencies, differential expansion limits and HP rotor heatup/cooldown rates.

5.5 Maintenance Requirements

- 5.5.1 Contractor shall furnish one set of special tools and materials necessary for any components requiring field assembly/ disassembly.

All parts, spare parts and tools provided shall have identifiable nomenclature in English traceable to both drawings and spare parts lists.
- 5.5.2 Measures to be considered in view of reduction time for maintenance and outage as:
 - a. Coupling bolting
 - b. Control of rotor clearances
 - c. Bolt torqueing system

5.6 Calibration Requirements & Accuracy

For all required performance testing the existing NPP Krško process information system shall be used. Calibration and accuracy requirements will be established at kick-off meeting between the Contractor and NPP Krško.

5.7 Project Management & Project Control

- 5.7.1 The Contractor shall identify and describe the organization under which the Project will be performed, identifying the resources (number and types of personnel) available to carry out the work associated with the scope Scope of Services and Delivery. The Contractor shall also identify the executive who will have the responsibility and authority to approve the completion of the Project Scope.

- 5.7.2 Project management should include all personnel and other resources necessary to plan, organize, direct, and control the “New HP Turbine” Project. Project management shall be responsible for:
- Engineering the “New HP Turbine” Project
 - Developing the Project Plan & Schedule
 - Working with the Purchaser to approve the plan & schedule
 - Implementing this plan, ensuring that it is completed on schedule and within budget
 - Coordinating all “New HP Turbine” efforts on Site as well as off Site, and ensuring that these efforts are accomplished in a timely and efficient manner.
- 5.7.3 The Contractor shall provide the necessary personnel and equipment to successfully engineer and manage the “New HP Turbine” Project as identified and described elsewhere in this Specification. The Contractor shall be responsible for selection and supervision of all personnel within the Project's organization under the Contractor's control. Various elements to be included in the Contractor's project management are described herein.
- 5.7.4 The Contractor shall provide a competent Project management staff capable of managing the implementation and completion of the Scope of Services and Delivery. The Contractor shall provide home office and site project organization charts (including subcontractors) that correspond to the following phases of the Project:
- Engineering and management prior to Site mobilization
 - Site mobilization and the non-outage period prior to the “New HP Turbine” outage
 - During the 2021 outage
- 5.7.5 The Contractor shall provide managers and supervisors with specifically defined duties, responsibilities, and authorities to direct the construction/implementation; procurement; project controls; quality assurance/quality control; safety. The 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 on any and all organization charts when applicable. The Contractor will not change personnel assigned to key positions without the prior agreement by the Purchaser.
- 5.7.6 The Contractor shall designate an Authorized Representative to act on behalf of the Contractor for all matters related to the Contract, including:
- Receiving all communications from the Purchaser
 - Providing all approvals, consents, authorizations, and proposals
 - Transmitting all communications to the Purchaser
 - Acting for and committing for Contractor
- 5.7.7 During the course of the “New HP Turbine” Project, regularly scheduled and special meetings (Steering Committee Meetings) will be required between the Purchaser and the Contractor to review progress, establish and review schedule requirements, and discuss other items (modifications) concerning the status of the “New HP Turbine” Project. The Contractor will be required by the Purchaser to provide representation at plant outage meetings. During the outages there are typically 2 planning meetings per day and 2 status or problem meetings per day
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with the station management group. These meetings will be scheduled at the Purchaser's facilities and will be attended by the appropriate Purchaser and Contractor personnel. Meeting minutes may be taken by the Purchaser at his discretion.

- 5.7.8 From time to time throughout the duration of the "New HP Turbine" Project, the Purchaser may request special assistance from the Contractor. This assistance, not previously identified, may be in the form of special studies, presentations to outside agencies, or unique requests from URSJV.
- 5.7.9 Project Controls include provision of personnel, supplies, software, and equipment necessary to perform all planning and schedule functions for the "New HP Turbine" Project. The objectives of the Project Controls function are:
- a. Support the Purchaser's overall "New HP Turbine" Budget.
 - b. Integrated site-wide Outage Management for the NEK "New HP Turbine" outage.
 - c. Performance of "New HP Turbine" -related non-outage activities.
- 5.7.10 At the project control level, a Work Breakdown Structure will be used to integrate cost and schedule data.
- 5.7.11 All "New HP Turbine" scheduling shall be performed on project management software (such as Primavera) to facilitate electronic transfer of schedule data. Specific software product and versions are to be approved by the Purchaser prior to the installation and use and must be compatible or transferrable to the Purchaser's current scheduling system.
- 5.7.12 All scheduling software shall be capable of full functionality in a personal computer based network environment.
- 5.7.13 The Contractor's Project Controls scope includes provisions of personnel, supplies, software, and equipment necessary to perform all schedule functions for the Contractor's Scope of Services and Delivery. It is envisioned that the Contractor will integrate cost and scheduling data using a Work Breakdown Structure.

5.8 Other Conditions/Services (Time Response Requirements)

- 5.8.1 All of the parts furnished shall include the design, manufacture, shipment and technical direction of installation required to make the new steam path design capable of replacing the existing steam path, but with a gain in performance, and no loss of unit availability, operational flexibility, or maintenance accessibility.
- 5.8.2 The cost of additional instrument connections inside the turbine cylinder, to perform an SUP-16.061 alternative nuclear test. Contractor will be responsible for all test connections associated with the HP turbine up to the connection with the outer cylinders.

5.9 Installation Requirements

The safety scope includes the provision of all personnel, materials, equipment, tools, facilities, and supplies necessary to implement the health and safety program required to accomplish the New HP Turbine Project. All the work associated with the New HP Turbine Project shall be performed in accordance with and in full compliance with all applicable regulations and laws and the Purchaser's safety rules. All work shall be performed in a systematic manner under a documented Safety Plan, developed by Contractor, which provides the necessary direction to comply with the rules and regulations and provides for the health and safety of the personnel and protection of the plant.

All persons employed by the Contractor, agents, subcontractors, or other persons for which the Contractor has responsibility shall perform work under the direction of the Contractor's health and safety program. All persons shall be instructed and be familiar with safety rules and regulations applicable to the work being performed. The Contractor shall have sole responsibility for ensuring that such persons are so informed and that safe work practices are followed.

The Contractor shall designate a qualified Safety Representative. The Safety Representative shall attend all project safety meetings and participate fully in all activities outlined in Contractor's safety program. The Contractor's Safety 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 Contractor's occupational health and safety staff shall be adequate to respond to the administrative aspects any emergency or medical situation resulting from the New HP Turbine work. The Contractor shall maintain reports of all accidents and injuries and report to NEK. The Contractor, once mobilized, shall hold regularly scheduled meetings to instruct its personnel on safety practices and the requirements of the safety program. The Contractor shall furnish safety equipment and enforce the use of this equipment by its personnel.

Before the installation, the Contractor shall submit the Safety Plan to the Purchaser for approval. Program shall have a statement which industrial health standards and safety standards were used in preparation of New HP Turbine activities. Approval of Contractor's Program by the Purchaser does not relieve the Contractor of any Contractor health and safety responsibilities. Safety Plan is part of the Installation Package.

6 APPLICABLE NEK- CONTRACTOR DESIGN CONTROL PROGRAM

- | | |
|---------------|--|
| • ED-1 | Design Modification Control Program |
| • ED-2 | Document Control Program |
| • ED-15 | Program nadzora konfiguracije |
| • ADP-1.2.116 | Nadzor dokumentov v NEK |
| • ADP-1.2.003 | Plant Design Modification and Control Process |
| • MD-23 | Risk Assessment (Celovito upravljanje tveganj) |

- ESP–2.301 TS Changes and Licensing Amendments
- ESP–2.607 Design Verification
- QD-1 Quality Assurance Plan
- QS 610, rev.1 Generic Quality Assurance Program Requirements

7 APPLICABLE CODES, STANDARDS, DESIGN CRITERIA FOR WORK

The design criteria, regulations, codes and standards listed below are applicable to the New HP Turbine Construction and are to be considered in the detailed design. They will apply to either the design of the new systems, supporting systems or components and their structures.

To the extent specified herein, the version and full identity of all codes, standards, and other documents applicable to this Specification are shown in Section 7. A later version of some of the dated documents may become mandatory under the regulations that have jurisdiction. If this develops, the newer version of each document shall be identified by means of a revision to the Specification. If there is a conflict between this Specification and a referenced document, the Contractor shall refer the matter in writing to the Purchaser to inform him of the conflict and to provide a proposal to resolve the conflict for Purchaser's approval. This process will also apply in the case of a conflict between codes and standards.

The code and standard dates are provided as a reference. The Contractor, unless otherwise stated by the Purchaser, shall use the appropriate codes and standards listed in this section in effect at the time of Contract signature .

Contractor will provide a detailed review of listed references in Sections 7.1 through 7.7 during the Project initiation phase. Any conflicts or contradictions between references will be addressed with proposed resolution by the Contractor to NEK.

7.1 Slovenian Codes

- 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, ammended by ZVISJV-C Ur.l. RS, No. 60/2011 and ZVISJV-D, Ur.l. RS, No. 74/2015)
- 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)
- 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)
- Zakon o varnosti in zdravju pri delu (ZVZD-1), Ur. l. RS 43/11(Law on Safety and Health at Work)
- Zakon o zasebnem varovanju (ZZasV-1), Ur. l. RS 17/11 (Private Security Act)

- All applicable standards SIST or EN for design
- Odredba o varnosti strojev (Ur. l. RS št. 52/00 in 57/00, Decree on machinery safety)
- Konvencija o jedrski varnosti, UL RS-MP, št. 16/1996
- 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)
- Other major SNSA legislations available at [Http://www.ursjv.gov.si/en/legislation_and_documents/legislation_in_force/](http://www.ursjv.gov.si/en/legislation_and_documents/legislation_in_force/).

7.2 General US codes

- 10 CFR 50, Appendix A, "General Design Criteria"
- 10 CFR 50.48 "Fire Protection"
- 10CFR73 Physical protection of plants and materials
- 10CFR50.59 Changes, Tests and Experiments

7.3 Codes and Standards

- ANSI/ASME B30.9 [1971] Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
- ANSI/ASME B30.10 Hooks
- ANSI/ASME B30.20 Below-the-Hook Lifting Devices
- ANSI N18.2 - "Nuclear Safety Criteria for Water Reactor Plants"; ANS; 1973;
- ANSI N14.6-1993, "Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 Kg) or More";
- ANSI N45.2.15, "Requirements for the Control of Hoisting, Rigging and Transporting of Items at Nuclear Power Plant Sites";
- ASME Boiler and Pressure Vessel Code Edition 2010
- ASME American Society of Mechanical Engineers
- ANSI American National Standards Institute
- ASTM American Society for Testing and Materials
- AWS American Welding Society
- ASTM C168 Terminology Relating to Thermal Insulating Materials
- ASTM C196 Expanded or Exfoliated Vermiculite Thermal Insulating Cement
- ASTM C353 Adhesion of Dried Thermal Insulating or Finishing Cement
- ASTM C547 Standard Specification for Mineral Fiber Preformed Pipe Insulation
- ASTM C612 Standard Specification for Mineral Fiber and Block and Board Thermal Insulation
- ASTM C667 Standard Specification for Prefabricated Reflective Insulation Systems for Equipment and Pipe Operating at Temperatures Above Ambient Temperatures
- ASTM C720 Spray-applied Fibrous Thermal Insulation for Elevated Temperature
- ASTM C892 High-Temperature Fiber Blanket Thermal Insulation

7.4 Other Supplemental Criteria and Information

- NFPA 803-1989 "Standard for Fire Protection for Nuclear Facility Applications"

7.5 Other NEK Supplemental Criteria and Information

- Zakon o varstvu pred požarom, Ur.l. RS 3/07, 9/11
- Pravilnik o požarni varnosti v stavbah, Ur.l. RS 31/04, 10/05, 83/05, 14/07
- Pravilnik o študiji požarne varnosti, Ur.l. RS 28/05, 66/06, 132/06
- Pravilnik o protieksplzijski zaščiti, Ur.l. RS 102/00, 91/02, 16/08, 1/11, 17/11, 103/11
- Tehnična smernica TSG-1-001:2010; Požarna varnost v stavbah
- SIST DIN 14090 - Površine za gasilce na zemljišču

7.6 NEK Programs, Procedures and Licensing documents

7.6.1 NEK Programs

- ED-1 Design Modification Control Program
- ED-2 Document Control Program
- ED-14 Reactivity Management Program
- ED-15 Program nadzora konfiguracije
- MD-23 Risk Assessment

7.6.2 ADP - Administrative Procedures

- ADP 1.0.131 Organizacija izvedbe modifikacije (Development of modifications)
 - ADP 1.0.500 Program protipožarne zaščite – Požarni red (Fire Protection Program)
 - ADP 1.1.033 Varnost in zdravje pri delu v NEK (Health and Safety at Work at NEK)
 - ADP 1.1.051 Vstop, izstop in gibanje v tehnološkem delu NEK (Entry, exit and mov. within the technological part of the NPP Krško)
 - ADP 1.1.016 NEK Document Control Program
 - ADP 1.1.101 Preprečitev vnosa tujkov (FME Program)
 - ADP 1.1.105 Priročna skladišča in kontrolirano odložena oprema (Temporary storage and controlled deferred Equipment)
 - ADP 1.1.125 Izvedba delovnega naloga (Work Order Process)
 - ADP 1.2.003 Plant Design Modification and Control Process
 - ADP 1.3.004 Osamitev in označevanje sistemov / naprav (Tagging)
 - ADP 1.3.013 Kontrola ključev (Key Control)
 - ADP 1.4.022 Prevoz, skladiščenje, rokovanje in notranji transport (Storage, handling and internal transport)
 - ADP 1.14.202 Normativi osebnih zaščitnih sredstev (Standards of personal protective equipment)
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- ADP-1.1.128 Upoštevanje in dokumentiranje preventivnih ukrepov preprečitve vnosa tujkov (PVT) ob odprtih sistemih ali komponentah (Adherence to and Documenting of FME Preventive Measures at Open Systems or Components)
- ADP-1.1.141 Ravnanje s težkimi bremenami v NEK (Heavy Loads Manipulation in NPP Krško)
- ADP-1.6.701 Kontrolirani vstop nevarnih kemikalij v NEK (Controlled Entry of Hazardous Chemical Substances at NPP Krško)

7.6.3 ESP – Engineering Procedures

- ESP-2.113 EAM-MECL equipment numbering system
- ESP-2.301, Technical Specification Changes and Lic. Amend.
- ESP-2.302, Administration of Changes to the USAR
- ESP-2.303, Evaluation of Changes in NEK
- ESP-2.306, Administration of Changes to the Radiological Technical Specification (RETS)
- ESP-2.602, Plant Design Modifications
- ESP-2.604, Design Considerations, Bases and Inputs
- ESP-2.605, Design Analyses and Calculations
- ESP-2.606, Peer Reviews
- ESP-2.609 Field Design Change Request
- ESP-2.611, Design Modification Turnover and Closeout
- ESP-2.613, Izdelava, preslikovanje, popravljanje in predaja načrtov
- ESP-2.617, Engineering Services, Material and Equipment Technical Specifications (Technical Specifications)
- ESP-2.618, System Design Description
- ESP-2.619, Preparation of Installation Packages
- ESP-2.624, Design Impact Evaluation
- ESP-2.660, Uporaba programa PC-CKS v procesu modifikacij

7.6.4 FPP - Fire Protection Procedures:

- FPP 3.7.002 Postopanje v primeru požara
- FPP-3.7.004 Kontrola vnosa gorljivih snovi
- FPP-3.7.006 Požarna dovolilnica
- FPP-3.7.007 Ravnanje z vnetljivimi plini in tekočinami
- EIP 17.044 Nudenje prve pomoči in prve medicinske pomoči v primeru nezgode v NEK

7.6.5 Other Procedures

- EDC-3 Cable Tray Design Criteria
 - EDC-4 Cable Tray, Cable & Conduit Separation Criteria
 - EDC-5 Grounding System Criteria
 - EDC-9 Lighting & Small Power Systems
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- EDC-10 Cable Rating Criteria
- SP-S702, Seismic Analysis, Testing and Documentation
- GMC-4.004 Gradbeni odri
- QD-1 Quality Assurance Plan
- QS610, rev. 1 Generic Quality Assurance Program Requirements
- SP A322 Painting Exterior and Interior Surfaces of Secondary Plant and Equipment
- SUP-16.061 Plant Performance Test
- SP-G349, Technical Specification Fabrication of insulation outside of containment
- SP-G100, Storage and Instalation of Insulation outside containment

8 IDENTIFICATION OF AFFECTED SYSTEM(S)

TU, TD, TG, MS, EH, EX, PDEH, LO, HD, CY, FW

9 IDENTIFICATION OF AFFECTED EQUIPMENT

TU110TUR-001
TU114TUR-001
TU118TUR-001
PCV3704, PCV3705, PCV3706, PCV3707
TU900STV-001, TU900STV-002, TU900STV-003, TU900STV-004
20191, 20192, 20193, 20194, 20195, 20196, 20197, 20198
TC1130, TC1140, TC3050, TC3070, TC3080, TC3400, TC3410, TC3420, TC3430,
TC3550, P-505, P-506

10 SUPPLEMENTAL DATA

The NEK is located on the northern bank of the Sava River, approximately 2 km southeast of the town of KRŠKO in the east-southeast part of the Republic of Slovenia. The Site is on the northwestern brim of an alluvial valley surrounded by hills varying in relative elevation from 200 m to 700 m. The ground surface elevation of the Site is 155.20 m above sea level.

NPP Krško has installed Westinghouse HP turbine, two Mitsubishi LP turbines and Siemens generator as a tandem compound flow unit with reheat. Turbine consists of H.P.Turbine S.O.13A5461 **BB296**, L.P.Turbine #1 Serial No.: 6-366203 and L.P.Turbine #2 Serial No.: 6-366204. The high pressure turbine is a double flow element with reteau control stage followed by reaction blading in each end of the element. The steam enters the HP turbine through four MS pipes and associated flow stop-control valve (control valves type BB96, size 19,5”) assemblies installed at the turbine deck, two located on each side regarding the direction of the HP turbine axis. The steam flows to the nozzle blocks through the control stage and axially in both directions to the four openings (two

at each end) in the casing base, then through the crossunder piping to the moisture separator reheaters. Crossover pipes return the steam through the reheat stop and interceptor valves to the low pressure turbine.

10.1 Design Data before SG Replacement

The main turbine which corresponds to Westinghouse NSSS output of 1882 MW thermal consists of three casing tandem compound quadruple flow, condensing 1500 rpm turbine designed guaranteed to deliver 664,477 kW NET (measured at the generator terminals), when operating with rated steam conditions of 872 psia, 0.46 % maximum moisture at turbine stop valves, external moisture separator and two stage steam reheater in service, 1.5 in.Hg exhaust, all six (6) stages of feedwater heating in service and zero % make-up. The Guaranteed NET heat rate when operating under these conditions was 9,665 Btu/kwhr.

The turbine-generator unit had a maximum calculated (not guaranteed) net output of 690,829 kW with the governor valves wide open at steam conditions of 872 psia, 0.46 % maximum moisture at turbine stop valves, external moisture separator and two stage steam reheater in service, 1.5 in.Hg exhaust, all six (6) stages of feedwater heating in service and zero % make-up. The NET not guaranteed heat rate when operating under these conditions was 9,679 Btu/kwhr.

Each low pressure turbine TU114TUR-001 and TU118TUR-001 is a double flow element employing reaction blading. The last row blades are 1118 mm (44 inches).

The generator rating was 812,740 kVA, 0.85 power factor, 0.50 short circuit ratio, 3 phase, 21,000 volts, 50 Hertz. The machine operates at 1500 rpm with a hydrogen pressure of 6.5 kg/cm² (75 psig). Excitation is provided by a shaft driven, brushless exciter.

TURBINE PERFORMANCE SPECIFICATION – OPERATING CONDITIONS AT MAXIMUM GUARANTEE

The conditions under which the original turbine had operated were as follows:

Steam flow	8174416 lb/hr	3,707,853 kg/hr
Initial pressure at turbine throttle	872 psia	61.3 Kg cm ² A
Initial temperature at turbine throttle	527.7°F	275.4°C
Moisture % at turbine throttle		0.46
Exhaust pressure	1.5 in Hg A	3.81 cm Hg A
Speed		1,500 rpm
Number of FW heater extractions		6
% makeup		zero
Final feedwater temperature	429.8°F	221°C

The unit is expected to operate in the base load mode for the majority of its design life. Normal load swings are limited to the rate of change of the Nuclear Steam Supply System. The turbine generator is capable of accepting a load reduction from 100 percent to less than 15 percent (station auxiliaries only) using the approximately 80 percent capacity Steam Dump System.

A step load reduction of 10 percent of rated power can be accommodated without using the bypass system. The Plant can be manually controlled over its entire operating range at a rate of 5 percent of rated reactor thermal power per minute.

The steam turbine Digital Electro Hydraulic (DEH) Control System is designed in accordance with AIEE 600-1959.

The main condenser, furnished by others, is equipped with expansion joints in its turbine exhaust steam inlets. The extraction piping has expansion bellows connected to the turbine.

NPP Krško has already replaced moisture separator reheaters TU111HEX-001 & 002 and main condensers CO101CND-001 & 002.

Turbine effect on primary system operation is discussed in USAR Section 7.0.

10.2 Design data after SG, LP Turbines and Generator Replacement

After steam generators replacement in the year 2000 (which corresponds to NSSS output of 2000 MW thermal) NPP Krško has had licensed »Operating Window« concept. Heat balances were created to model operation at three different steam pressures (887, 919 and 952 psia at RSG outlet corresponding to 839, 871 and 904 psia at turbine valve inlet). After the LP turbines replacement in the year 2006, the turbine-generator has been rated at up to approximately 730 MWe gross with six stages of feedwater heaters in service, a condenser vacuum of 3.81 cm HgA (1.5 inches Hg, abs.) and zero makeup. Steam conditions at the upper limit of the "Operating Window" are 6.23 MPa (904psia), 278.0 °C (532.4 °F) and 0.47 percent moisture at the turbine valve inlet and final feedwater temperature is 219.8 °C (427.6 °F) of the maximum calculated heat balance of USAR Figure 10.1-8, which corresponds to 726.8 MWe. The generator uprated rating was changed up to approximately 850 MVA (USAR page 10.2-6).

USAR Data Table 10.1-1 (Maximum Calculated Heat Balance) provide the next informations about turbine:

Steam flow from steam generator	3931 t/h
Inlet pressure at turbine governor	6.23 MPa
Inlet temperature at turbine governor	278.1 °C
Moisture % at turbine governor	0.47
Exhaust pressure	1.5 in Hg a
Speed	3.81 cm Hg a
Number of FW heater extractions	1,500 rpm
% makeup	6
Final feedwater temperature	zero
	219.8 °C

Maximum calculated heat balance is shown on USAR Figure 10.1-8 and attached to this Specification.

