

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

NE 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 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.

1.2 Description of Problem

After steam generators replacement in the year 2000 (which corresponds to NSSS output of 2000 MW thermal) NE Krško have 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 year 2006, the turbine-generator is 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 an original one, now more than 35 years in operation. New HP designs offer several areas of improvement like 3D profile blades, all reaction type with improved seals. Significant MWe gain is achievable.

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
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
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
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
PMM	Project Management Manual
PQP	Project Quality Plan
PQR	Procedure Qualification Record
PT	Penetrant Testing
PTC	Performance Test Code
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
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
URSJV	Uprava Republike Slovenije za Jedrsko Varnost
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

2.2 Definitions

Bidder - one who offers the price for scope of work and supply

Contract - shall mean the Agreement between the Purchaser and the Seller, the Specification which shall include the 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 project which has to assure:

- a. replacement of degraded HP Turbine with "New HP Turbine" in the outage 2019
- b. at least 7 more total gross MWe through better efficiency of replacements HP turbine
- c. resistance of materials to erosion/corrosion and stress corrosion cracking and 12-years maintenance period
- d. to provide replacement (removal and installation) in 18 days during the October, 2019 outage, which means that work will be started on 2nd day of outage and finished on the 19th day of the outage
- e. To successfully completed Start-up test on 28th day of outage in October 2019
- f. To successfully completed Site Acceptance Test in October 2019
- g. compatibility of new HP turbine with existing equipment and systems (LP Turbines, GN, CO, TC, TD, TG, EX, DEH ...) in NE Krško
- h. 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 NE Krško under power uprated conditions.

Owner - shall mean Nuklearna Elektrarna Krško

Physical Delivery - shall mean delivery of all manufacturing documentation, pieces of equipment and materials as per this Specification SP-ES1297, Rev.0 item 3.2 Scope of 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 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. 0 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

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 supply, unless clearly specified in any article of the Contract.

Turnkey project consists of:

- Preparation of design documentation (DMP, documentation according to 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 is:

- Project documentation (PMM, PQP, etc)
- Preparation of design documentation (DMP, documentation according to NEK procedures)
- Manufacturing and purchasing of Hardware (HP Turbine and associated equipment/material)
- Hardware delivery on Site
- Supply of recommended spare parts and consumables
- Performance of reference Performance 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% 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 in connection with Licensing with SNSA for the “New HP turbine” as “turn-key” project.

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 on 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 NE 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 what also include transportation of "New HP Turbine" from Manufacturer's facility till NEK turbine deck el.115,5, preparation of "New HP Turbine" for installation with development of installation package with all documentation requested by this Specification, removal of existing "Old HP Turbine" and attachments and transportation in warehouse, put old rotor on existing (old) rotor stand, steel construction for supports, restraints, platforms, insulation, assembly and installation, welding, non-destructive testing, removal of scaffolding & cleaning 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 NE 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 will 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 NE Krško because of »New HP Turbine« necessary to achieve goals of the project or is required to allow NE Krško safe and reliable operation with "New HP Turbine" is part of "Scope of Work" or »Scope of Supply« under this Specification.

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. Development of DMP shall run in parallel on 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 and related Conceptual Design Packages (CDP). 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 and the existing 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 correct As-Built Mark-up documentation for known purposes. The Contractor is not requested to correct NEK DCM documents and drawings at this phase of project. The subject walk-down/As-Built Mark-ups shall be performed prior to the development of the DMP.

3.2 Scope of supply, transportation and replacement

The Scope of Supply 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 Scope of Supply is 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 and limits of Supply 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 assure:
- a. At least 7 more total gross MWe through better efficiency of replacements HP turbine
 - b. Resistance of materials to erosion/corrosion and stress corrosion cracking and 12-years maintenance period
 - c. Compatibility of new HP turbine with existing equipment and systems (LP Turbines, GN, CO, TC, TD, TG, EX, DEH ...) in NE Krško,
 - d. That all turbine supervisory parameters shall be the same or better than before equipment replacement.
 - e. That vibrations levels of "New HP turbine" are lower than 2 mils

- 3.2.2 The Contractor shall remove the existing HP Turbine, existing equipment, disassemble all existing connections, prepare all for the installation and install the "New HP Turbine" and equipment. The work shall be performed in time frame, that does not in any way jeopardize the NEK outage duration:
- a. To provide replacement (removal and installation) in 18 days during the October, 2019 outage, which means that work will be started on 2nd day of outage and finished on the 19th day of the outage,
 - b. To successfully completed Start-up test on 28th day of outage in October 2019
 - c. To successfully completed Site Acceptance Test in October 2019

During implementation of project the Contractor shall organize his activities on TB el. 107 and TB 115.5 on such way that will allow performing other NEK outage activities.

- 3.2.3 One (1) Fully Bladed (3D blades) Advanced Design HP rotor Monoblock type with all reaction stages, with governor and generator end couplings compatible with existing design, factory balanced and overspeed tested for installation in the new NE Krško HP Turbine Outer Cylinders. Recommended one (1) Set of spindle and stationary steam stage seals shall be included.
- 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 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 be included
- 3.2.5 Two (2) Sets of HP tilting pad, self-aligning type bearings together with adjusting liners and bearing supports and additional two sets (2) spare bearings. 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. The insulation shall be partially removable on the new HP Outer Casing in the horizontal joint bolting area, balancing/inspection openings ...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.
- 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 supplier shall provide an
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engineering evaluation of the existing gland steam regulating system with recommendations for improvements, if required. Recommended spare two (2) sets of inner and two (2) sets outer gland seal segments shall be included.