Intermediate point calculated heat balance is shown on Appendix B, Fig. 2 and attached to this Specification.

Lower limit calculated heat balance is shown on Appendix B, Fig. 3 and attached to this Specification.

NOTE: NPP Krško will provide available information upon request later. If further detailed information is necessary and NPP Krško does not have it in possession or they are Proprietary to Westinghouse it shall be the Contractor's obligation to have proper arrangement to get it.

10.3 NEK Documents

The design inputs from the following NEK documents will be available upon request:

- USAR (Updated Safety Analysis Report) Rev. as effective on Contract Effective Date.
- TS (Technical Specification)
- Construction Drawings:
- Gilbert Associates Inc.(GAI)
- SS-211 ...Electrical Block Diagram
- D 302 ... Flow Diagrams
- E 304 ... Piping Systems
- E 405 ... Structural and Civil
- 816-... Process Information Systems Diagrams

11 DOCUMENT SUBMITTAL

Documentation required to be submitted by the Contractor shall be as requested in this Specification and the Contract. In addition, the Contractor shall provide any additional, mutually agreed, documentation not specifically identified herein.

Documentation (as defined in section 3.4) shall be provided according to the delivery schedule defined in the Contract, this Specification or associated Appendix A.

All documentation shall be prepared and finalized for the complete Scope offered and shall be in the English language. Metric system shall be used for unit measurement expression in submitted document.

11.1 BID Phase

CAUTION: If it is necessary to perform any other field measurements the Bidder shall coordinate with Purchaser all the activities at least three (3) weeks before the measurement execution. NEK can grant limited time and access (up to three night shifts with the duration from 05.04.2018 8 pm to 08.04.2018 6 am) and up to four individuals per shift during the outage. All workers shall fulfil all NEK's requirements (Attachment L) which allowed to work as unescorted person.

NOTE: During the bidding process the term Contractor shall be considered as Bidder while after Contract signature, the term Bidder shall be replaced by the term Contractor.

The Bidder shall identify and provide below required "Bidding Documentation" with all technical descriptions (Maximum offered MWe with MW Breakdown structure), 2021 outage work duration and technical explanations for major design features as: FIR, Shroud Blades, material resistance to E/C and prone to SCC, services required to replace the existing degraded high pressure turbine and install "New HP Turbines". The Bidder shall comment via a report to the Purchaser the compatibility between proposed "New HP Turbine" and the existing B.O.P. systems and Integration shall be shown.

The Bidding Documentation shall consist of the following chapters:

- a. Technical proposal with sufficient explanation of technical solution for the Project:
 - i. Present the HP turbine new design advantages and comparison with the existing one.
 - ii. Present the control valves and hydraulic actuator:
 - Valve design, actuator design, connection with EH system, LVDT, servo valve, ...
 - Key elements of the flow induced vibration proof design (design analysis, detail about muffler bonnet connections,...)
 - Valve flow versus lift characteristics
 - Flow versus lift characteristics for SINGLE and/or SEQUENTIAL mode of operation
 - Valve body fitting requirements
 - Present control valves operation from 0% to 100% Rx power (valve position versus RX power, valve operation mode change,...)
 - Present valve position versus main steam pressure for 100% Rx power for NEK operating window and SINGLE/SEQUENTIAL mode of operation
 - Valve and hydraulic actuator position interchangeability
 - Compatibility with the existing PDEH
 - Present compatibility with the existing EH system (EH fluid, pump capacity, pressure, EH tank capacity, ...) and proposed modifications of EH system due to valve actuator replacement
 - Present design elements to minimize pressure drop and quantify improved efficiency
 - Plant condition for turbine valves surveillance testing
 - New LVDT (manufacture, part number, drawings, technical data, accuracy,...)
 - New servo valve (manufacture, part number, drawings, technical data, accuracy,...)
 - Control valves and HP turbine shall be designed with at least 0.5% additional throttle reserve at Low Tavg and 5% steam generator tube plugging. The proposal shall evaluate, describe and present control valve no. 4 position for complete NEK operating window with 0,5% additional control margin at Low Tavg and 5% steam generator tube plugging at 100% reactor power (diagram: axis X- Steam generator output steam pressure in the range from 59 kp/cm2 to 67 kp/cm2 ; axis Y-control valve position from 0% to 100%)
 - iii. Mechanical interface: The Bidder shall prepare a comparison between the existing and new design presented on the BB296 Westinghouse turbine drawings. The Bidder shall consider that crossunder pipes are
-

- protected with a layer of austenitic stainless steel (309L) on the inner surface.
- iv. Instrumentation interfaces; the Bidder shall prepare a comparison between the existing and new design presented in the table and on the NEK drawings.
 - v. System interfaces: The Bidder shall prepare a comparison between the existing and new design and present in the table and on the NEK drawings influences on NEK systems.
- b. Detailed presentation of:
- i. The change in the impulse pressure measurement
 - ii. The new/updated method of measuring turbine power
 - iii. Provide comparison between the new and the existing measurement.
 - iv. Influence of new HP turbine to turbine control valves curve for all power levels with the valve opening rate as function of the pressure/load/flow; flow versus lift coefficients for governor valves in SINGLE and/or SEQUENTIAL valve modes.
- c. The Bidder shall supply a detailed description of how, why and where proposed performance improvements will be done
- d. The Bidder shall present in diagram (Output MW/Steam generator output steam pressure for NEK operating window) electrical output for complete NEK operating window with 0,5% additional control margin at Low Tavg and 5% steam generator tube plugging (diagram: axis X-Steam generator output steam pressure in range from 59 kp/cm² abs to 67 kp/cm² abs; axis Y-Power output from 720 MWe to 745 MWe.
- e. The Bidder shall supply preliminary heat balance diagram, with detailed explanation of performance improvements overview and present in the table detailed summary of megawatt expected to be achieved before/after replacement for:
- 1. Upper limit 0% SGTP (Appendix B USAR Fig.10.1-8; Appendix J)
 - 2. Lower limit 0% SGTP (Appendix B USAR Fig.10.1-8; Appendix J)
 - 3. Intermediate point 0% SGTP (Appendix B USAR Fig.10.1-8; Appendix J)
- f. Description of the equipment to be used in transport
- g. Description of how the cutting and machining Scope will be performed
- h. Description of the type of equipment to be used and how it will be installed
- i. Manufacturing experience and capabilities, including operating experiences and reference list for the Scope of work
- j. Organization chart for execution of work (+list of suppliers/subsuppliers)
- k. Key personnel description and resumes
- l. Preliminary detailed manufacture and overall project schedule
- m. Proposed schedule for manufacturing, transportation, preparation and removal/installation activities
- n. Proposed list of temporary/permanent activities on the existing plant equipment, systems
- o. List and brief specification of Major Equipment to be brought on Site
- p. List of potential subcontractors and description of work scope to be performed by each
- q. A description of the contractor's proposed construction/implementation program
- r. A description of the insulation scope of work. Type and design of the insulation for:
- 1. HP turbine outer casing
 - 2. Turbine stop and control valves
 - 3. Turbine reheat stop and interceptor valves
-

4. Turbine drain and turbine gland piping.

The Bidder shall present and describe the required thermal insulating sprayed (fix) design and removable horizontal joint bolting area, balancing/inspection openings, flange connections, insulation design, installation requirements and other materials like: supports, attachments, fasteners, adhesives, fabric, coatings, jacketing...

The insulation shall limit the system heat loss to an overall average not to exceed 100 W/m² (32 BTU/hr-ft²). The insulation shall be designed to limit surface temperature to 55°C and for 40 years life time.

- s. A description of the duration of all work activities in Turbine Building with the 2021 outage works duration presentation
- t. Estimate of the required numbers & types of the necessary equipment
- u. Estimate of the required amount for all consumables
- v. Bidder's special requirements, if any
- w. Detailed description of the proposed temporary enclosure
- x. List of recommended spare parts for purchased equipment – detailed description (location, name, quantity,...)
- y. Related drawings
- z. Preliminary torsional analysis
- aa. Preliminary PMM
- bb. Preliminary PQP in accordance with 43.2
- cc. List of used standards
- dd. Contractor's QA Manual
- ee. List of special tools with detail description

The Bidder shall supply a detailed description with calculations of how, why and where such performance improvements where done (plant uprate based on higher turbine and control valves efficiency). Additionally, in support of such analytical data and/or information, the Bidder shall supply information on the actual performance improvements achieved, at other nuclear facilities like NPP Krško.

For each activity/service required to successfully complete the installation and test, each Bidder has to submit the scope description, bar chart schedule, a key project level milestone, graph of manpower loading and location, manhour estimates, and other information the Bidder deems appropriate. At least the next activities/services shall be described:

- a. Engineering/Manufacturing/Construction/Transportation/Installation
- b. Quality Assurance/Quality Control
- c. Procurement Support
- d. As Built Drawings/Documents/Records
- e. New HP Turbine Replacement Report
- f. Other Services the Bidder may propose as appropriate

Bidder has to develop a computer model of the existing (2012-2017) rotor train, consisting of HP turbine, LP turbines and generator and exciter rotors based on which it will perform preliminary torsional analysis. The Bidder has to confirm that the results of the preliminary torsional analysis match with the results of the valid NEK torsional analysis and torsional test performed in 2012.

Bidder shall also specify required conditions and time frame for performing post installation torsional test, including mounting and removal of all required measuring equipment.

The Bidder shall provide details in the proposal of the new component construction (number of stages, blades heights, also efficiencies comparison and chart in i-s diagram), describing in detail the differences between the proposed turbine design and the original design. This

shall include the historical data (i.e., reliability of the Bidder's blade designs, rotor design and stationary parts erosion resistance) the 40 year design life, and all requirements in section 5. The Bidder shall describe the materials proposed to be used for the major parts of the equipment, such as rotor, blades (all stationary and rotating rows), cylinders/blade rings and outer casing, to be supplied using either an ASTM designation or the closest material standard association designation. This shall include moisture erosion protection features for all new components per Section 13. The Bidder shall also furnish confirmation that the HP design offered in response to this Specification has had zero (0) incidences of Stress Corrosion Cracking for at least the last five (5) consecutive calendar years on all operating rotors. The Bidder shall identify as a part of his bid, the use of any undesirable materials such as copper (Section 13) or other environmentally unfriendly materials.

The Bidder shall provide details in the proposal of the new/updated measurement of the turbine load, describing in detail the differences between the proposed impulse pressure design and the original design and show that new design is equivalent and such that it shall not be adversely affected by closing of individual turbine governor and/or stop valves, or by the operation in SINGLE/SEQUENTIAL mode of operation.

Scope of Services and Delivery for "New HP Turbine" Project is rather complex for NPP Krško, because it covers: a. Engineering/Design of "New HP Turbine", b. Manufacturing/Transporting of parts and components, c. Disassembly of old HP turbine and d. Assembly/Installation & Testing at Krško Site. Additionally, it creates a problem for Purchaser because of essential differences in established procurement process for services and for equipment in NE Krško.

The Bidder shall also provide:

- a. Description of the equipment to be used in transport
- b. Proposal organization with insurance of transportation
- c. Identification all needs for NEK support
- d. Description of how the cutting and machining scope of supply will be performed
- e. Description of the type of equipment to be used and how it will be installed
- f. Demonstration of the Bidder's full knowledge of the NPP Krško Site
- g. Description of the process Bidder (Contractor) will use to mitigate the entry of debris inside the turbine and piping system - FME program.
- h. Clear demonstration of the Bidder's knowledge of the Scope Services and Delivery, discussing all of the conditions associated with conducting work in an operational nuclear power plant
- i. Detailed list of tools, machines, and equipment that will be used for the cutting and machining scope of supply. For critical equipment (i.e. its failure would stop work), the Bidder shall list the proposed quantities and discuss contingency plans and actions in the event of equipment failures.
- j. Detailed description of the Scope included in the Bid price, to perform the thermal performance test, including a description of all supplied hardware, software and instrumentation
- k. List of spare parts

Each Bidder shall indicate additional documentation proposed to supply and shall submit with the proposal one copy of his Quality Assurance Program Manual covering the quality assurance measures imposed on the Bidder's Work and Bidder's subsuppliers or subcontractors.

All drawings, data and technical documents submitted to NPP Krško shall be in the English language. SI units of measurement shall be used. If necessary, other languages or units shall appear in the parenthesis with smaller font size used. The drawings, data and technical documents shall be submitted in accordance with NPP Krško requirements.

The Bidder shall comment in the special section of his Bid all requirements established in this Specification that he considers inadequately specified/defined, hard to understand or anyhow creating a problem for him or causing that his Bid to be less attractive to the Purchaser.

The Bidder shall explain any requirement for additional measuring or checking of NPP Krško turbine. A detail measuring session (without disassembly of HP), if necessary, can be organized during the outage 2018.

All technical solutions required for a safe, reliable and efficient operation of the new installed systems shall be considered and provided in the design.

Execution of HP turbine replacement is planned for the outage 2021.

The Bidder shall furnish to NPP Krško any special parameters or conditions applicable to the equipment provided or owned by NPP Krško which may affect the Contractors ability to fulfill the requirements of the performance criteria and warranties specified herein.

NOTE: Contractor can mark Bidding Documentation as proprietary; everything can be marked as proprietary except the price per item, number of items to be delivered and total price.

Contractor shall state its compliance to this Specification as a whole or in part and specify any and all other proposed approach to fulfill specific requirements. Detailed instructions about the preparation of the Bid are given in the document "Instructions to Bidders".

Within the proposal the Bidder shall submit Detailed Contractor Approach to Work describing technical solution and how the scope is understood. Compliance with the Technical Specification shall be also delivered/confirmed within the proposal demonstrating the compliances/non-compliances with the NEK requirements.

Within the proposal a separate technical proposal is expected which will describe the way how the Contractor understands the NEK requirements and the scope of this Specification. Technical proposal shall be based on the set of the individual design modifications per ESP-2.602 as described in Section 3.

The Bidder/Contractor shall furnish adequate information to the Purchaser to evaluate the Contractor's proposed design.

The information submitted by the Contractor in response to requests throughout the Specification shall be included in the purchase documents as a firm commitment of what the Contractor shall furnish. The inclusion of the information in the proposal shall in no way release the Contractor from its responsibilities for subsequent submittals as set forth in this Specification. The Contractor shall provide specific information addressing the location of interface points of the new designed equipment. This

information shall be compared to the existing structural and equipment layout of Krško NPP.

The design of all new equipment shall conform to the greatest extent possible to the existing plant structure and equipment layout. Consideration shall be given to the existing location of walls, support pads, columns, access platforms, instrument cable routing and any other interface, which may affect the existing plant structure and equipment layout. Any modification to the existing plant structure and equipment layout determined to be unavoidable shall be clearly specified and described to allow for planning and implementation of modifications in a timely manner.

11.2 Project Execution Phase

All document deliverables shall be submitted in two versions as a minimum: for NEK review and FINAL version to be approved by NEK. All documents for review shall be delivered to NEK in two hard copy (paper) and one soft copy (pdf files structured with bookmarks and active cross reference links). All final documents shall be delivered in three hard copies and six soft copies (CD with files in format as applicable: structured pdf, MS Word, Excel, Access, AutoCAD).

A detailed project schedule, that factors in the key project milestone schedule of Section 3.0, shall be submitted for NPP Krško review as a part of PMM and PQP no later than sixty (60) days after award of Contract. The detailed schedule shall include a listing of all engineering design deliverables (both calculations and drawings), manufacturing, testing, inspection and shipping milestones.

The documents shall be formatted in files and printed as hardcopies in A4, A3, or A2 sizes only. The exceptions could be related only to the revisions or mark-ups of the existing NEK drawings that could be formatted in different (larger) formats.

In addition to the DMP Project documentation to be delivered as a structured set of pdf files, Contractor shall deliver the following documents (potentially to be revised in future), in their original file format that can be revised by NEK when and if needed (two copies of files on transportable media – CD are sufficient):

- SAT and SUP procedures - MS Word (.docx).
- Textual parts of Procurement Specification, DMP in MS Word.
- Drawings in AUTOCAD (ACAD dwg format file).
- Spread sheets in Excel.
- Data bases in Access, SQL or Oracle.
- Training materials (lessons and exercises) in MS Word.
- Training presentations in MS PowerPoint (pptx files).

All the submitted documents shall bear at least the following identification:

- Contractor's Name.
- Date of issue.
- Document number.
- Revision number
- Supplier.

- Mandatory construction code
- NEK's Purchase Order/Contract Number.
- NEK's Specification Number

Final drawings shall be prepared in a form required by NEK procedure ESP-2.613 and shall be ready to be entered to NEK Document Control Module.

The Contractor shall be responsible for furnishing the following engineering/design items in accordance with the Project schedule and document submittal requirements of the Contract:

- a. Design Summary Report (DSR) shall be furnished eight (8) months after the Contract signature and shall include at least: design outline, analysis for »New HP turbine« effect on foundation, turbine missile data (USAR Ch.10), bearing design and review of the existing lubrication system, analysis of bolt design for all joints, overspeed calculations, rotor stress analysis, lateral and torsional vibration analysis, HP Turbine inner casing stress analysis, ...
 - b. Torsional analysis
 - c. Longitudinal cross-section through HP from the bearing 1 to 2 including the stationary parts (scale layout drawing).
 - d. Cylinder Flange Bolting Diagram
 - e. A copy of the weight and moment chart for each blade row that is weight and/or moment balanced.
 - f. A Rotor Design Summary Report. This shall include as a minimum a Finite Element analysis of the HP rotors showing both the design stresses and design temperature distribution throughout the shaft. Another part of this report shall contain the shaft torsional analysis. It should also contain rotor sensitivity charts for field balancing.
 - g. Stationary Parts Design Summary Report.
 - h. Turbine Expansion and Clearance Data Report. This shall include individual stage axial and radial clearances along with maximum differential expansion at each stage. Both the assembled rotor sag curve and the alignment of each coupling shall be a part of this report.
 - i. Blade Mechanical Calculation Summary Report showing the maximum stress locations and magnitudes for each HP row, taking into account stress concentration factors, in the blade root, rotor bore and different rotor dimension regions.
 - j. A Missile Probability Design Report. This shall include, but not be limited to, the calculation method, a list of input items and associated data, and the calculation results for turbine missile probability and related documentation. The probability section of the report shall include all of the individual component and subsystem probabilities. The results shall confirm that missile probability from HP turbine is less than from LP turbine.
 - k. Heat balance calculations (B.O.P.) shall be provided based on NPP Krško inputs. At least the upper limit, intermediate point and the lower limit of operation shall be covered as well as the reduction in FW temperature (Ref. reports: SSR-NEK-2.0 & 9.10).
 - l. Thermodynamic data for each HP stage, specifically individual stage temperatures and pressures. A single table of stage pressures and temperatures should be provided. Expansion curves for different power levels.
 - m. HP Turbine efficiency at design parameters, as a function of steam flow (for different condenser pressures).
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- n. Metal heat capacity, steam to metal heat transfer (as a function of flow/power), steam to metal heat transfer for condensation (as a function of flow/power), condensation as a function of power (% of steam flow condensed and drained before steam is reaching last stage), ambient heat loss (as a function of Turbine Building environment) and other data necessary for modeling "New HP Turbines" Project on the simulator of NPP Krško.
- o. A summary report of interfaces with existing components, including design characteristics of the interface such as dimensions, bearing design loads, foundation loads and movements, flow rates of lubricating and/or cooling system, PDEH, gland steam seal systems, extraction steam nozzle movements, supervisory instrumentation, existing instrumentation, LP turbine and other mechanical interfaces. This shall include, but is not limited to, the items described in section 5.3.
- p. A summary report of interfaces with the existing systems: TU, TD, TG, MS, EX, PDEH, LO, HD, CY, FW, EH, ...
- q. Design Approach Report to fulfil 40 Years of Service Life

The Contractor shall be responsible for furnishing the following manufacturing/testing items in accordance with the Project schedule and contractual document submittal requirements.:

Final documentation from manufacturing shall comprise the following as a minimum:

- a. Index
- b. The last revision of the fabrication and inspection plan showing the identification number of all records
- c. Records of all the manufacturing and inspection operations chronologically scheduled in the fabrication and inspection plan
- d. Bill of materials
- e. All material test records as required in Section 8.0
- f. All certificates required by materials specifications
- g. Welding reports
- h. Welding procedure qualification records
- i. Heat treatment certificates
- j. Deviation reports
- k. Repair reports
- l. As-built parts lists
- m. All NDE records, radiographs (originals) etc.
- n. Final cleaning specification
- o. A rotor balance and overspeed test report for each rotor
- p. Packing specifications
- q. Transportation specifications
- r. Other categories of records

The Contractor shall be responsible for furnishing the following shipping/transportation documents in accordance with the Project schedule and contractual document submittal requirements:

- a. The estimated mass weight of each individual major piece of equipment (i.e., rotors, stationary cylinders, lifting beams) shall be provided three hundred and sixty days (360) prior to shipment. Final weights shall be provided at shipping that includes the shipping and handling packaging.

- b. Shipping and preservation requirements per Section 30.0.
- c. Packing & protection specifications
- d. Transportation specifications and all details related to transport of equipment and parts from Contractor/supplier to NPP Krško.

The Contractor shall be responsible for furnishing the following assembling installation/testing documents in accordance with the Project schedule and contractual document submittal requirements:

- a. A set of field installation procedures (as requested by NPP Krško ESP-2.619) for erection, fabrication, transportation, quality control, painting, insulation, material handling, welding and organisation shall be provided in the form of a Installation Package. Installation and work packages shall be available and approved by Purchaser twenty two (22) months after Contract signature and not later than six (6) months prior to the work beginning.
- b. A list of consumables with Material Data Sheets (MDS) for each item as applicable.
- c. As-installed dimensions for the following. (Note: This shall include all dimensions required by NPP Krško to maintain the units or to any dimensions needed by NPP Krško to construct maintenance platforms or other special maintenance fixtures).
 - a. Rotor dimensions identifying:
 - i. The radial clearances of all blade shrouds and body diameters where a seal rides.
 - ii. The axial position measured from a master face on the rotor of all measured points called out on the rotor clearance drawing.
 - iii. The diameters of all bearing areas.
 - iv. Coupling rabbet fit diameters and depths as applicable.
 - b. Inner cylinder dimensions showing the axial and inside diameter location of all diaphragm fits, nozzle locating fits, external locating posts, and steam seal faces of packing glands.
 - c. Diaphragm measurements that identify:
 - i. The radial clearances of the seal strips (hooks, bore and seal ID).
 - ii. The axial location of all steam seal faces for seals referencing the diaphragm steam seal face.
 - iii. The axial location of all locations on the diaphragm identified on the clearance drawing.

The Contractor shall be responsible for furnishing the following Final Documentation in accordance with the Project schedule and contractual document submittal requirements:

- a. The Contractor shall provide all the data, as required in Chapter 43, to fully incorporate the impact of the »New HP Turbine« on the original plant design basis. The Final Documentation is a complete set of documents, compiled and arranged by Contractor in compliance with the requirements set forth in Ch.43
- b. Set of the Final Manufacturing Documentation shall be submitted to Purchaser in a collected delivery at last two weeks before Physical Delivery of »New HP Turbine« and irrespective of the fact that individual documents of the Final Documentation were submitted to Purchaser in an earlier stage.

- c. The Documentation of the Technical Supervision and Testing. These documents are required to be the original ones, bearing the original signatures.
- d. The "As-Built" drawings
- e. The Final Design Data Report
- f. The Contractor shall prepare document revision for updating Chapter 10 of Krško USAR. The Contractor shall identify any changes, and provide a markup of the changes required to USAR Sections 10.
- g. To the extent any document required to be included in the Final Documentation has not been subject to review and approval by Purchaser, the Contractor shall arrange for such review and approval prior to its insertion in the Final Documentation set.
- h. The initial issue (rev. 0) of Instruction Manuals (10 hard copies + 1 electronic copy) shall be furnished at last one month before shipment of the first new steam path parts for the specific equipment under the Contract. Where general or standard instructions are used, inapplicable data shall be deleted. Sufficient data and instructions shall be provided or modified to install, operate and maintain the Krško »New HP Turbine«.
- i. The instruction manual shall include revision of existing data in the manual for TU110TUR-001 and below described items:
 - a. A complete and detailed description of all systems. Data sheets giving design, construction and performance data for various pieces of equipment. The performance data shall include changes to the thermal kit.
 - b. Maintenance requirements and instructions.
 - c. Operational troubleshooting guides.
 - d. Manufacturer's operating and maintenance literature (not sales brochures) with parts lists and with applicable data including materials clearly indicated. This shall include assembly/disassembly drawings and sequences.
 - e. A list of erection and installation instructions shall be furnished.
 - f. Startup and operating instructions.
 - g. Manuals must be submitted in hard copies. Electronic copies are also desirable. Microfilm copies are not acceptable.
 - h. NPP Krško requires that the Instruction manuals cover every item purchased, including those materials that the Contractor obtained from a sub-supplier. An electronic parts list in the Contractor's standard format shall be provided in the instruction manual.
 - i. Both the schedule of predictive maintenance requirements as well as a detailed write-up of the maintenance instructions for each component supplied.
 - j. A recommended maintenance frequency.
 - k. All applicable field service bulletins including those already included in the design.
 - l. A recommended spare parts list and any recommended options shall be included in this.

The Contractor shall be responsible for revision of Instruction Book 13A5460.

The Contractor shall also prepare:

- Rotor Dynamic Analysis of upgraded rotor train: Lateral vibration and torsional vibration design report
- Overspeed calculation

- Maintenance instruction manual
- Report: Mode of valve operation, influence to bearing T
- Coupling bolt design report
- List of Deliverables
- Report for metal temperature measurement
- Report for water induction protection
- Horizontal joint bolt tightening design report and Instruction for bolt tightening
- Field balance procedure
- Work Safety plan at least 6 months before instalation

11.2.1 Documentation according to NEK ESD Procedures:

- a. Detailed Procurement Specifications as described in 3.6 above
 - Procurement Specifications
 - BOMs for the remaining material per each modification and discipline
- b. Design Modification Package shall be prepared in accordance with the requirements of ESP 2.602, including all other applicable ESD procedures (acc. to Sect. 7.6). Contractor shall prepare DMP according to NEK procedure ESP-2.602, Plant Design Modifications for NEK review and approval. DMP shall be reviewed and approved by NEK prior to the installation. Before the submittal to NEK for review, the preliminary DMP shall be subject to an independent review cycle organized and implemented by Contractor. This independent review may be performed by the Contractor, or by involving the subcontractors. After the resolution of all the comments as well as corrections related to the results of independent review, the preliminary DMP shall be submitted to NEK for review. The need for expeditious changes to the "Approved for implementation" DMP shall be covered by the FDCR (Field Design Change Request) document prepared in accordance with NEK procedure ESP-2.609. FDCRs will cover the problems identified during the installation that require correction of the DMP. They will not cover new design requirements defined after the acceptance of the original DMP. DMP shall be developed as described in item 3 of this Specification.
- c. Calculations / Analysis Reports
Design calculations shall consider operation during normal conditions, OBE, SSE and plant operational transients. Contractor shall define applicable acceptance criteria for each analysis. Plant specific calculations shall be prepared in accordance to NEK procedure ESP-2.605.
- d. Contractor shall prepare necessary licensing documentation as described in section 3.5 of this Specification according to NEK procedures ESP-2.301, Technical Specification Changes and Licensing Amendments, ESP-2.302, Administration of Changes to the Updated Safety Analysis Report (USAR) and ESP-2.303 Evaluation of Changes in NEK, ESP-2.306 Administration of Changes to the Radiological Technical Specification (RETS).

- e. Installation Package (IP) – At least six (9) months prior to the Site installation in accordance to ESP-2.619 the Contractor shall develop and submit the IP for review and approval as specified in item 5 of the Attachment A. Filed implementation and SAT procedures shall be included in IP.
- f. Electronic copies of MSDS (in Slovene language) for all hazardous materials to be used during the implementation phase, shall be provided separately.
- g. Factory Acceptance Test (FAT) procedure
Contractor shall review Factory Acceptance Test procedure to exercise the full scope of equipment functioning and performance of major equipment vendor documentation and in cooperation with the vendor.
- h. Contractor shall prepare Site Acceptance procedures to exercise the full scope of functional and performance testing, including power testing, which may not have been possible during FAT.
- i. Final Documentation - Essential drawings shall be furnished by Contractor to NEK as soon as possible but not later than when the systems are ready for operability declaration.
- j. Start Up Procedures (SUP)
Contractor shall prepare Start Up Procedures (SUP) which shall be reviewed, commented and approved by NEK. The scope of Start Up shall envelope all the equipment manipulation needed to start the equipment in all designed configurations.
- k. As Built drawings - They include all affected and new drawings reflecting as built configuration. Essential drawings shall be delivered before the declaration of operability.
- l. Turn Over Package (TOP) - Maximum 3 months after the installation completion, the Contractor shall prepare TOP according to NEK procedure ESP–2.611 Document Turnover and Closeout for NEK review and approval.

Table 1: Number of required documents per NEK procedures

Design Modification Package (DMP) for Review	2 hard and 1 soft copy
Final Design Modification Package (DMP)	1 hard and 1 soft copy
Installation Package (IP); (to be submitted for NEK review 9 months prior to installation start)	1 hard and 1 soft copy
Turnover Package acc. to the ESP 2.61; (hard + soft together with the revised originals in NEK archives - three month after successful acceptance testing)	1 hard and 1 soft copy

11.2.2 Engineering Documents for NEK Review and Approval:

- a) Project Management Manual
- b) Project Quality Plan
- c) Monthly Progress Report (for information)
- d) Walk-down report (for information)
- e) Purchasing specification for equipment
- f) Shipping procedures
- g) Prior to the respective fabrication step
- h) Manufacturing and testing Plans and Schedule
- i) Fabricated Equipment Documentation Package
- j) Installation & Inspection Plans
- k) As-Built Drawings
- l) Revised NEK documentation
- m) Installed Equipment Documentation Packages
- n) Operations and Maintenance Manuals
- o) Welding, PWHT and NDE Procedures
- p) NCR and deviation Reports
- q) FME Plan

All documents, available in soft media, shall be delivered to NEK in hard and soft copy. The documents available in hard copy only should be scanned and delivered in PDF format, if requested by NEK.

11.3 Additional Requirements

11.3.1 General Requirements

All documents (including drawings, graphs ...) submitted shall be in the form of hard copies and electronic media. Hard copies shall be in the form of three good quality full-size reproducible and three good, sharp, black and white, direct-contact prints of the Contractor's original drawing. Electronic media shall be in a format fully compatible with the following software:

- Word Processing: Word 2010 version©
- Spreadsheet: EXCEL©
- Computer-aided Drafting ©
- Planning & Scheduling: PRIMAVERA© or MS Project

Additional details shall be defined between Contractor and Purchaser (like paper format A4, "dictionary" for Primavera software, etc.) after Contract award. The Contractor shall furnish a complete set of the drawings.

- a) A black line reproducible and hard copy of each drawing shall be submitted with the transmittal stating the application and drawing status. A unique drawing number shall be defined by NPP Krško.
- b) The outline drawings shall provide sufficient outline dimensions to permit arranging the space in the Plant to accommodate the installation and maintenance of the newly installed equipment. As a minimum, the outline drawings shall provide overall dimensions, foundation mounting details,

including size and orientation of integral support structure, and all other interfaces that will require connecting in the field. These physical outlines must clearly indicate any differences in the size and space requirements as compared to the as-installed equipment. For maintenance purposes, the access for repair shall be indicated.

- c) Detailed drawings shall contain information as to materials and process specifications, materials ordering and procurement specifications.

The Contractor shall also furnish all testing procedures related to modified systems. Two sets of the Final Documentation shall be submitted to Purchaser in a collected delivery two months after Operational Delivery and irrespective of the fact that individual documents of the Final Documentation were submitted to the Purchaser in an earlier stage. The Final Documentation is required to contain at least, the following:

- a) Documentation on Technical Supervision and Testing, which will be approved by the Purchaser before the insertion into the Turn Over Package (TOP). One of the sets of these documents shall be original bearing the original signatures.
- b) The "As-Built" drawings.
- c) The Technical Manuals.

To the extent any document required to be included in the Final Documentation has not been subject to review and approval by Purchaser, the Contractor shall arrange for such review and approval prior to its insertion in the Final Documentation set.

11.3.2 State of the Art Tools for Electrical and I&C Design Area

Contractor shall use raceway and cable systems design tool, which shall be capable to provide efficient complete layout, routing, and material estimating functions in a single, integrated system for raceways, cable trays, conduits, and the cables that run through them.

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

In its Project manual Contractor shall describe in detail which software tools will be used for the design and for reproduction of the drawings and how it will maintain Purchaser equipment numbering system including cable and wire numbering, use of Purchaser drawings symbols, drawings format (headers) and series (206, 207, 208, 302, 911, 912, etc.). The required software tools will be identified and updated in the PMM throughout project execution as each tool is used. If the Contractor is using its own software tools, its outputs (calculations, drawings ...) shall be compatible with Purchaser software and in accordance with Purchaser requirements for drawings.

12 PERFORMANCE REQUIREMENTS

- 12.1 Performance tests involve the checkup of equipment characteristic against the Contract. The »New HP Turbine« Project must meet all pre-established acceptance criteria to satisfy the operation with new turbine which include electrical, mechanical and thermal performance (+ noise level measurement, vibration, amb. temperatures, etc.).
- 12.2 The thermal performance test procedure will use the methodology of SUP-16.061 alternate nuclear test as guidance, and shall utilize as much of Krško installed plant instrumentation as acceptable to meet test tolerances.
- 12.3 The Contractor shall provide/propose test procedure with required calibrated test instruments, data acquisition system, an isolation list for the tests marked on reviewed piping and instrumentation diagrams.
- 12.4 The Contractor shall also provide engineering to supervise the tests, to analyze all data, to perform test resolution calculations and prepare the Final Performance Report which shall be submitted to NPP Krško.
- 12.5 The Contractor shall furnish three new heat balances (one lower limit, one intermediate point and one upper limit upgrade heat balance). These heat balances shall provide the basis for the thermal performance warranty. They shall be done each at 5.78 MPa (839 psia), 0.45% moisture, 6.01 MPa (871 psia), 0.46% moisture and 6.23 MPa (904 psia), 0.47% moisture at the Turbine Valve inlet, respectively and the following conditions:
- i. Pre-installation SUP-16.061 test conditions
 - ii. Post-installation SUP-16.061 test conditions
- 12.6 Pre-installation testing will be performed in two points of NEK operating window (in two (2) different Taverage) in SEQUENTIAL mode of governor valve operation one month prior to the shutdown in the outage 2021. NPP Krško will conduct an electrical output test, as close as reasonably possible to the conditions set forth in the pre-test guarantee heat balance (to be supplied by Contractor) to determine the turbine-generator output with original turbine rotors in service. This electrical output will be corrected using the SUP-16.061 to the thermal heat input specified on the pre-test heat balance diagram. This corrected electrical output will be referred to as the »Pre-installation Electrical Output«. These tests shall provide the basis for the thermal performance warranty.
- 12.7 Post-installation testing will be performed in SINGLE and/or SEQUENTIAL mode of governor valve operation no later than four months after the date of initial synchronization following installation of the equipment supplied under this contract. The tests will be done in two (2) operating points in NEK operating window. Again, measured electrical output will be corrected using the SUP-16.061 to the thermal heat input specified on the post-test heat balance diagram. This corrected electrical output will be referred to as the »Post-installation Electrical Output«. These tests shall provide the basis for the thermal performance warranty.

- 12.8 The Contractor shall guarantee the incremental improvement in thermal performance (increase total gross electrical output by at least 7 MWe for NEK operating window) with the new steam path based on better turbine efficiency of New HP Turbine and control valves as compared to the old HP turbine and control valves. Any anticipated changes in the guaranteed heat balance or performance data shall be brought to the immediate attention of NPP Krško.
- 12.9 It shall be noted that not all equipment will be in new condition at the time the replacement steam paths will be installed. It is expected that differences will be in:
- Turbine expansion line end points.
 - Extraction stage pressures versus throttle flow.
 - Exhaust pressure correction factors.
 - Gland leakages and mechanical losses.
 - Turbine stage moisture removal effectiveness.
 - Correction to expansion line end point for exhaust pressure.
 - LP turbine exhaust loss (Btu/Lb versus annulus velocity) and including the exhaust flow area per end.

13 MATERIAL REQUIREMENTS

Materials and equipment shall be suitable for the specified service as determined by the Contractor and subject to the approval of NPP Krško.

Materials used in the manufacture of the stationary parts, and the rotor and blades shall be consistent with current technology so as to provide the maximum amount of service under the specified service conditions.

In the design of the rotors, attention shall be paid to the selection of materials to ensure low ductile/brittle transition temperatures, minimum stress concentrations and ability to withstand cyclic thermal stresses. A thermal stability test shall be carried out on solid forged rotor. Material certifications shall be provided to NPP Krško for all rotating and stationary components.

Data for HP Rotor shall include, but not be limited to:

- Tensile strength
- Yield strength
- Percent reduction in area
- Percent elongation
- Charpy impact strength as a function of temperature including values at the upper shelf temperature
- Fracture Appearance Transition Temperature (FATT)
- Chemical analysis, including all major alloying elements and those minor elements which affect material properties such as C, Si, P, S, Cu, V, Mn, Mo, Cr, Ni, As, Sb and Sn.

The Contractor shall explain, by referring to the appropriate ASME/ASTM specification or equivalent, how his proposed design compares with the above referenced data. If there is a significant difference, then the Contractor shall provide a detailed explanation of how his material will provide an equivalent reliable 40-year life.

The Contractor shall provide material test records for rotor forging. These shall be actual acceptance properties and shall include chemical analysis, physical properties, fracture mechanic properties, sonic test results (size and location) and magnetic particle test results (size and location).

Other Component Parts Material Properties

The Contractor shall identify the ASME/ASTM or ASTM equivalent material specifications for every stationary and rotating component other than the rotors.

Archive Sample

The Contractor shall provide one last stage blade for archive sample. The archive sample shall be adequately marked and documented, and shall have the same treatment as all last stage blades.

The Contractor shall provide a sample for white Babbit. The archive sample shall be adequately marked and documented.

Moisture Erosion Protection

Moisture erosion protection is required in all areas subject to erosion. The location and type of moisture erosion protection shall be identified and described. Where cladding is used, the type and extent of such cladding and its purpose shall be described. Where shot peening is used, the extent of such shot peening and its purpose shall be described. Where hard surfacing, such as flame hardening, induction hardening or material inserts is used, the extent of such hard surfacing and its purpose shall be described.

This moisture protection shall include but not be limited to:

- a. water removal provisions at steam extraction locations.
- b. horizontal and vertical joints and sealing surfaces of every stationary part where steam leakage can occur.
- c. Other areas subject to moisture erosion such as cylinder surfaces, extraction nozzle connections and rotor sealing surfaces.

For all materials which the Contractor plans to use on Krško Site such as: paints, solvents, chemicals ..etc. Material Safety Data Sheet shall be provided. Also, the Contractor shall get obligatory advance approval from NPP Krško Chemistry Department.

13.1 Approved Materials

Material selection not specifically identified herein shall be the sole responsibility of the Contractor. This does not relieve the Contractor from the responsibility for comply with the applicable codes and standards. Materials shall be compatible with each other for corrosion resistance due to galvanic effects, erosion resistance, and mechanical strength and weld ability as applicable.

The Contractor shall provide a complete list of materials used in the fabrication of the supplied New HP Turbine. The materials shall be in accordance with the approved licensing documents and in compliance with the appropriate ASME Code or ASTM material specification. Materials shall withstand the cumulative effect of the corrosion exposures anticipated over their design life.

All materials used shall be new and in accordance with the applicable fabrication code. The Contractor shall submit shelf life information for all applicable components.

13.2 Unapproved Materials

1. Asbestos shall not be used in any components.
2. Teflon tape and parts containing unacceptable levels of halogens shall not be used. Plastic wrap shall meet the qualifications of Regulatory Guide 1.38.
3. Mercury and other low melting point alloys shall not be used

14 FABRICATION AND ASSEMBLY

14.1 General

1. Fabrication of all components of the New HP Turbine shall be performed by the Contractor. All items fabricated by the Contractor shall meet the requirements described herein.
2. Turbine components manufacturer shall have experience/references on same work performed in US and/or in EU
3. Fabrication materials, methods, and quality assurance shall be in accordance with the Contractor's Safety Analysis Report, Certificate of Compliance, Contractor's approved quality assurance program, and the applicable codes and standards in Section 7.0.
4. All material used in fabrication shall be new and shall conform to the appropriate material specifications. Prefabrication shall be performed to minimize field welding.

14.2 Dimensions and Tolerances

The dimensions of the new steam path components shall be within the tolerances shown or referenced on the Contractor's design calculations and manufacturing drawings. Deviations from these dimensions shall be documented and evaluated by the Contractor. These design tolerances/drawings shall be available for NPP Krško review at the Contractors facility. This dimensional verification does not relieve the Contractor from his responsibility to meet dimensional requirements within stated tolerance.

14.3 Welding & PWHT

All aspects of welding shall be in accordance with the Contractor's approved Safety Analysis Report, Certificate of Compliance, Contractor's approved quality assurance program, and the applicable codes and standards defined in Section 7 APPLICABLE CODES, STANDARDS, DESIGN CRITERIA FOR WORK.

All WPS, PQR and welder qualifications shall be in accordance with ASME IX. Fracture toughness testing of the welding procedures and weld filler metal shall be in accordance with ASME II and the requirements of ASME IX. Welding procedures shall be submitted, along with post weld heat treatment (PWHT) procedures, for review prior to initiating any welding. Welder qualification records shall be retained in the Contractor's shop and made available for Purchaser review upon request.

A system shall be established to provide a weld map that includes all permanent welds, repair welds and temporary welds. A weld log shall be generated that documents the welds, weld procedure, procedure revision, weld location, weld map number, and fillet material used. A drawing which identifies the weld material by heat number and lot number for each weld shall be submitted to Purchaser. Contractor has to provide drawings that show welding joints, together with the joint geometry and welding process in accordance with practices of AWS A2.4.

A weld map drawing, which identifies the welding procedure numbers, shall be provided to the Purchaser by the Contractor.

The filler material control, storage, and handling program shall be submitted for acceptance.

Stainless steel or Inconel cladding on low alloy steel components shall be in accordance with Regulatory Guide 1.43.

The Contractor shall submit to the Purchaser a detailed outline of its PWHT procedure.

14.4 Forgings

All steps in forging shall be documented and dimensions and weight of each forge recorded.

14.5 Fabrication

A. Base Metal Preparation

The methods used to prepare the base metal for installation shall be approved by NPP Krško.

Tools for base metal preparation and cleaning used on nickel-base alloys or austenitic stainless steel shall not be used on any other material.

Solvents used for base metal cleaning shall be analyzed for contamination and restricted to demineralized water denatured ethyl alcohol, isopropyl alcohol, methyl alcohol or acetone. Alternative solvents may be used only after approval by the Purchaser.

B. Alignment and Fixturing

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 the welding sequence. The use of temporary attachments for fixturing shall be avoided.

C. Tack Welds

Tack welds to be incorporated into the final weld shall be deposited with a contour suitable for fusion with the root pass. The contour may be achieved by grinding if necessary. When tack welds are to become part of the finished weld, they shall be performed by a qualified welder and visually examined, and defective tack welds shall be removed. Tack welds that have cracked or are defective shall be removed, and the area retacked prior to welding. Tack welds in grooves shall be kept to the minimum. Block welding shall not be used.

D. Welding Processes

The requirements of Regulatory Guides 1.31 and 1.44 shall be followed for welding austenitic stainless steel. When corrosion testing is required by Regulatory Guide 1.44, the welded test specimen shall be fabricated using the following:

- (1) the highest heat input to be employed in production welding,
- (2) the highest carbon content to be used in production,
- (3) thickness equal to the minimum thickness to be welded in production and,
- (4) the maximum interpass temperature to be used in production.

ASTM A262 Practice shall be used as the corrosion test on bend specimens to demonstrate that the welding procedure for unstabilised grades has not caused the base material heat-affected zone to become excessively sensitized. Corrosion test bend specimens shall consist of two (2) side bends or one (1) face bend and one (1) root bend, as required by ASME IX for the qualification test plate thickness. The bend specimen shall be bent over the appropriate radius specified in ASME IX with the weld-base metal interface located at the centerline of the bend. The specimens shall be evaluated as stated in ASTM A262 and shall indicate the absence of intergranular attack.

The results of the corrosion test and the heat input, carbon content, thickness, and interpass temperature qualified for each welding process shall be incorporated as part of the procedure qualification test record.

Welds performed between austenitic stainless steel and ferritic steels or nickel-base alloys shall be performed with the following classification of filler material: ASME II, Part C, SFA 5.14 ERNiCr-3 or a manual electrode meeting the same composition requirements. Filler material used to join austenitic stainless steel to itself shall conform to Regulatory Guide 1.31 and the delta-ferrite requirement shall be 8-15 FN and measured in accordance with AWS A4.2-86 for an all weld metal deposit.

All arc strikes shall be removed and the areas ground to a smooth contour and blended fair (minim 3:1 taper). Ground areas shall not reduce section thickness below required thickness. The areas shall then be PT or MT inspected.

Nicks, gouges, scratches, punch marks, etc. which do not violate the required minimum thickness of the material shall be mechanically faired.

Grinding on stainless steel shall be controlled to prohibit burning, cold work smearing and tearing.

Repairs by welding shall be examined for acceptance by the same NDE technique/procedure by which the indications were found. The repair shall meet all codes and specification requirements. The location of these repairs shall be identified on drawing or permanent record.

15 INSPECTIONS AND TEST

15.1 TESTING

All the measuring and testing or inspection equipment must have valid calibration certificates.

The Contractor shall ensure that all tools, gauges, instruments, calibration standards, and other measuring and test equipment used in activities affecting quality are of the proper range, type, and accuracy to verify conformance to established requirements.

All tests not otherwise specified shall be performed by the Contractor or subcontractor in his shop. This testing shall at least consist of but not be limited to the following:

- 15.1.1 All specimen testing procedures (Tensile and Instrumented Charpy V-Notch) shall be performed in accordance with the latest appropriate ASTM standards. The Contractor shall provide a load-time record of the fracture event and high quality prints of photographs of all the tested Charpy specimens showing the fracture appearance and the gauge length of the tensile specimens. Documented evidence of the appropriate calibration of test equipment used shall be included in the Final Report. The tests to be witnessed will be agreed in advance and identified in the examination sequence plan.
- 15.1.2 All blades shall be tested with magnetic particle and/or dye penetrant on non-magnetic areas, tested as required by Contractor manufacturing standards.
 - a. No magnetic particle or penetrant indications shall be acceptable.
 - b. Each blade shall receive full dimensional checking according to the Contractor's Quality Control Program and would be required to fall within the design tolerances of the original blade drawing.
- 15.1.3 All stationary airfoils shall be tested with magnetic particle and/or dye penetrant on non-magnetic areas, tested as required by Contractor manufacturing standards.
 - a. No magnetic particle or penetrant indications shall be acceptable.
 - b. Each blade shall receive full dimensional checking according to the Contractor's Quality Control Program and would be required to fall within the design tolerances of the original blade drawing.

- 15.1.4 Rotor spin testing at not less than 120% overspeed shall be required for new turbine rotor. The shop balancing should be sufficient so that subsequent field balancing is not required during the startup after the initial installation.
- 15.1.6 The Contractor shall prepare testing procedure for post-installation and start-up test with all necessary check lists to record measured data and shall establish acceptance criteria.

15.2 INSPECTION

The Contractor shall submit to NPP Krško Inspection Manual which shall include the recommended maintenance inspection(s) for each of the new steam path components (HP rotor, HP stationary parts, flow guides, control valves etc.).

HP turbine inspection intervals shall be twelve (12) years. The Contractor shall furnish the documentation showing previous history of meeting this requirement to both regulatory agencies and Insurance carriers.

For each recommended inspection the submittal shall include but not be limited to: type (NDE, ultrasonics, visual, etc.), purpose, frequency, etc.

Inspections and tests shall be described in DMP where specific Installation and Test Procedures shall be developed.

Testing, inspection and related acceptance criteria shall conform to the applicable codes and standards (exp. ANSI/ISO/IEC -17025 last edition) as specified in section 7. In the absence of the specific code, the Contractor shall use the standards, which shall be submitted with the proposal.

Contractor has to have implementation program for Detection of Counterfeit and Fraudulent Products. All code material reconciliations shall be supplied to Purchaser.

16 QUALIFICATION, PARTS CLASSIFICATION AND DOCUMENT TRACEABILITY REQUIREMENT

All WPS, PQR and welders shall have qualifications in accordance with ASME B&PV Code Section IX.

All NDE personnel shall be qualified in accordance with ASNT-TC-1A or CP-189.

Training and Qualifications

The Contractor shall be responsible to ensure all Contractor and subcontractor personnel are qualified and trained to perform the engineering, fabrication, inspection, repair or installation activities. Personnel qualifications shall remain affective for the duration of the individual's assignment to the Project.

All Contractor personnel who will work on the site area will be required to attend and pass General Employee Training (GET).

17 SPECIAL REQUIREMENT

17.1 Health and Safety

The Contractor shall manage and be responsible for the performance of the safety measures and services for all the work performed within the Project.

The Purchaser shall be provided with unrestricted access to the Contractor's facilities and safety records for the purpose of auditing the Contractor's safety program.

All persons employed by the Contractor, agents, subcontractors, or other persons for which the Contractor has responsibility, shall perform work under the direction of the Contractor's health and safety program. All persons shall be instructed in and be familiar with safety rules and regulations applicable to the work being performed.

The Contractor shall have sole responsibility for ensuring that such persons are so informed and that safe work practices are followed.

Contractor shall also bear all responsibilities also for its subcontractors to be included into health and safety program.

Other services and hardware supply include provision of all miscellaneous services not defined elsewhere in this Specification that are necessary to successfully complete the New HP Turbine replacement Project.

Replacement and supporting working area shall be performed on the turbine deck elevation 115.

17.2 FME

Contractor shall take appropriate FME actions to prevent the introduction of foreign material into plant systems and its components. Contractor shall prepare FME program for installation and implementation of complete project FME according to SELLER's requirements and NEK FME procedures ADP-1.1.101 Preprečitev vnosa tujkov and ADP-1.1.128 Kontrola izvajanja vzdrževalnih aktivnosti z namenom preprečitve vnosa tujkov. All workers should be aware of the possible consequences of a failure to properly implement effective FME controls and practices during their work activities. Any workers should stop work if FME becomes or is in danger of becoming compromised. Workers' understanding and implementation of the FME program is critical to the overall success of the FME program.

During machining and factory assembling particular attention shall be paid to FME according to SELLER's requirements.

18 CLEANING

The Contractor shall establish and maintain standard industrial cleanliness throughout fabrication, assembly, removing, installing, testing, and inspection of equipment. The Contractor shall be responsible for ensuring that these same requirements for cleanliness are met by its sub-suppliers.

Presence of foreign material that includes grit, metal, particulate matter, oil slag, scale, rust, fiber, and designated detrimental material, which can obstruct operation of hardware or cause wear or erosion, shall be avoided. Necessary precautions shall be taken to maintain the cleanliness as high as possible during the piping modification activities.

Cleaning shall be performed during the manufacture or assembly, prior to shipping, prior/during and after installation of »New HP Turbine« in NPP Krško.

Cleaning of the component(s) of all grease and salts deposited on their surface as a result of the manufacturing operations.

During the removal/installation, cleaning shall be performed in accordance with written procedures and FME PLAN which have been reviewed and approved by NPP Krško. The responsibility for establishing, ensuring, and maintaining cleanliness shall rest with the Contractor.

The Contractor shall establish cleanliness program and maintain cleanliness throughout manufacturing, disassembly, assembly, testing, and inspection of each part. The Contractor shall be responsible for ensuring that its sub-suppliers and subcontractors meet these same requirements for cleanliness.

18.1 Cleanliness

During the removal of old turbine rotor and installation of "New HP Turbine", cleaning shall be performed all the time inside the working area in the turbine building in accordance with written FME procedures reviewed and approved by the NPP Krško. Cleaning of equipment shall also be in accordance with the additional requirements contained in this Specification.

The Contractor shall be responsible for ensuring that these same requirements for cleanliness are met by its sub-suppliers/subcontractors.

18.2 Removal/Installation

The Contractor shall also be responsible for ensuring that the same requirements for cleanliness are met in the whole working area. Work execution shall be done in accordance with the developed Foreign Material Program (ADP-1.1.101, ADP-1.1.128).

Heavy loads manipulation shall be done in accordance with the plant's procedure ADP-1.1.141.

Clothing

All personnel continuously entering the turbine deck shall wear the safe shoes and clothes as safe as necessary to protect EQUIPMENT from loose parts, pieces of equipment, buttons, or markers and similar items.

Foreign Material Production

Operations such as cutting, grinding, welding, or burning shall be shielded to isolate or confine any foreign material produced to prevent loss of cleanliness of hardware in the area. New HP Turbine and piping hardware shall be protected to preclude loss of cleanliness.

18.3 Cleanliness Requirements

Foreign material includes grit, metal, particulate matter, oil slag, scale, rust, and fibre, but not necessarily a designated detrimental material, which can obstruct operation of hardware or cause wear or erosion.

The installation and assembly of hardware shall be conducted to facilitate cleaning, inspection, and maintenance of cleanliness during the installation. Post-assembly cleaning is not an acceptable alternative to maintaining cleanliness before and during the assembly. Parts shall be cleaned and maintained clean prior to the assembly and maintained clean after the assembly.

The documents accompanying hardware shall inform subsequent receiving organizations of the cleanliness requirements and identify inaccessible and critical areas. No foreign material is allowed.

The hardware surfaces shall be inspected for cleanliness during the installation.

18.4 Material Control

Expendable materials, i.e., adhesives, caps and plugs, desiccants, labels, leak testing fluids, lubricants, marking materials, NDE materials (i.e., those materials used in the performance of penetrant examination, including penetrant agent, penetrant remover or cleaner, emulsifier, developer, and specified unique post-cleaning agents), rust preventatives, tapes, temperature indicating sticks, ultrasonic testing couplants, weld purge dams, welding/cutting compounds, wrapping materials including temporary insulating materials, cleaning agents, solvents, grinding and cutting wheels, gloves, shoe covers, and snoop solutions which contact finished "New HP Turbine" surfaces shall be in accordance with the following requirements:

- a. They shall not contain the following as a basic and essential chemical constituent: lead, mercury and other low melting point metals, their alloys and/or compounds.
- b. For expendable materials, the following limits shall apply. Engineering approval is required for the use of an expendable material whenever the chemical analyses exceed these limits.

Water leachable chlorides	100 ppm
Halogenated compounds	1000 ppm
Sulphur and its compounds	1000 ppm
- c. All NDE materials shall meet the impurity limits of ASME Section V.

19 CORROSION PROTECTION/COATING

Corrosion protection/painting shall be performed respecting compatibility of applied products to NEK approach for secondary plant equipment (see Paragraph 7.5).

19.1 Protective Coating Requirements

All exposed exterior carbon steel surfaces of each part, except weld preparations and stainless steel shall be painted in accordance with the Contractor's normal practice. The Contractor shall submit for Purchaser's approval the surface preparation and coating

procedure including identification of the coating system to be used. The requirements to apply protective coating systems to the equipment installed in the Turbine Building of the NPP Krško shall be specified in the Contractor's coating procedure.

19.2 Handling of Coated Members

Coated members shall not be handled until they have dried in accordance with the manufacturer's recommendation except for necessary handling in turning for coating or stacking for drying. Coatings which are damaged in handling shall be removed and 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.

20 MARKING AND IDENTIFICATION

The Contractor shall establish and maintain a system for the identification and control of materials, parts, and components, and partially fabricated assemblies. These measures shall ensure that the 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 the records traceable to the item throughout the installation, shipment, and use of the item.

These identification and control measures shall be designed to prevent the use of incorrect or defective material, parts, and components as well as to provide a permanent record to assist in future evaluations of in service degradation of parts. As a minimum, these procedures shall include detailed accountability procedures for all tools and equipment used during the manufacture, appropriate controls on foreign objects such as eye glasses and welding rods, cleanliness requirements, and accountability procedures for any temporarily installed devices.

The Contractor shall provide complete and accurate records which relate to each piece of used material, to its heat and lot numbers, dimensional data, manufacturing history (including all installation, heat treatment steps and deviations from normal practices from melting to final treatment and assembly/inspection), and material certifications, including chemical and physical properties.

The requirements for equipment labeling before transportation will be defined later between Purchaser and Contractor based on the Slovenian Customs & NPP Krško requirements and regulations.

21 PACKAGING, HANDLING AND STORAGE

21.1 Packaging and Handling

The Contractor shall prepare, pack and load all materials and components in such a manner that they are protected from damage during the transportation. The Contractor shall be responsible for any damage resulting from improper packaging, handling or transportation. All items transported to open vehicles or stored in the open air at Site shall be suitably protected from weather damage.

The New HP Turbine components shall be prepared for shipment and on-site storage in accordance with the Contractor/subcontractor's standard procedures. All parts shall be packed in such a way that they are protected against contamination, deformation or damage during the shipment, handling and storage. Each package shall be marked to allow quick identification.

The Contractor shall comply with the packaging, shipping, receiving, storage, and handling requirements of ANSI Standards, except as otherwise specified herein, and the quality assurance requirements of Regulatory guide 1.38. Alternatively, Contractor's internal specifications can be acceptable if they are not of a lower standard. The packaging procedure shall take into account the method of transportation to be used, as well as the possible storage duration and storage environment.

Equipment shall be stored, inspected, handled, installed, and cleaned by applying the methods which ensure that harmful contaminants do not remain on any component surface in contact with process fluids.

The protection of internal cleanliness shall be achieved by sealing all openings with plugs, caps, or covers. Covers shall be designed and installed in such a way that their removal can be accomplished without damaging the joint preparation area.

Coated equipment shall be handled at all times with equipment such as stout, wide belt slings and wide padded skids designed to prevent damage to the coating. Bar cables, chains, hooks, metal bars, or narrow skids shall not be permitted to come in contact with the coating.

The "New HP Turbine" shall be prepared for shipment in accordance with Contractor's procedures for "Protection of Turbine Components during Shipment and Prior to Start-up". The Contractor shall furnish to NPP Krško a copy of this document for review three hundred and sixty (360) days prior to shipment of the first of the new parts.

The rotor and stationary parts will be prepared for extended indoor and outdoor storage at the NPP Krško facilities at Site. This shall include as a minimum:

Coating of the final assembly of rotor and blade or stationary part with a compound, which will exclude moisture and salts from direct contact with the metal at any time during the anticipated storage time. The coating should be removable without undue effort and without subsequent damage to the metal. The coating should be inert (i.e., does not react chemically) with the metal it is protecting and must not contain the elements (such as chlorine) which can cause stress corrosion cracking in steels. The coatings shall meet the requirements of the Krško Chemistry Department (ADP-1.6.701) that are in effect at the time of shipment of the parts.

Sixty (360) days prior to shipment of the first of the new steam path components Contractor shall supply a document which outlines the procedure used for removing the protective coating including the names of the solvents needed and their care, handling and disposal.

If any of the coatings, solvents or chemicals used are hazardous by contact, combustible or explosive, warning labels must be applied and displayed prominently for the protection of people working around them. Warnings must also be inserted in the removal procedures to warn of potential dangers to personnel.

The Contractor shall provide, for Purchaser's review and approval, procedures for packaging, shipping, site receiving, site storage, handling, and cleaning after installation

of delicate equipment. The packaging procedure shall take into account the method of transportation to be used, as well as the possible storage duration and storage environment.

21.2 Storage

The Contractor shall organize and maintain necessary storage area at the Site. Depending on the equipment storage requirements, storage areas shall be arranged outdoors and indoors according to the mutual agreement about the location at NEK property.

The Contractor shall inform NEK of any special storage requirements to allow for necessary preparation. The Contractor shall verify the Site conditions and provide written procedure for packing, receiving, handling and storing of the delivered equipment. All delivered equipment shall be on a delivery list, with marked specific instructions for handling and storage. If requested, the Contractor shall submit Handling and Storage procedure to NEK at least two (2) months before of shipping.

The Contractor shall verify the Site storage and/or specify additional requirements necessary to maintain equipment warranties. The Contractor shall provide any special requirements and advice for maintaining of equipment in proper shape during THE extended site storage, indoors or outdoors.

22 NONCONFORMING MATERIALS

Nonconformance 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 Purchaser.

Non-conformances to be reported for approval by the Purchaser are those non-conformances which cannot be brought within specification requirements by rework or replacement. When such a condition exists, the Contractor shall initiate a Nonconformance Report (NCR) using the Contractor's standard proposed disposition.

Additionally, the Contractor shall:

- a) segregate the nonconforming item to prevent any further processing which may result in a change of the nonconformance as identified,
- b) make the NCR available to the Purchaser's Inspector for review to assure the nonconformance is completely identified and accurately stated, and
- c) Properly disposition and transmit the NCR to the Responsible Engineer by the most expeditious means. The NCR may be telecopied, followed by direct transmittal of the original. The Contractor shall provide technical justification if recommended disposition is "Accept-As-Is" or "Repair".

NOTE: For better understanding a sketch shall be made or picture taken in order to show Nonconformance.

The requirements of the Specification are binding; no departures are acceptable without the prior consent of the Purchaser. The resolution/approval of Deficiency Notices, Nonconformance reports, Field Change Notices, etc. must be approved in advance by the Purchaser. Further engineering and/or manufacturing after the detection of non-conformances, prior to Purchaser's approval, shall be at Contractor's risk.

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

23 SPECIAL HANDLING

Contractor shall prepare instruction/procedures for handling the equipment to be used within New HP Turbine Project.

As required by NPP Krško procedure ESP-2.619 »Preparation of Installation Packages« all material and equipment handling shall be specified in the procedure. Special attention shall cover handling of heavy weight components, parts, boxes and others. All handling with heavy parts and components shall be covered with writing instructions in accordance with NEK's procedure ADP-1.1.141.

24 SHELF LIFE

The Contractor shall not ship any item (consumables, spare parts,...) , which has less than fifteen (15) years remaining shelf life at the time of shipment. The Contractor shall provide shelf life data by expiration date.

25 10CFR21 REPORTING

N/A

26 COMMERCIAL GRADE ITEM DEDICATION

N/A

27 SUPPLIER DOCUMENTATION REQUIREMENTS

The Contractor shall provide a technical description for collecting full scope of documentation from different phases of service described in this Specification.

Each shipment must be accompanied by certification containing the signature of Contractor's person responsible for the quality function of the supplier, stating the material or items conform to all contractual requirements. Applicable part numbers and other item identification, qualification reports and the NEK Contract order number shall be referenced by the certification.

28 REPAIR RECORDS

A record system shall be established and maintained by the Contractor to provide documentary evidence of the quality of items and activities affecting quality. The quality assurance (QA) records shall include the results of reviews, inspections, tests, monitoring of work performance and material analyses. Records shall as a minimum identify the inspector or data recorder, inspection date, scope of inspection, type of observation, procedures used, results, acceptability, and actions taken with deficiency noted and shall conform to the requirements.

The "Repair Records" shall include the following information as a minimum when the item is returned to NEK:

- a. Summary of repair/refurbishment work that has been performed on the item(s).
- b. Brief analysis of the reasons for failure of the item(s).
- c. Details of any "Special Processes" used during repairs that were not used during installation.
- d. A list of replacement parts installed in the repaired item(s).
- e. Repairs marked on drawings.

Should the need for repairs (e.g., machining or welding not per the design) to any new steam path part be identified during the work and categorized as a Supplier Deviation Disposition Request in accordance with Section 20 and 43, then the Contractor shall not repair any parts until a detailed description of such repairs has been submitted in writing to NPP Krško for review per Section 20 and 43, and written permission received from NPP Krško prior to proceeding with such repairs. Contractor may proceed at its own risk to repair any parts pending NPP Krško acceptance.

If material is improperly designed or fabricated, so that the installation in the field requires rework of either a new steam path component, especially a rotor or any other existing turbine component, then it shall be the responsibility of the Contractor to submit a written detailed description of the required field rework, to NPP Krško for review per Section 20 and 43. NPP Krško's written permission must be granted to Contractor prior to proceeding with any rework of any turbine components.

All additional rework in the field will be evaluated and the Contractor shall bear consequences in accordance with Contract General Terms and Conditions.

All repair records shall be delivered to the Purchaser.

29 SOURCE INSPECTION/SURVEILLANCE NOTIFICATION

The Contractor shall officially notify the Purchaser about manufacturing "hold" and "witness" points according to the Manufacturing and Inspection Plan. Notification time shall be ten (10) working days ahead of anticipated occurrence.

30 SHIPPING REQUIREMENTS

The Contractor shall provide packaging and shipping methods for protection from the effects of temperature extremes, humidity and in transit shocks. The NEK's authorized source inspector has the right to hold shipment if contractual requirements are not met. The Contractor is responsible to get all permissions for transportation of the equipment.

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

Protection of internal cleanliness shall be achieved by sealing all openings with plugs, caps or covers. Covers shall be designed and installed in such manner that their removal can be done without damaging the pipe nozzle weld joint preparation area. Internals shall be protected against moisture during shipment and storage by suitable means. Coated equipment shall be handled in such way to prevent damage to the coating.

Material and all certifications or accompanying documentation supplied under this Contract shall be directly shipped from the Supplier/Manufacturer to DAT NPP Krško Site. The Distributor shall not take possession of material or documentation.

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

Purchaser:

Nuclear Power Plant Krško
Vrbina 12, 8270 Krško, SLOVENIA
New HP Turbine Project
Attn: Mrs. Nataša Sagernik

CONTENTS: Contents Description (Provide reference to the Contract and Heater No.)

The Contractor shall make sure that the shipment includes packing list identifying each item or assembly shipped.

31 VENDOR TECHNICAL MANUAL AND REGISTERED UPDATES

The Supplier shall furnish four (4) copies and one (1) searchable electronic copy (pdf files structured with bookmarks and active cross reference links) of the Turbine Instruction Manual. The Turbine Instruction Manual is a document on submittal list which shall be revised/updated and all future updates shall be certified as applicable to the equipment furnished to NPP Krško. The revision shall be in English and cover:

INTRODUCTION

- i.1 Purpose and Scope of Manual
- i.2 Definitions

SECTION 1 EQUIPMENT DESCRIPTION

- 1.1 Description and Purpose
- 1.2 Specifications

SECTION 2 INSTALLATIONS

- 2.1 Receiving
- 2.2 Handling
- 2.3 Installing
- 2.4 Connections, Grounding and Shielding
- 2.5 Cleaning and Inspection
- 2.6 On-Site Testing Service

SECTION 3 OPERATING INSTRUCTIONS

- 3.1 General
- 3.2 Safety Precautions
- 3.3 Start-up Procedure
- 3.4 Instrumentation with Interlocks
- 3.5 Operation
- 3.6 Operational Checkout at Plant Shutdown
- 3.7 Testing at Power
- 3.8 Equipment Setpoints

SECTION 4 MAINTENANCE INSTRUCTIONS AND PROCEDURE

- 4.1 Preventive Maintenance Procedure
- 4.2 Safety Precautions and Interlock Checks
- 4.3 Test Equipment and Tools for Maintenance and Troubleshooting
- 4.4 Dismantling & Reassembly of Assemblies and Subassemblies
- 4.5 Alignment and Adjustment Procedures (including Torque Sheet Data)
- 4.6 Operational Performance Test
- 4.7 Leak Detection
- 4.8 Conservation and Storage

SECTION 5 TROUBLESHOOTING

- 5.1 Troubleshooting Procedure and/or Troubleshooting Chart

SECTION 6 REPLACEMENT PART

- 6.1 Parts List
 - 6.1.1 Introduction
 - 6.1.2 Maintenance Parts List
 - 6.1.3 List of manufacturers and addresses with ordering instructions
 - 6.1.4 Recommended Spare Parts

SECTION 7 SPECIAL TOOLS AND INSTRUMENTATION

- 7.1 List of Special Tools, P/N, Special Tools DWG's

SECTION 8

DRAWINGS & all documents/including drawing, graphs, specifications...) submitted shall be in the form of hard copies and electronic media.

Vendor technical manual shall contain all sections listed in the items above, NEK will update the existing onsite documentation. Contractor shall provide all relevant data to supplement EAM-MECL database, which are related to the HTRs.

32 TRAINING PROGRAM FOR NEW HP TURBINE

The Contractor shall provide a comprehensive training program for the training of the Purchaser's maintenance, operation and testing technical personnel for competency regarding the operation and maintenance of the New HP Turbine and control valves.

The training program(s), training modules, and materials shall be easily transferable into Purchaser's Systematic Approach to Training (SAT) program with the following objectives:

1. Scope of modification
2. Description of the overall design and description of the components
3. Thermal kit, efficiency improvement
4. Turbine drain system, turbine gland system, erosion protection and water drain features
5. Operation instructions and limitations
6. Scope of preventive maintenance work
7. Preventive Maintenance Procedure with measuring protocols and acceptance criteria

The Contractor's training program shall include lesson plans and classroom presentation material.

33 REVIEW AND VERIFICATION OF WORK

The Contractor* is required to perform a detailed "line-by-line" checking operation, review and/or verification of the changed portion of all documents in the Plant Design Modification package per ESP-2.607. The Contractor shall provide distinct evidence that such a review was conducted by presenting with the DMP package for NEK review, a set (copy) of checked drawings and documents that have been marked up and would indicate that: all design inputs and design outputs match, calculation equation references and quantitative formulas have been checked, and various drawings have been checked against each other for continuity and overall agreement.

The Contractor shall provide a copy of all directly available and releasable reference documents (pages) used in calculations as an appendix to the calculation or design input documents so that the NEK review of the Contractor's review process can be expediently performed. Contractor's proprietary documents that are classified as non-releasable may be made available for consultation by Purchaser and regulatory authorities on a case-by-case basis.

*Main Contractor cannot delegate this task to the subcontractor involved in the preparation of the DMP.

34 SCHEDULE REQUIREMENTS

In order to comply with the objective of full implementation of the modification the following Schedule completion activities/milestones are considered (detailed schedule is provided in Table 2).

Table 2: Requirements for Deliverables

No,	Description	Duration (months)
1	PMM and PQP (Project Management Manual and Project Quality Plan) Approved by Purchaser	T0+2
2	Design Documents (design documents, analysis, calculations, reports in accordance to ESP-2.604 section B, equipment specifications, procurement specifications, .. approved by Purchaser)	T0+8
3	DMP (Design Modification Package approved by Purchaser)	T0+16
4	IP and Work Safety Plan (Installation Package approved by Purchaser)	T0 + 22 but not later than nine (9) months before the installation
5	TW ,MSDS and Spare Parts List (Transport weight, dimensions and Material Safety Data Sheets and spare parts list) submittal to Purchaser	12 months prior to shipment
6	IM (Instruction Manual) Approved by Purchaser	at least one (1) month before shipment of the first parts, but no later than six (6) months before installation
7	FMD (Final Manufacturing Documentation) Approved by Purchaser	at least two (2) weeks before Physical Delivery
8	FAT Successfully completed Factory Acceptance Test	one (1) months before shipment but no later than 30.11.2020
9	Hardware delivery to DAT NPP Krško Site	At least two month before installation, but no later than 31.01.2021
10	Pre-Installation Test Pre installation performance testing	At least One month before Outage start 2021
11	Installation	April, 2021, 21 days in accordance with attachment K
12	Essential Drawings (in accordance to ESP-2.604, approved by Purchaser)	One (1) day before start-up starts
13	SUP Successfully completed Start-up Test	Start-up finished on 28 th day of outage in April 2021
14	SAT Successfully Completed Site Acceptance Test	April 2021
15	Post Installation Test Post installation performance testing at 100% power	One month after Plant return to 100% power
16	TOP (Turn Over Package submittal to Purchaser)	three months after installation
17	Project closeout	three months after installation

35 STATUS REPORTING REQUIREMENTS

Contractor is responsible for the status reporting and can NOT delegate this responsibility to the subcontractor. Status shall be given based on the common task project.

- a) Reports of Design Activities Progression
- b) The Contractor shall provide to NEK a monthly written status report for design work being completed, started, open problems, planned activities in next month and delayed.

36 WORK OR INFORMATION TO BE PROVIDED BY NEK

Potential Contractor shall define required documents/information to be provided by NEK. The use of this information by the Contractor will be restricted according to specific instructions provided by NEK.

The Purchaser will provide:

- a) all interface information with any plant activities related to this project
- b) access for onsite inspection to all the areas where new systems, major equipment and accessories will be located.
- c) all available as-built documentation
- d) Site Safety and Access Training (General Employee Training)
- e) technician
- f) electrical power connections (220/400 V 3 phase, 50 Hz)
- g) location for one container/office near the HP Turbine construction site
- h) Provide two containers (offices) for construction team on container area (outside the of technological area)

Whenever Purchaser approval is required by this Specification for submittals, procedures, methodologies, approaches or options, such approval shall be provided in writing or if provided orally, it shall be confirmed in writing.

The Purchaser will:

- a) designate a Project Manager who will serve as the principal interface with the Contractor on the individual modification
- b) perform preliminary and final design documentation review and approval within 4 (four) weeks after submittal.
- c) perform revision of all procedures based on the inputs provided by Contractor. These inputs are markup of affected procedures.

Approvals & Inspections - the Purchaser's Project Controls scope includes the provision of personnel, supplies, facilities, software, and equipment necessary to perform all cost and schedule functions for the overall Project.

37 CHANGES OF WORK SCOPE

The Contractor shall notify the Purchaser 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 Purchaser for approval prior to continuing work.

38 RECORDS

The Contractor shall turn over to the ING all reproducible drawings and other documents such as any changes to the Plant procedures, equipment technical specifications, USAR updates, and reviewers checked drawings and documents over to the ING.

All documents shall bear unique identification number with revision and need to be sorted into groups and subgroups. Details have to be explained in to the PMM.

A records system shall be established and maintained by the Contractor to provide documentary evidence of the quality of items and activities affecting quality. The Quality Assurance (QA) records shall include the results of reviews, inspections, tests, audits, monitoring of work performance etc. Records shall, as a minimum, identify the inspector or data recorder, the date inspection was performed, type of observation, procedures used, results, acceptability, and action taken with any deficiencies noted.

Additional records or supporting data shall also be maintained. All quality verification records, procedures, and qualifications shall identify the item or activity involved.

These records shall be retrievable and available for examination. One copy of all documents (including computer software - validation reports and any referenced documents) required by this Specification, applicable regulations, codes and standards, or generated as a result of the Contractor's QA program shall be transferred to the Purchaser.

Responsible persons for generating, completing, or reviewing records shall ensure that the following requirements are met:

- a. ensure that records are technically correct in accordance with applicable procedures.
- b. ensure that records are complete including all attachments. The records shall be reviewed to ensure all required data, i.e., signatures, dates, etc., have been completed or marked "Not Applicable" (N/A) as required.
- c. ensure that corrections to data have been made properly. Corrections to the data shall include the date and the identification of the person authorized to make the correction. Examples of corrections are line through, write overs, white-out, correction tape and any other correction method. This is required anytime when record data (numbers, or the meaning, intent, or integrity of a

record) are affected by a correction. This is not required for other information not considered as data.

- d. Ensure that records are legible - can be clearly read and suitable for microfilming. The original of all records should be transmitted to the Purchaser as the record. If a record is not legible one of the following methods shall be applied:

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 Contractor person authorized to perform this function shall initial and date the area enhanced or clarified.

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.

After installation and testing of "New HP Turbine" all documents developed in the installation phase become records and shall be provided by the Contractor to the NEK. The Contractor shall provide all procedures, drawings, checklists, test results, measurements, etc .

The Contractor shall designate all procedures in accordance with next scheme:

Company – Group of procedures from installation package – Number.

For example: NEK – E – 001 "Erection of Extraction Piping"

E - (Erection) Procedures

F - (Fabrication) Procedures

T - (Transportation) Procedures

Q - (Quality Control) Procedures

P - (Painting) Procedures

I - (Insulation) Procedures

M - (Material Handling) Procedures

FH – (Flushing Hydro) Procedures

O - (Organisation) Procedures

W - (Welding) Procedures

39 ORGANIZATIONAL CONTACT

Purchaser contact persons:

Enver Gashi, Project Manager

- Phone: + 386 7 4802 751
- E-mail: enver.gashi@nek.si

Franc Kranjc, Project Manager

- Phone: + 386 7 4802 521
- E-mail: franc.kranjc@nek.si

Nataša Sagernik, Purchasing department

- Phone: + 386 7 4802 446
- E-mail: natasa.sagernik@nek.si

40 CONTRACTOR'S TECHNICAL APPROACH TO THE WORK

As a part of the NEK "Request for Bids/ Quotation", the Contractor shall prepare a brief preliminary Project Management Manual and Project Quality Plan (PQP) which outlines how and where the work will be performed and indicates how the Contractor understands his Scope of Services and Delivery. The quotation should also indicate if similar projects applications have been performed by the Contractor.

The Contractor is not hindered to submit any additional documents to ensure completeness of the quotation.

The Contractor's responsibilities (Scope of Services and Delivery) are specified in of this Specification. Additionally, this Specification also provides the requirements the Contractor must comply with.

The Contractor shall be responsible for the following resources:

- All labor required to physically perform the work. This labor force shall possess skills to perform the work on the Project.
- Field Engineering. Contractor's field personnel shall be capable, qualified, and able to perform the tasks required to the satisfactory resolution of field problems and preparation of FDCRs.

41 ACCESS TO CONTRACTOR/SUBCONTRACTOR FACILITY AND DOCUMENTS

The Contractor shall provide full access to the Contractor's and authorized sub-contractor's facilities to the NEK's Representatives who are engaged in the work for the purpose of reviewing the quality and the amount of the work being performed.

42 SUBCONTRACTED WORK

NOTE: Contractor personnel working under Contractor's direct responsibility are not considered as sub-contractors in this context.

All Subcontractors shall be listed in the Quotation. If the selected Contractor after Contract signature wants to change or select a new sub-supplier, this is subject to NEK approval FDSS

The Contractor shall impose to its subcontractors the requirements of this Specification. The Contractor shall ensure that all subcontractors meet the requirements of this Specification. The Specification requirements for procedure submittals shall apply to sub-contractors for services not performed by the Contractor. The Contractor shall first review subcontractor's procedures to ensure compliance with the Specification requirements, submit these procedures, and obtain the Purchaser's acceptance in writing prior to performance of subcontractor's work. The Contractor's procedure may be used at the subcontractor's facilities if necessary.

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

The Contractor has to engage qualified companies with a proven experience record of development of Design Modification Packages in accordance with NEK procedures.

Such qualified companies (subcontractors) shall ensure support in the engineering phase and installation phase with response time less than eight (8) hours to ensure timely preparation and processing potential FDCR (Field Design Change Request) per NEK ESP-2.609 procedure.

All subcontractors need to be qualified by Contractor and approved by NEK. They shall also have experience/references on same or similar work performed on nuclear power plant(s).

The Contractor or his subcontractor shall not subcontract any portion of the Work without the written approval of the Purchaser.

43 QUALITY ASSURANCE REQUIREMENTS

43.1 General

General Requirements:

- a) The Contractor has to be qualified for the Scope of the Contract.

- b) NEK QA requirements are specified in Quality Specification QS-610 rev.1 - Generic Quality Assurance Program Requirements, which is attached to the Request for Bid/Quotation.
- c) The Contractor's QA Program review and acceptance by the Purchaser shall be a prerequisite for selection of a Bidder as the Contractor. The Contractor shall implement and maintain this program while carrying out the requirements of this Specification. All proposed changes to the program shall be submitted and approved by the Purchaser prior to the implementation.
- d) One (1) controlled copy of the Contractor's Level I QA Program Manual shall be submitted to NEK with the Quotation unless already submitted to NEK. Contractor shall notify Purchaser of any Level I QA Program changes issued during the Contract execution.
- e) The Contractor has the responsibility for QA activities for all work pursuant to this Specification. All technical and quality requirements shall be met
- f) QA requirements specified in this Specification apply to the Contractor's subcontractors. All work performed by subcontractor(s) shall be subject to the technical and quality requirements of this Specification as well. The Contractor shall be responsible for all subcontracted activities.

43.2 Project Quality Plan (PQP)

The Contractor shall submit PQP to NEK for review and approval. PQP shall generally describe Contractor's QA approach, project organization, provide specific information concerning the interfaces between various Contractor departments/facilities and describes application of the Contractor's QA program to the activities included in the scope of work (including supplier/procurement control, treatment of Nonconformances, reporting of deficiencies, corrective actions implementation).

43.3 Inspections

The Contractor shall provide manufacturing, testing, transportation, installation and inspection plans 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 Contractor inspections that are required to be performed. Based on the above information, NEK will determine record (R), witness (W) and hold (H) points. The Contractor shall update the plans and submit copies thereof to the NEK after changes have been approved by NEK.

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

1. Component (i.e. material/part/assembly/complete set),
2. Type of test, activity and method (e.g. destructive/non-destructive; visual, liquid dye-penetrant, magnetic particle, X-ray, ultrasonic, probes; analysis for chemical composition, etc.);

3. Standards according to which new material, construction and other parts shall be purchased, or standards/procedure according to which a test, measurement, or inspection shall be performed;
4. Procedure with acceptance criteria according to the applicable standard.

If there is a Witness or Hold Point, and the acceptance criteria or testing procedure have been established according to the manufacturer's standard, such a standard and reference testing procedure must be made available to NEK for inspection at least three (3) days before the test execution. All provided documents must be in English. The standard shall be included in the list of all applicable standards with the Bid.

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

43.4 Notification Points

NEK shall have the right to establish notification points for which the Contractor shall give prior notification to the NEK. In addition, NEK may establish temporary notification points if necessary to ensure the resolution of temporary quality problems. Notification for Witness or Hold Points require the receipt of notification at least ten (10) working days in advance of the scheduled time of performance. Alternatively, if there is a resident NEK Representative, the schedules may be submitted in advance to the NEK Representative identifying the activities which have been designated as notification points in the Inspection Plan. The Purchaser may require that the activities performed without proper notification be repeated for NEK Representative observation at the Contractor's expense.

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

Mandatory hold points are considered to be those tests, inspections, or operations which require witnessing by the NEK Representative and beyond which operations shall not proceeded without written consent provided by NEK.

The Contractor'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.

43.5 Documentation

43.5.1 Records Systems

A record system shall be established and maintained by the Contractor to provide a documentary evidence of the quality of performed activities. Records shall, as a minimum, identify the Purchaser's name, Purchaser's Contract number, inspector or data recorder, inspection date, type of observation, procedures used, results,

acceptability, and action taken with any deficiencies noted. Records of inspection shall also include identity of drawings and procedures utilized, along with the revision level. All quality verification records, procedures, and qualifications shall be identifiable to the activity involved.

43.5.2 Contractor's Documentation

QA & QC documents are a deliverable item. The Contractor's Quality Control Representative shall approve them, and then present them to NEK for review and approval. The documentation to be transmitted shall be adequately packaged, protected, and secured to ensure it will arrive undamaged.

Each page of each document submitted shall be clearly identified by the Purchaser's name, Contract number, equipment description and Specification identification, and the Contractor's name and address. Page numbers (e.g. 1 of 5, 2 of 5, etc.) are required or tables of contents detailing attached pages. Each individual document shall be legible and shall have reproducible microform capability. No information shall be recorded closer than 20mm to the binding edge or closer than 6mm to any other edge of the paper. Also, the approval status shall be clearly identified on each document.

All records required by this Specification, applicable regulations, or codes and standards, or generated as a result of the Contractor's QA program shall become part of NEK QA Records. The Purchaser shall be notified in advance if, at any future date, Contractor should plan to destroy any records. At the discretion of NEK, all quality assurance records and documentation related to this Specification shall be transferred to NEK.

43.5.3 Deviation/Change Requests

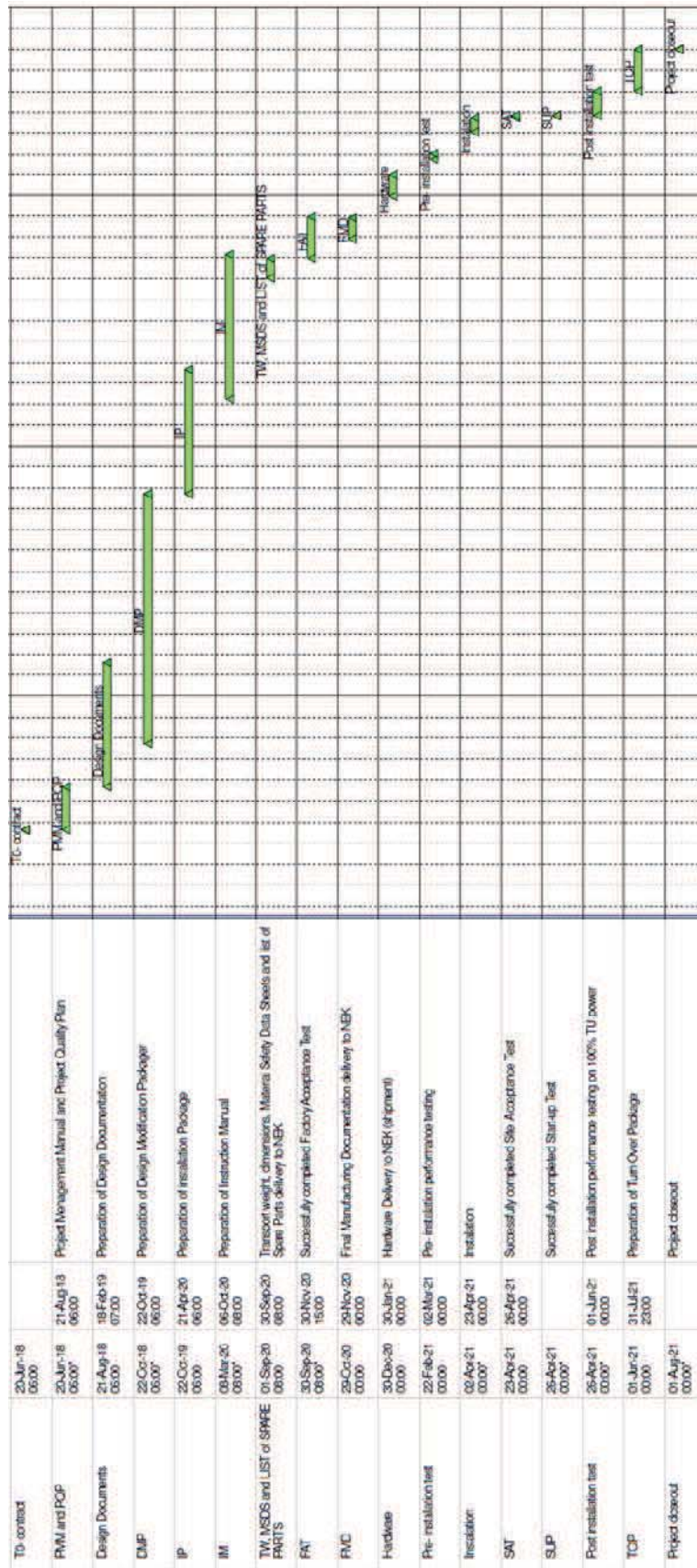
The Contractor has to have established and implemented the control of design and licensing interfaces (internal and external) including:

- a) Identification of interfaces in writing (responsible organization, person),
- b) Organization responsibilities for documents (review, approval, release, distribution, revision...),
- c) Transmittal of design and license information in writing (status of information, complete, incomplete item, further evaluation required, for review, for approval...)

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 Contractor desires to accept, must be accepted by NEK. Any such deviation request must be made in writing by means of a Deviation/Change Request Form submitted to the Purchaser for acceptance prior to continuing the work.

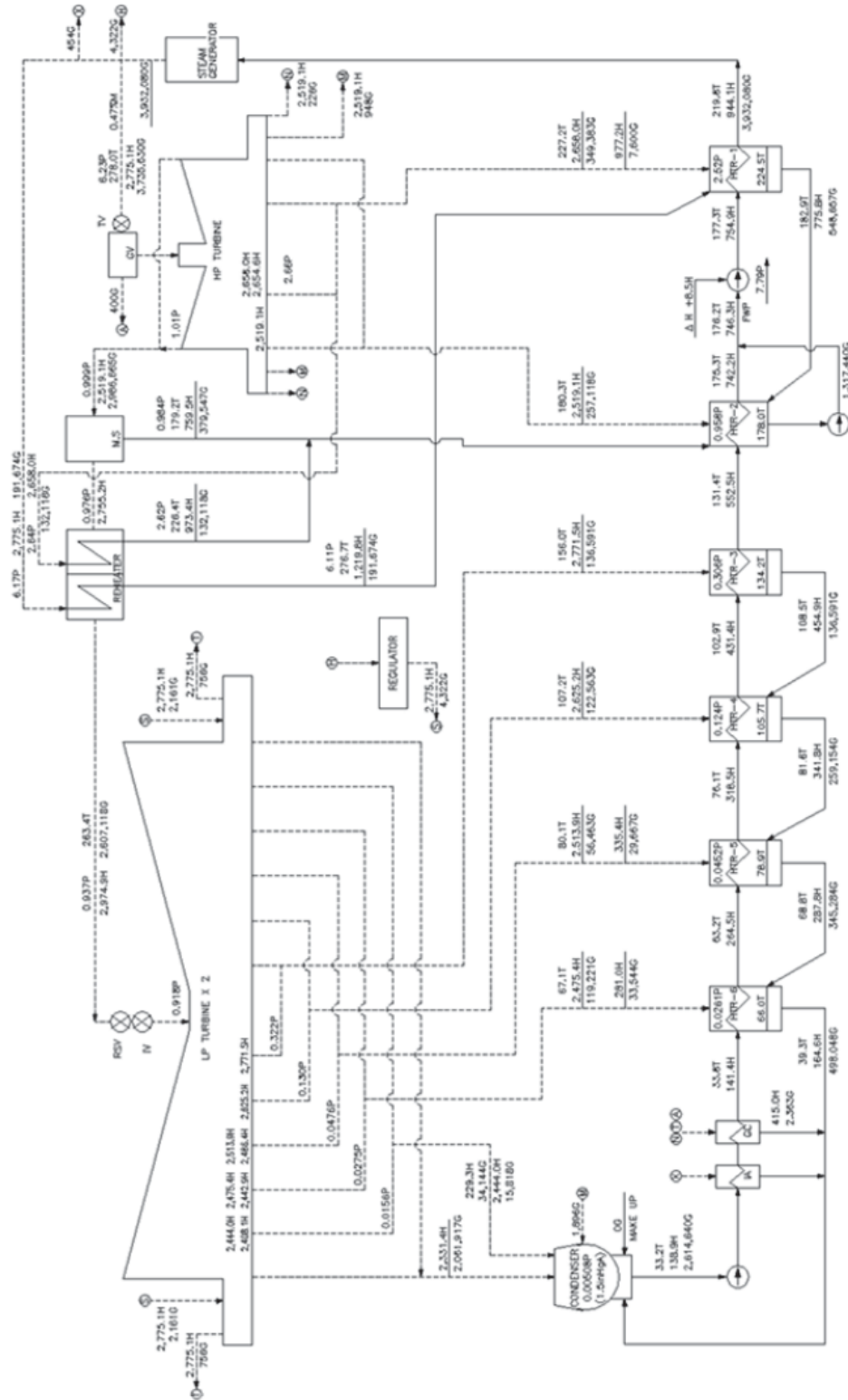
Appendix A

Table 45.1: Project Schedule



Appendix B

Maximum Calculated Heat Balance – USAR Fig.10.1-8



MAXIMUM CALCULATED HEAT BALANCE

NE KRSKO USAR FIG.10.1-8

Rev.13

HEAT BALANCE DIAGRAM
726.800kW 100%LOAD, 2000MWth
904PSIA TV INLET PRES. <UPPER LIMIT>
AFTER LP TURBINE REPLACEMENT

P = PRESSURE.....MPa
T = TEMPERATURE.....°C
H = ENTHALPY.....kJ/kg
G = FLOW.....kg/h
P = MOISTURE.....%

Fig. 2: Intermediate point calculated heat balance

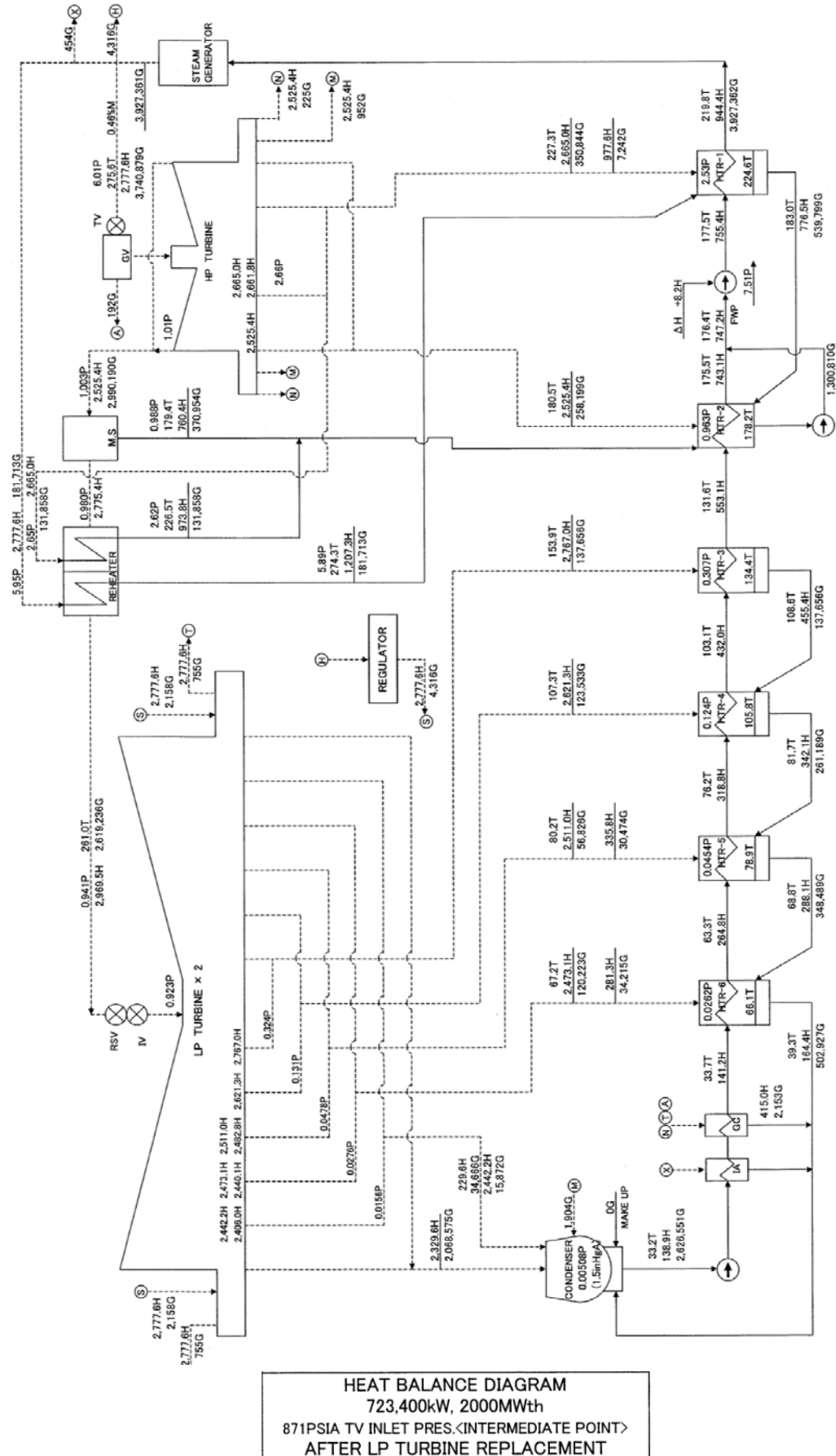
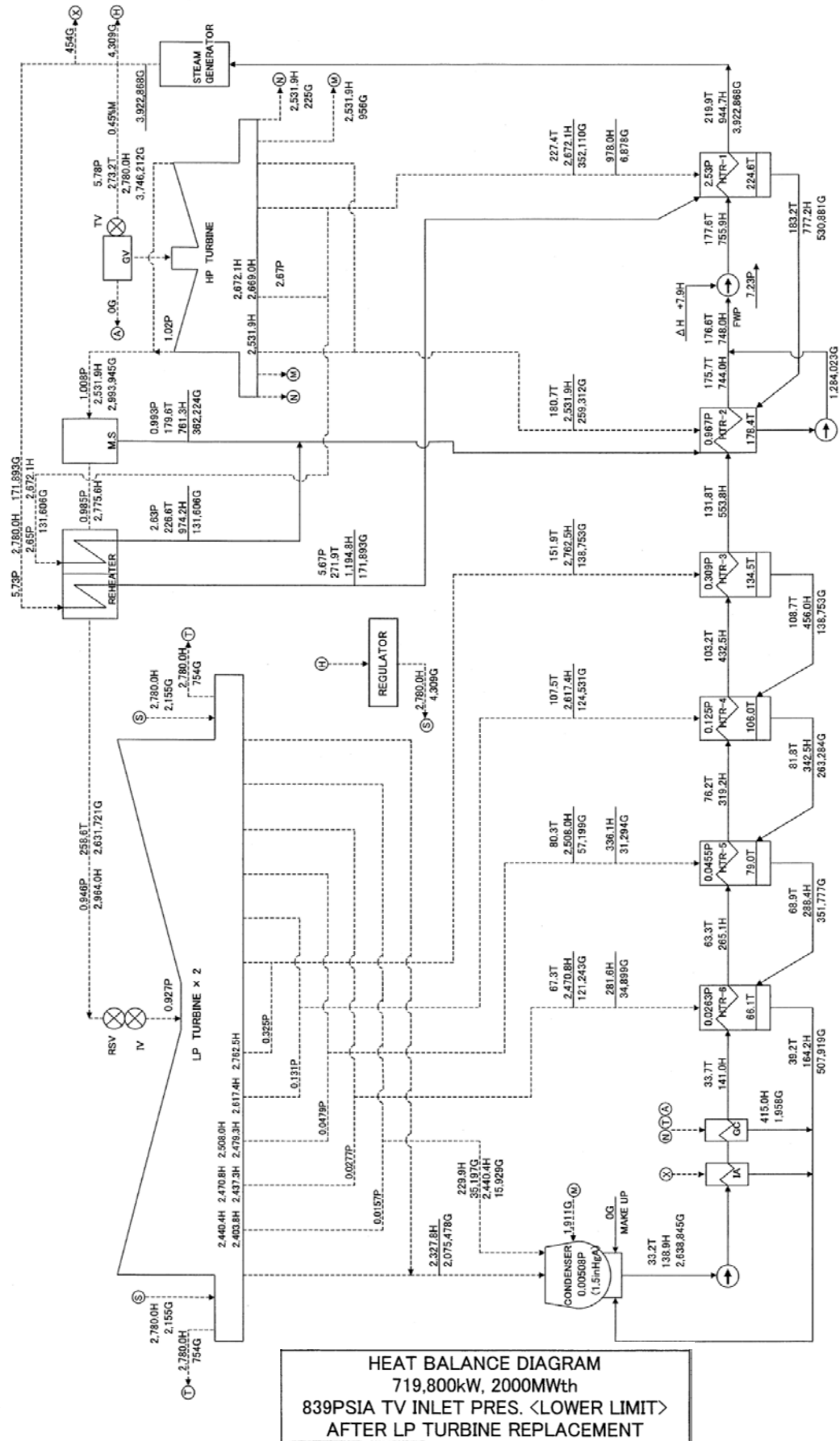


Fig. 3: Lower limit calculated heat balance



Appendix C:

Fluid System Diagrams are added as separate documents to this Specification:

- D-312-012 Main Reheat and Turbine Bypass Steam
- D-312-041 Extraction Steam
- D-312-121 Main, Reheat, Extraction Steam and Misc. Turbine Drains
- D-312-141 Turbine Gland Steam
- D-312-295 Sh.1: E.H. Fluid Supply System
- D-312-295 Sh.2: Steam Turbine Valves & Hydraulic Control System
- D-312-295 Sh.3: Turbine Generator Lubrication System

Appendix D: Picture 1: Turbine Drain and Turbine Gland piping 1

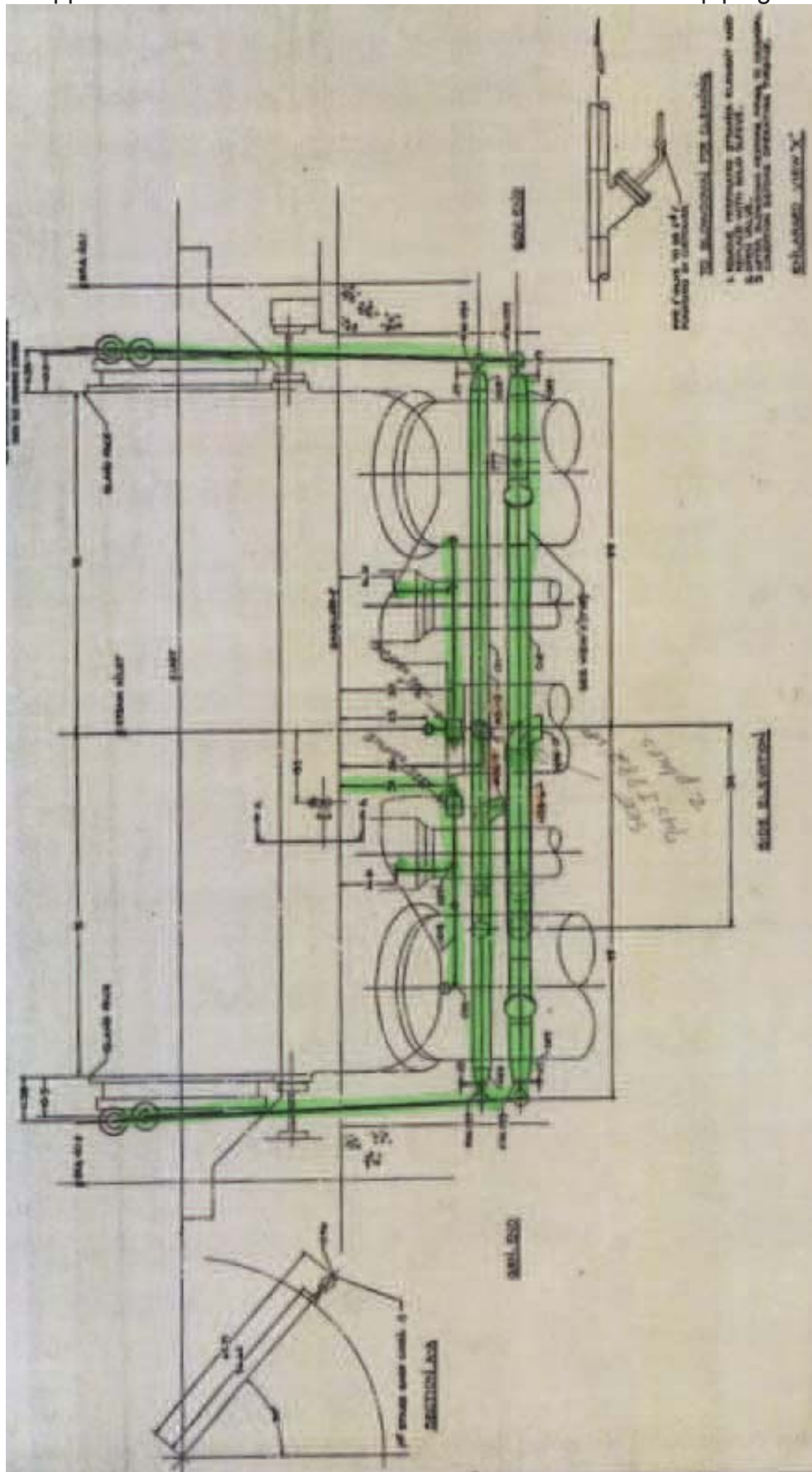
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59	PPG-STM DRN & GLD AS				DISTR CODE 700-296-000		72																										
ITEM	CHANGE				ITEM	CHANGE																											
001	REV. 2 WAS. 1 SEE ASSY DFTM N. Vatten 11/2/74 CHK'D N. Vatten 11/27/76 RESPONSIBLE ENGINEER <i>Delacour 11/27</i>				2																												
OFFICE DENTS FOR																																	
<table border="1"> <tr> <td>LT-10</td> <td>LT-11</td> <td>LT-12</td> <td>LT-13</td> <td>LT-14</td> <td>LT-15</td> <td>LT-16</td> <td>LT-17</td> <td>LT-18</td> <td>LT-19</td> <td>LT-20</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>												LT-10	LT-11	LT-12	LT-13	LT-14	LT-15	LT-16	LT-17	LT-18	LT-19	LT-20											
LT-10	LT-11	LT-12	LT-13	LT-14	LT-15	LT-16	LT-17	LT-18	LT-19	LT-20																							
<table border="1"> <tr> <td>DESIGN</td> <td>CHK'D</td> <td>APP'D</td> <td>DES ENGR</td> <td>MET ENGR</td> <td>MACH ENGR</td> <td>MFG ENGR</td> </tr> <tr> <td>11/2/74</td> <td>11/2/74</td> <td>11/2/74</td> <td>11/2/74</td> <td>11/2/74</td> <td>11/2/74</td> <td>11/2/74</td> </tr> </table>												DESIGN	CHK'D	APP'D	DES ENGR	MET ENGR	MACH ENGR	MFG ENGR	11/2/74	11/2/74	11/2/74	11/2/74	11/2/74	11/2/74	11/2/74								
DESIGN	CHK'D	APP'D	DES ENGR	MET ENGR	MACH ENGR	MFG ENGR																											
11/2/74	11/2/74	11/2/74	11/2/74	11/2/74	11/2/74	11/2/74																											
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59	PPG-STM DRN & GLD AS				DISTR CODE 700-296-000		72				
2ND PH	ITEM	SYM	DESCRIPTION		STYLE NO.	REV	QUAN REQ'D	Q01	Q02	Q03	Q04
01	001		PPG STM DRN & GLD AS		4694D67000	2	REF				
01	002		PPG STM DRN & GLD LL		829A440000	-	R				
01	003		DFTG DES NOTES, STM PPG		394A923000	1	E				
01	004		ELECTRODES .125 LB		358A580000	1	35				
01	005		PIPE		4694D67005	1	1				
			30.00 .375 .125 LDT 10107BM			-	1				
01	007		PIPE		4694D67007	1	1				
			12.00 .50 .147 LDT 10107BM			-	-				
01	008		PIPE		4694D67008	1	1				
			540.00 1.00 .179 LDT 10107BM			-	-				
01	009		PIPE		4694D67009	1	1				
			564.00 2.50 .203 LDT 10107BM			-	-				
01	010		PIPE		4694D67010	1	1				
			620.00 3.00 .216 LDT 10107BM			-	-				
01	011		PIPE		4694D67011	1	1				
			225.00 4.00 .237 LDT 10107BM			-	-				
01	012		PIPE		4694D67012	1	1				
			160.00 5.00 .258 LDT 10107BM			-	-				
01	013		TUBING		4694D67013	1	1				
			220.00 .500 .049 LDT 10107BM			-	-				
01	015		FLANGE-WELD NECK 2.50		626C175020	-	4				
01	016		FLANGE-WELD NECK 3.00		626C175024	-	4				
01	017					-	-				
01	018					-	-				

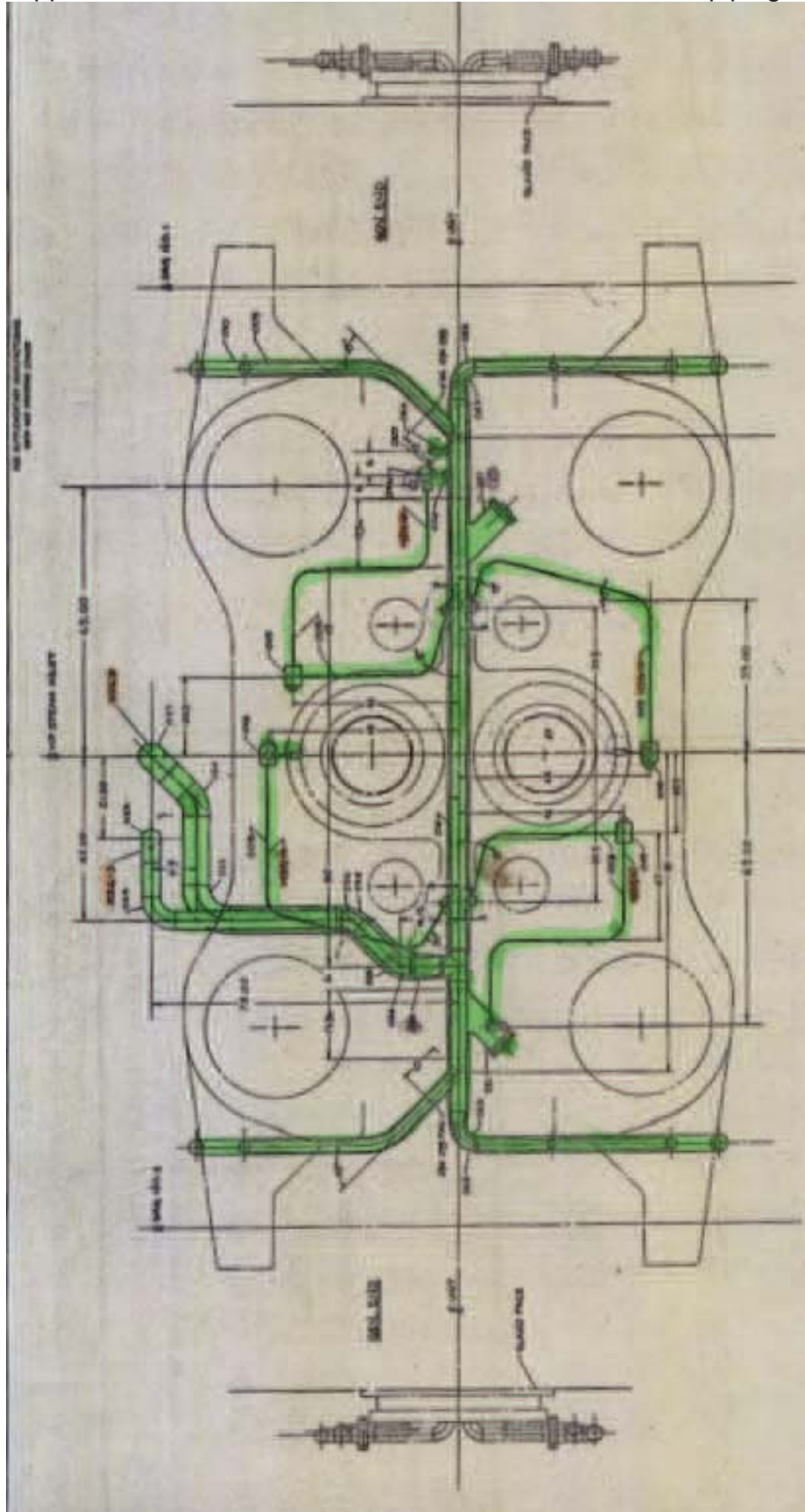
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59	PPG-STM DRN & GLD AS				DISTR CODE 700-296-000		72				
2ND PH	ITEM	SYM	DESCRIPTION		STYLE NO.	REV	QUAN REQ'D	Q01	Q02	Q03	Q04
01	019		FLANGE ASSY 5.00		273A280034	-	4				
	020		ELBOW BW 45° 6.00		4608057048	-	3				
01	021		ELBOW BW 10° 2.50		4608016020	-	4				
01	022		ELBOW BW 10° 2.50		4608026020	-	2				
01	023		ELBOW BW 10° 3.00		4608026024	-	6				
01	024		ELBOW BW 10° 4.00		4608026032	-	1				
01	025		ELBOW BW 45° 2.50		4608051020	-	12				
01	026		ELBOW BW 45° 3.00		4608051024	-	12				
	027		ELBOW BW 90° 6.00 S.R.		4608060400	-	1				
01	028		REDUCER BW 4.00x2.50		4608056035	-	2				
01	029		REDUCER BW 5.00x3.00		4608056040	-	2				
	030		REDUCER BW 6.00x5.00		4608066048	-	1				
01	031		THRODLET 2.50x5.00		626C029017	-	4				
01	032		SOCKET 5.00x5.00		626C021018	-	1				
	033		ELBOW BW 90° 4.00		4608037048	-	1				
01	034		COUPLING S.W. 1.00		626C015008	-	2				
01	035		ELBOW BW 10° 1.00		626C127008	-	8				
	036		ELBOW BW 45° 4.00		4608051032	-	2				
01	037		FITTING TUBE MALE CORN.		270A337113	-	8				
01	038		FITTING TUBE MALE CORN.		270A337111	-	2				
01	039		FITTING TUBE UNION TEE		270A344101	-	2				
	040		FITTING TUBE ELBOW		270A337113	-	2				
01	041		ELBOW SCRD 90° .300		270A374004	-	1				
01	042		ELBOW SCRD 90° .275		270A374003	-	1				
	043					-	-				

Westinghouse Electric Corporation										PAGE 4	
STEAM DIVISIONS, LESTER, PA., U.S.A.											
1ST PH	TITLE				B N 4694 D 67		SUB NO.				
59	PPG-STM DRN & GLD AS				DISTR CODE 700-296-000		72				
2ND PH	ITEM	SYM	DESCRIPTION		STYLE NO.	REV	QUAN REQ'D	Q01	Q02	Q03	Q04
01	044		TC WELL APPLICATION		458B758005	-	2				
	045					-	-				
01	046		VALVE GLOBE SCRD .500		270A391003	-	2				
	047					-	-				
01	048		DRIFED BLOCK .32125		6508673002	-	2				
01	049		DRIFED BLOCK .375		500C486004	-	2				
	050					-	-				
01	051		STEAM STRAINER 5.00		829A022001	-	2				
	052					-	-				
01	053					-	-				
01	054		WELD RING 2.50		626C047025	-	8				
01	055		WELD RING 3.00		626C047029	-	4				
	056					-	-				
01	057					-	-				
01	058		GASKET 3.00		270A318024	-	8				
01	059		BOLT STUD .625 3.5		627C704014	-	32				
01	060		NUT .625		4608496010	-	64				
01	061		GASKET 2.50		270A318020	-	8				
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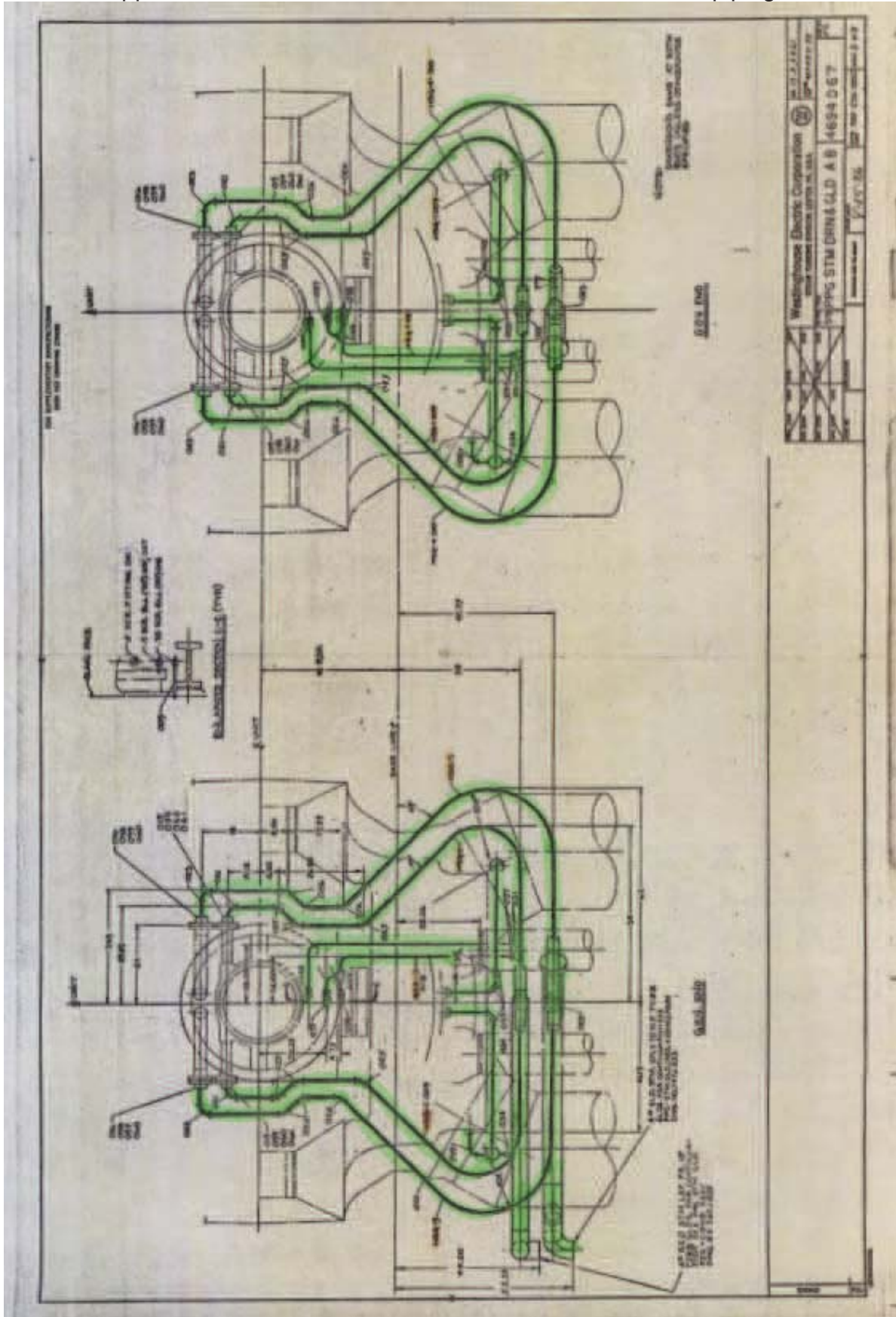
Appendix D: Picture 2: Turbine Drain and Turbine Gland piping 2



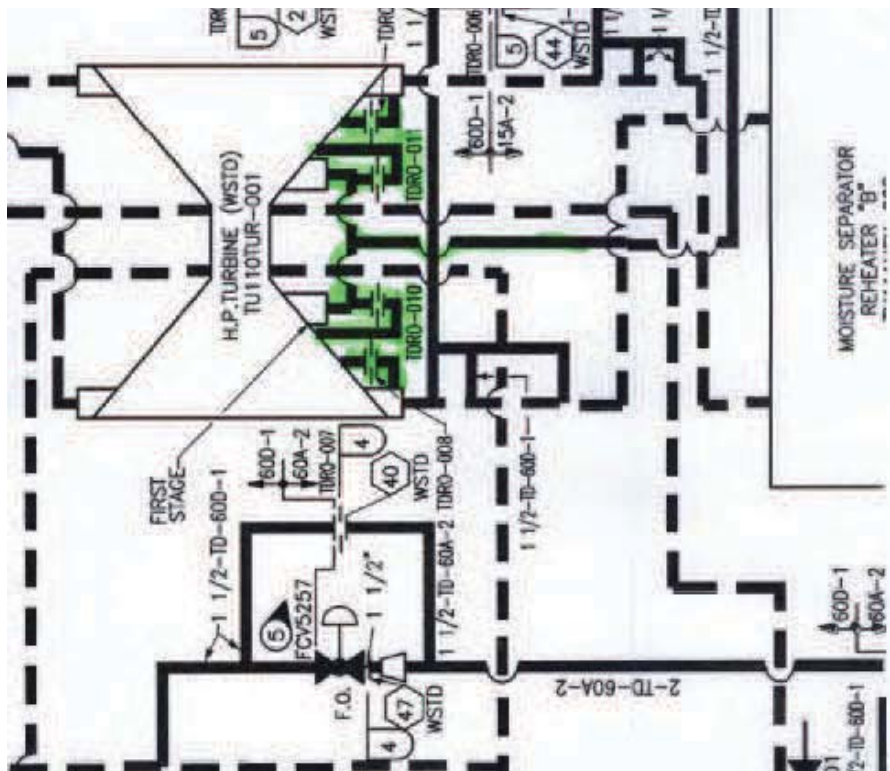
Appendix D: Picture 3: Turbine Drain and Turbine Gland piping 3



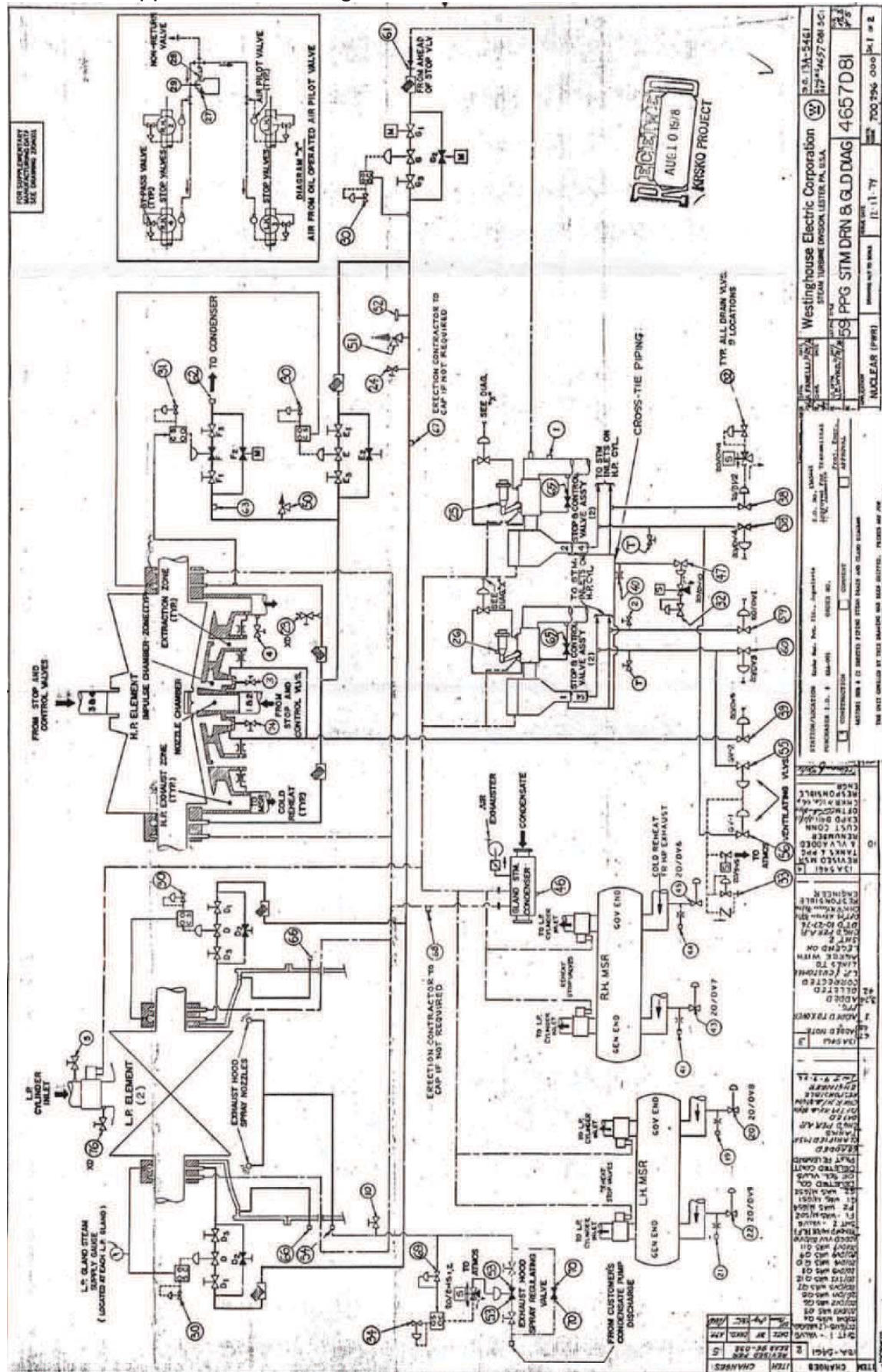
Appendix D: Picture 4: Turbine Drain and Turbine Gland piping 4



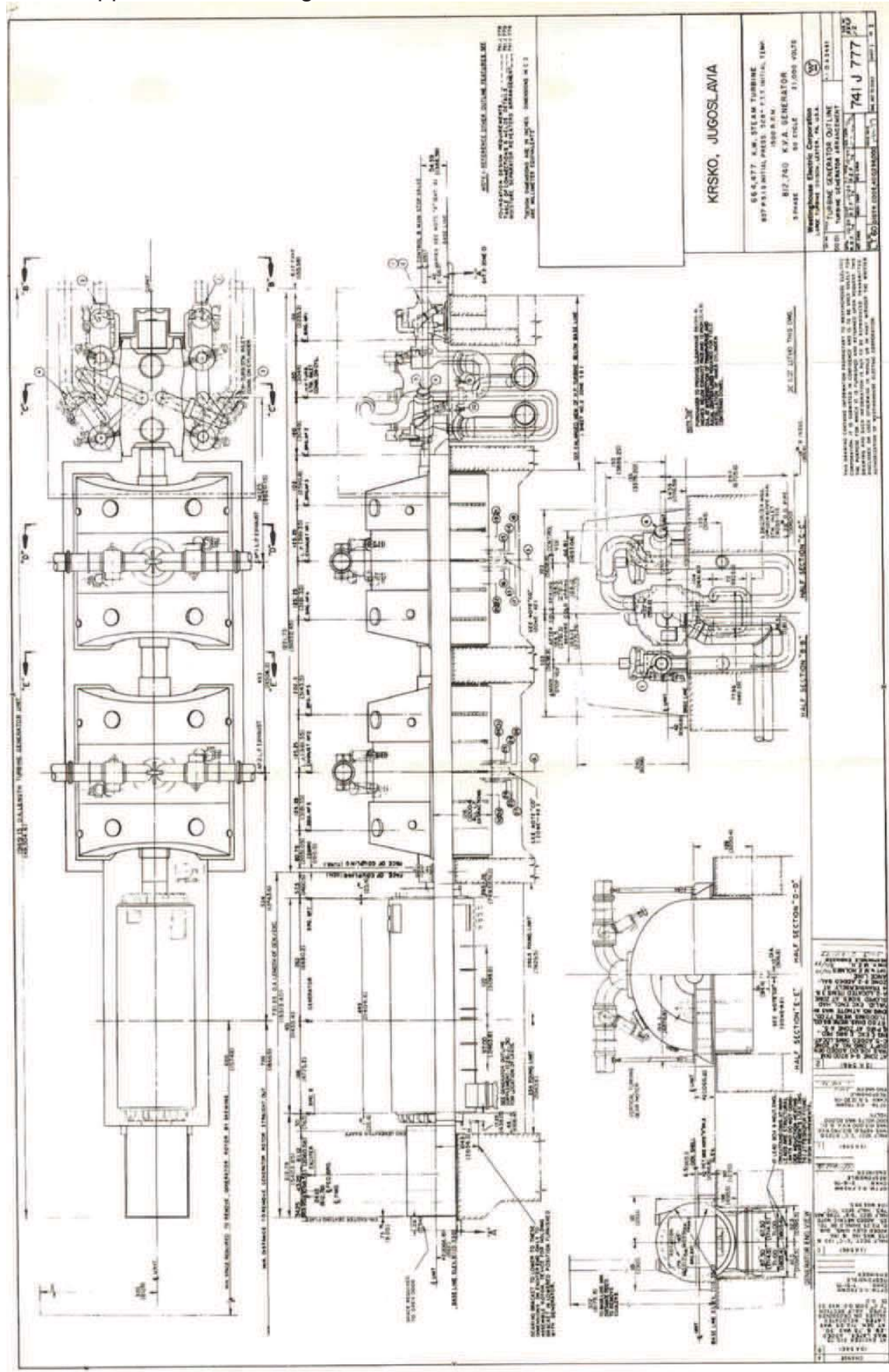
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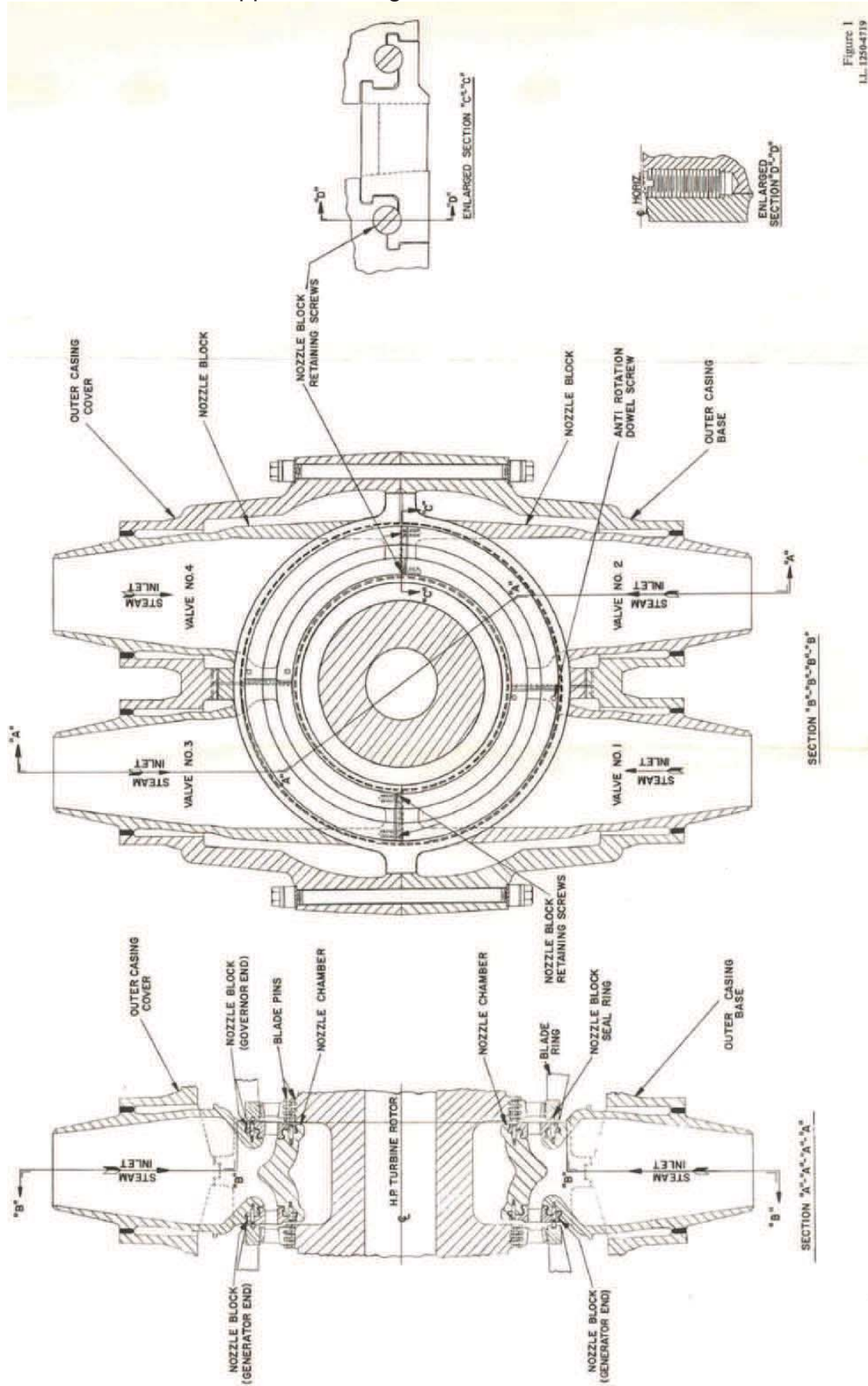
Appendix D: Drawing 4657D81: PPG STM DRN&GLD DIAG



Appendix D: Drawing 741J777: TURBINE GENERATOR OUTLINE



Appendix D: Figure 1 I.L. 1250-4719



Appendix D: Figure 1 I.L. 1250-3785-A

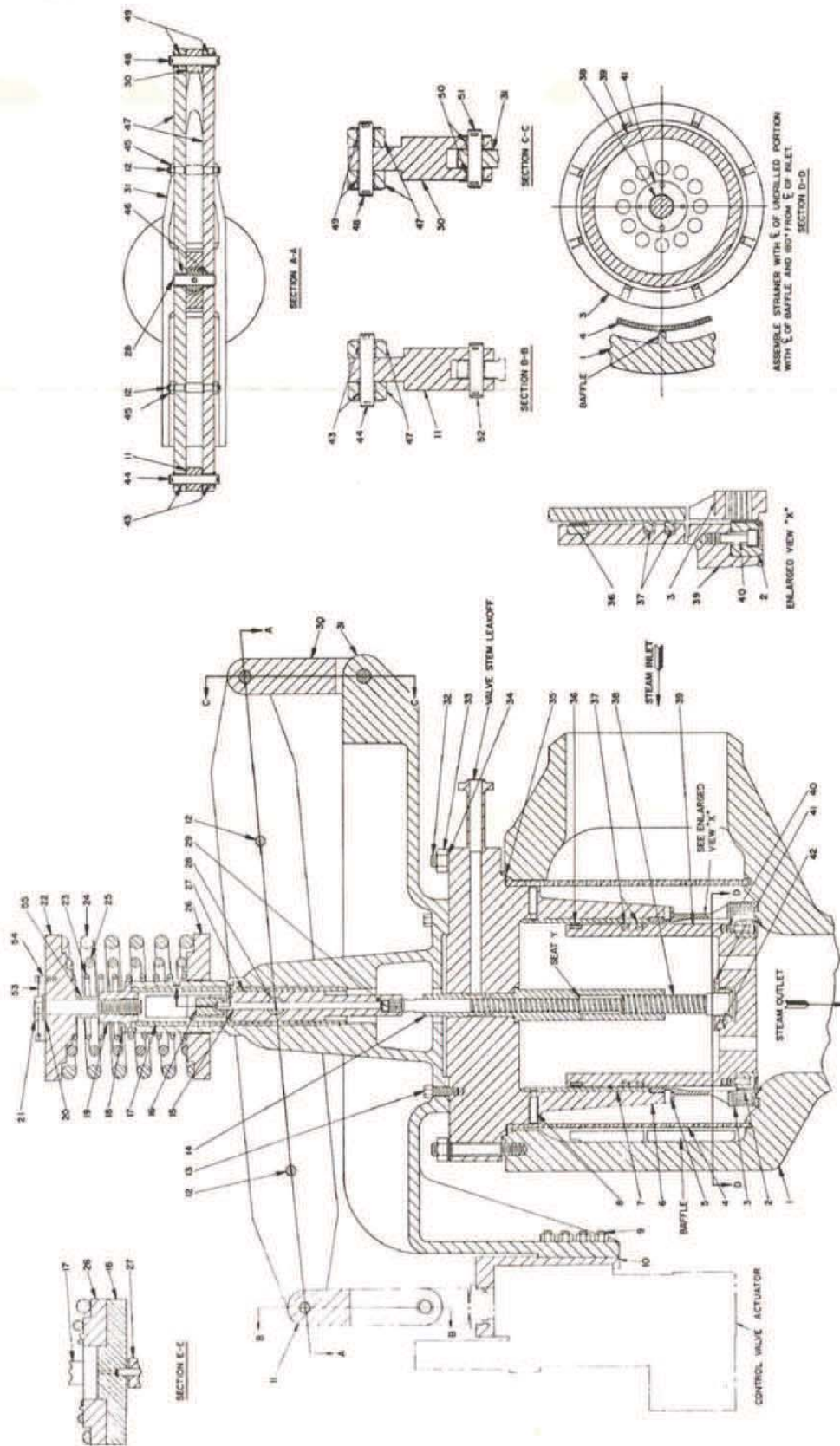
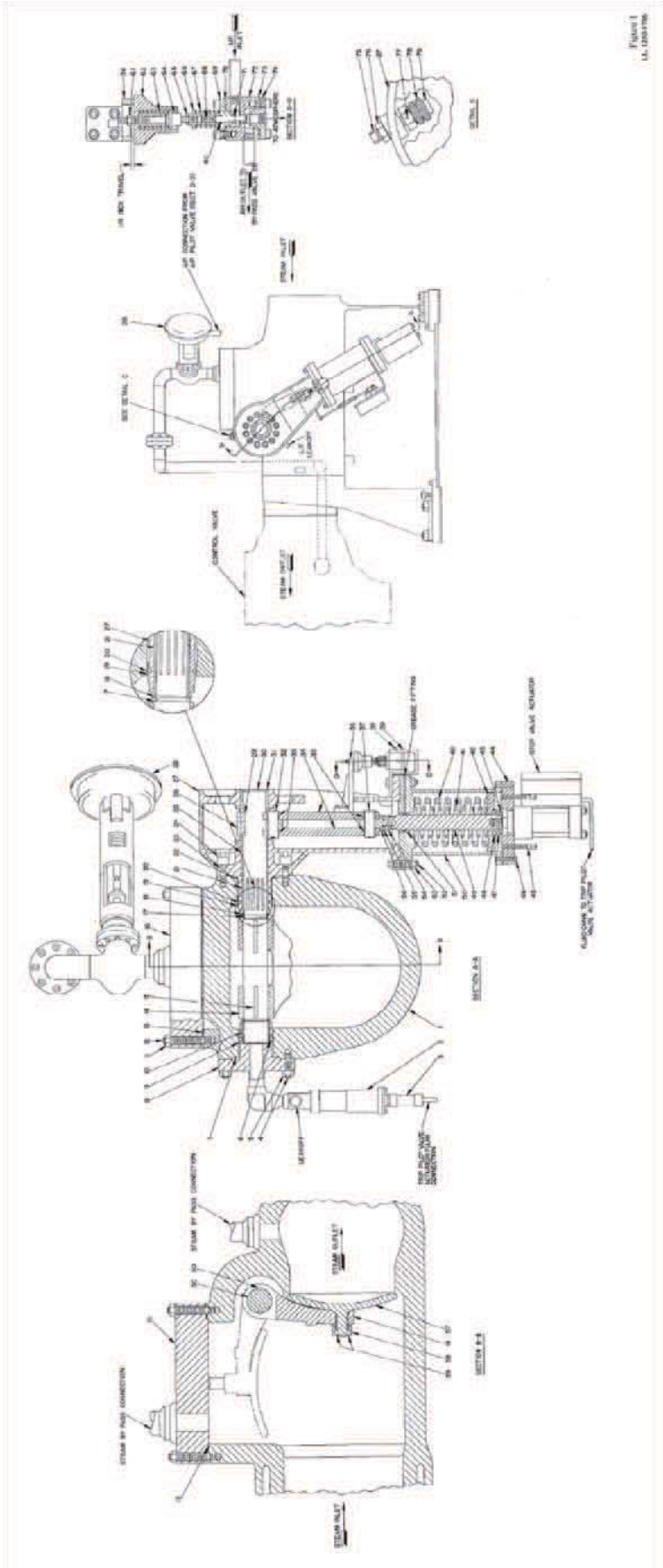
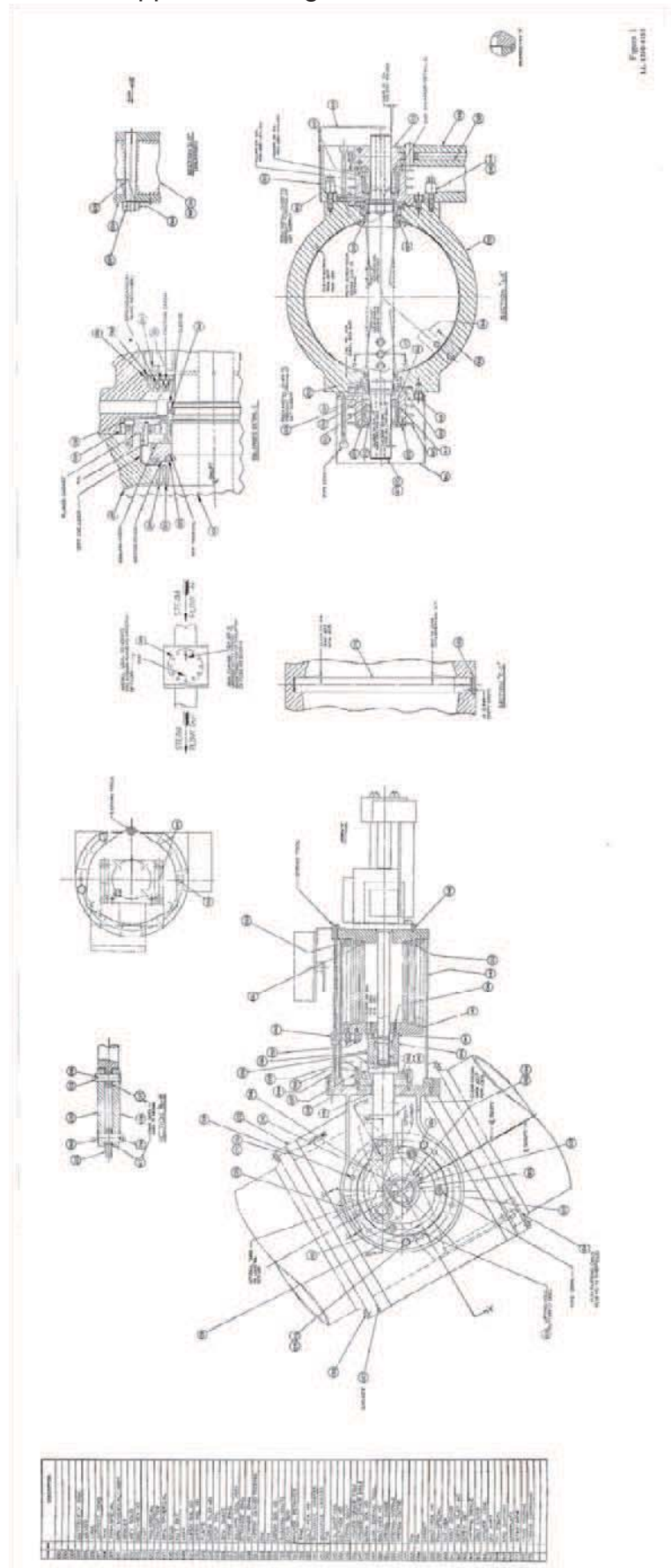


Figure 1
I.L. 1250-3785-A

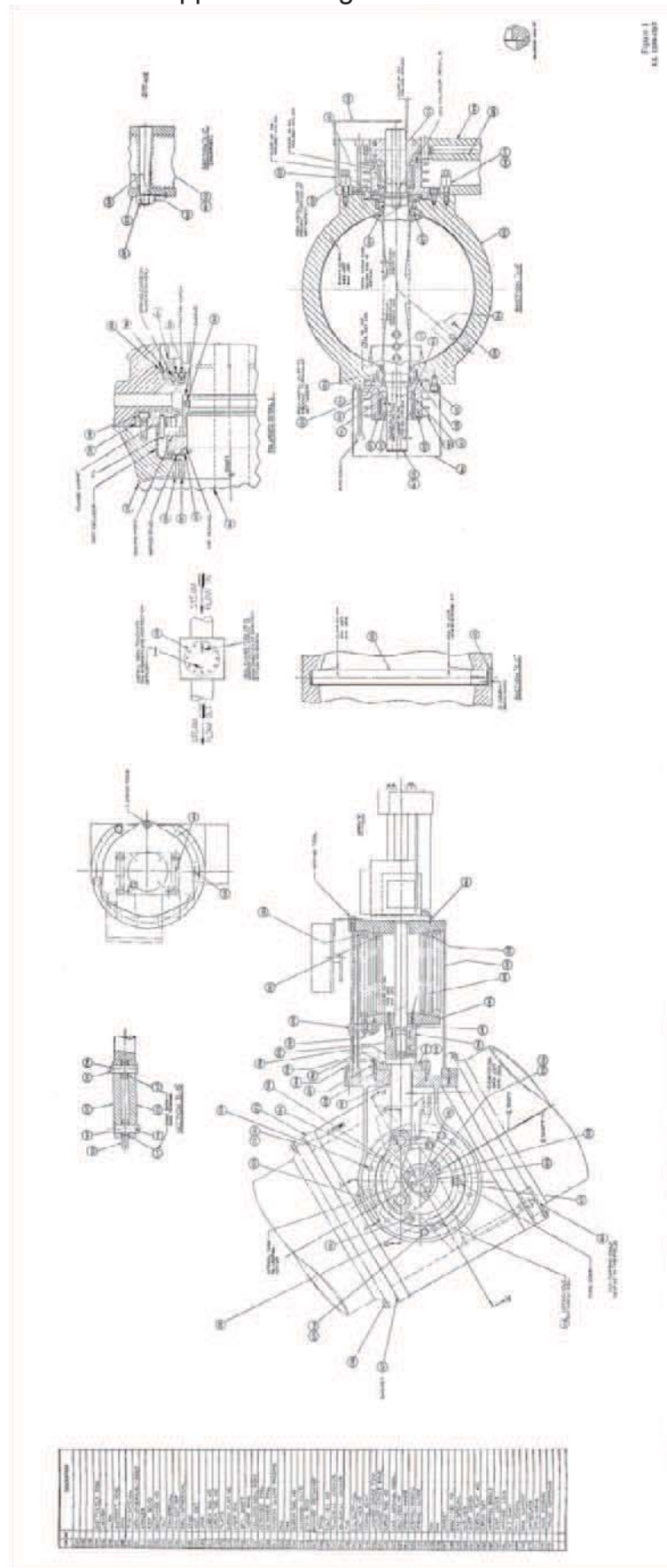
Appendix D: Figure 1 I.L. 1250-3786



Appendix D: Figure 1 I.L. 1250-4153



Appendix D Figure 1 I.L. 1250-4267



Appendix E

Proposed PMM Template is added as a separate document to this Specification.

Appendix F

QS-610 Rev.1: Generic Quality Assurance Program Requirements” is added as a separate document to this Specification

Appendix G

ESP-2.602 Rev.7: Plant Design Modification is added as a separate document to this
Specification

Appendix H
Requirements from ESP-2.617 for MECL

Equipment information for new components and spares

Part Number						
Item Description						
Manufacturer						
Manufacturer-Title- Address						
Mfr Part Number(MPN)						
MPN Description						
Safety Classification (Y/N)						
Seismic Category (1, N/A)						
ASME CODE PN (Y/N)						
IEEE PN (Y/N)						
ENV EQ PN (Y/N)						
Quantity						
Unit of Measure(UOM)						
Serial Control (Y/N)						
Serial Number						
Lot/Heat/Real/Batch No						
Shelf Life Control						
Shelf Life Months						
Storage Level (A,B,C,D)						
ISM REQ (Y/N)						
Qualified Life-Months						
Service/Operation Life- months						
Chemicals-MSDS (Y/N)						
Hazardous Material (Y/N)						
Nuclear Material (Y/N)						
Radioactive Material (Y/N)						
Item Price						
Contract No						
Ref records Ref. Document (OM; DWG; BOM)						

NOTE:

1. Contractor shall provide all required information for main component and subcomponents.

Equipment information

Part Number	
Item Description	
Manufacturer	
Manufacturer-Title-Address	
Ref. Document (OM; DWG; BOM)	

Equipment Spare Parts

Mfr Part Number(MPN)						
MPN Description						
Manufacturer-Title-Address						
Safety Classification (Y/N)						
Seismic Category (1, N/A)						
ASME CODE PN (Y/N)						
IEEE PN (Y/N)						
ENV EQ PN (Y/N)						
Quantity						
Unit of Measure(UOM)						
Serial Control (Y/N)						
Serial Number						
Lot/Heat/Real/Batch No						
Shelf life Control						
Shelf Life - Months						
Storage Level (A,B,C,D)						
ISM REQ (Y/N)						
Qualified Life-Months						
Service/Operation Life-Months						
Chemicals-MSDS (Y/N)						
Hazardous Material (Y/N)						
Nuclear Material (Y/N)						
Radioactive Material (Y/N)						
Item Price						
Contract No						
Ref Records						

NOTE:

- Contractor shall provide all required information for equipment spare parts delivered within the contracted Scope of Services and Delivery

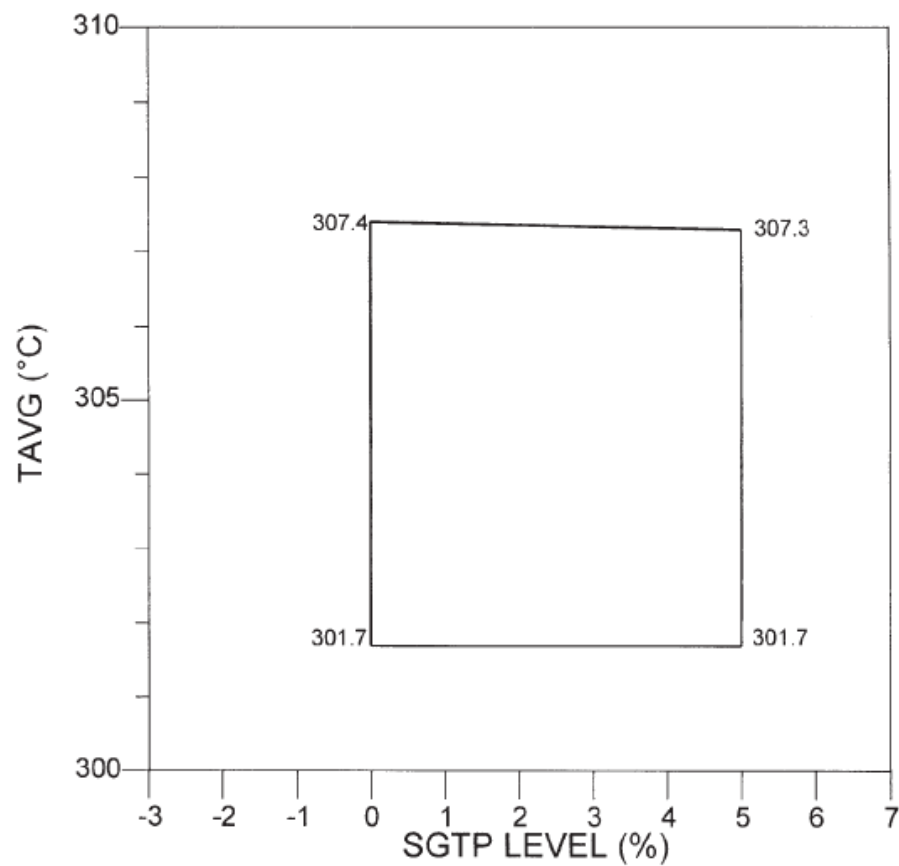
Appendix I

SUP-16.061 is added as a separate document to this Specification

Appendix J

NEK Operating Window

Parameter	Upper Limit	Intermediate Point	Lower Limit
Reactor Power	2000 MWt	2000 MWt	2000 MWt
Steam Generator Outlet Pressure	6.565 MPa 66.9 kp/cm ² 952 psia	6.336 MPa 64.8 kp/cm ² 919 psia	6.116 MPa 62.4 kp/cm ² 887 psia
Turbine Inlet Pressure	6.233 MPa 63.6 kp/cm ² 904 psia	6.005 MPa 61.2 kp/cm ² 871 psia	5.785 MPa 59.0 kp/cm ² 839 psia
Governor Valve Position	Throttling (*)	Throttling (*)	Wide Open (*)
Final Feedwater Temperature	492.7 K 219.7°C 427.5 °F	492.5 K 219.5°C 427.1 °F	492.5 K 219.5°C 427.1 °F



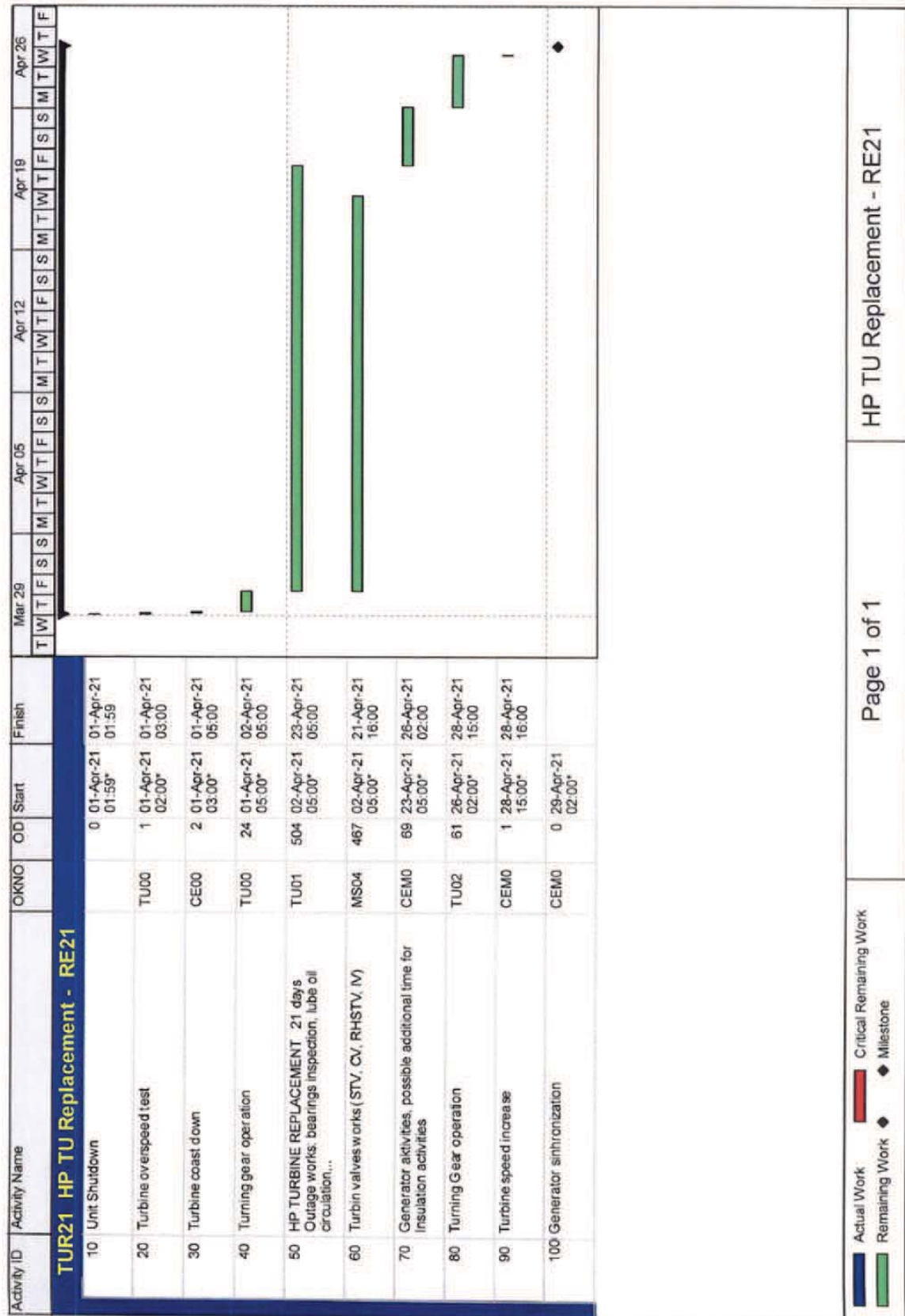
WINDOW REACTOR COOLANT TEMPERATURE
VERSUS STEAM GENERATOR TUBE PLUGGING
LEVEL (METRIC UNITS)

NE KRŠKO

USAR Rev.7

Fig. 5.1-3A

Appendix K
Time Schedule for HP Turbine Replacement RE21



Attachment L

NEK's requirements for workers which allowed to work as unescorted person

Documents needed for registration and security vetting

For the purpose of registration and security vetting of Supplier's personnel, Supplier shall fill in, sign and submit to NEK the following documents to be previously provided by NEK:

- Request for Entry Card (6.5-C)
- Statement on complying with Act on Ionising Radiation Protection and Nuclear Safety (6.3-C)
- Written Agreement on Ensuring Collective Occupational Health and Safety, Fire Protection and Environmental Management
- Agreement with Safety Verification (6.1 -C)*
- Security Vetting Questionnaire (6.2-C)*
- Request for Personnel Security Clearance(6.7)*

*These documents, completed and signed, should be kept in the personal file of worker in Supplier's company for five years after the service/work completion at NEK. These forms are not required to be submitted to NEK.

A foreign employer from EU is required to ensure that when he posts his workers to the RS, the following documents are kept on the location where the activity is carried out in Slovene language and can be provided for inspection at the request of the supervisory body:

- a. A copy of the contract or purchase order under which the work shall be performed;
- b. A certificate of EU company's application with the Employment Service of Slovenia;
https://www.ess.gov.si/delodajalci/zaposlovanje_in_delo_tujcev/spletna~prijava~dela-tujcev/~spletna~prijava-dela~tujcev~prijava~izvajanje~storitev~delodajalca~s~sedezem-v~drzavi~clanici-eu-egp~ali~svicarski-konfederaciji?cl=35
- c. Copy of Company's registration from the Registry office;
- d. Copy of Company's certificate / statement from the Craft Chamber;
- e. Copies of posted workers' employment contracts;
- f. Copies of pay slips and bank statements;
- g. Up-to-date time sheets available during the site performance;
- h. Risk Assessment Program and Injury and Illness Protection Program Certificates and Safety at Work Training Certificate completed by posted workers;
- i. A1 Forms:

https://europa.eu/youreurope/citizens/work/social-security/forms/contact_points_pd_a1.pdf

The workers must pass the General Employee training in English, Slovene or Croatian before the start of the work.