- 3.2.10 Evaluation 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 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 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 mode of operation. This signal must be valid representative of turbine power at all regular operating or testing modes of operation.

- 3.2.11 One (1) Coupling Spacer for LP turbine connection.

- 3.2.12 Validation and identification of the necessary changes to the existing instrumentation (temperature, pressure, differential expansion, eccentricity, speed, vibration, etc.).

- 3.2.13 Contractor shall perform evaluation of influence of turbine replacement to all existing adjacent and affected systems, structures and components, which includes but is not limited to main steam system, extraction steam system, auxiliary steam system, feedwater heaters, MSRs, lubricating oil system etc. Any impact to existing systems, structures and components shall be resolved by the Contractor.

- 3.2.14 Evaluation of the existing PDEH connections and in case of nozzle block and control stage removal provide an engineering evaluation, calculation and detailed instructions of the control valve operation to permit the simultaneous operation of valves in accordance with full arc admission design:

- a. Influence of new HP turbine to PDEH: Validation and/or definition of the 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 SEQUENTIAL valve modes.
 - b. IMPULSE pressure currently represents turbine power and is used for closed loop control. New method of measuring turbine power shall be introduced and 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).
 - c. HP turbine ROTOR STRESS calculations in PDEH system should be updated to reflect limitations of new turbine.
 - 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).
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- 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.
- f. Rescaling PDEH rated values.
- g. 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.

3.2.15 Evaluation of the existing Turbine Water Induction Protection System and proposed improvements. The modification of the HP turbine shall be designed that all internal recesses in which condensation may collect shall be properly drained. The design shall provide means for moisture separation and removal from stages in the wet region.

3.2.16 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 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.

3.2.17 One (1) Set of special tools and One (1) Set of balance weights.

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

3.2.19 Within the Scope of Supply of this Specification there should be also understood:

- 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 Work, even if not expressly included in the Installation Package, except to the extent specifically included in NEK's Scope of Supply.
- d. All transportation equipment and appropriate devices, tools and ropes for handling with heavy pieces of Project "New HP Turbine"

3.3 Optional/Additional scope

For the optional scope (paragraph 3.3.1, 3.3.2 and 3.3.3) the Contractor shall define what is required for successful implementation of New HP turbine project. All optional scope that is required for successful implementation of the project shall be included in base scope and quoted in proposal. The additional scope that is not required for successful implementation of the project (paragraph 3.3.4, 3.3.5 and 3.3.6) shall be separately quoted in proposal.

- 3.3.1 One (1) Jack Shaft with coupling bolts (if required it shall be part of base scope) for LP turbine connection.
- 3.3.2 Two (2) Sets of oil seal rings; Two (2) Sets of coupling Guards (if required it shall be part of base scope).
- 3.3.3 One (1) Extension shaft with main oil pump and elements to be consistent with existing turbine supervisory system (if required it shall be part of base scope).
- 3.3.4 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.
- 3.3.5 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.
- 3.3.6 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 and 4: PPG STM & GLD AB (see Appendix D). The contractor must perform a detailed walk down on the Turbine Drain and Turbine Gland system and prepare As-build documentation during outage 2018.

3.4 Design

New HP turbine shall be designed for 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 revision of the existing NEK Thermal kit T4-A6341

- Design Modification Package in accordance to ESP-2.602 NEK Procedure
- Safety Evaluation and USAR/TS/changes (10CFR50.59) in accordance to 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 to ESP-2.619 NEK Procedure
- Turnover package (TOP) in accordance to 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 licence 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 licence, 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 licencing documents (SES, SE and change packages) are a part of standard DMP. The required schedule for the completion of the licencing documents (including KOC and KSC Review) is defined in the plant procedure ESP-2.602 and is 90 days before the desired approval by the URSJV.

The Contractor shall also provide necessary support during licencing 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 licencing activities. The Purchaser will be responsible for arranging and conducting any management, regulatory, licencing or other presentations.

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

- SES according to plant procedure ESP-2.303
- SE according to plant procedure ESP-2.303 (if applicable)
- USAR Change Package according to plant procedure ESP-2.302 (if applicable)
- TS Change Package according to plant procedure ESP-2.301 (if applicable)
- RETS Change Package according to plant procedure ESP-2.306 (if applicable)
- documented analyses necessary to support the above mentioned licencing 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 approve drawings, tests and qualification reports
3. Inform Purchaser of Factory Acceptance Tests
4. Witness of 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 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 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. Perform 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 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 plant processes and personal he/she should speak Slovenian/Croatian.
13. For the FME zones an 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 which the Contractor 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 occurred to any plant structures, components, equipment, etc. during 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 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 Work, 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 of supply.

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 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 such that a record of problems encountered, delays, etc., that had an effect on cost and/or schedule is available. 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 to 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 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) Preparation of all other As-Built drawings
- c) As-Built update of DCM
- d) As-Built update of EAM-MECL (EBS asset)
- e) Preparation of TOP per NEK procedure ESP-2.611
- f) Signing of Handover Protocol

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:

- 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

Contractor shall supply recommended spare parts and a list: Itemized and priced.

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 supply. The Contractor shall also identify the executive who will have the responsibility and authority for 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 the work. The Contractor shall provide home office and site project organization charts (including subcontractors) that correspond to the following phases of the Project:

- a) Engineering and management prior to the site mobilization
- b) Site mobilization in the year 2019

The Contractor shall provide technical staff with specifically defined duties, responsibilities, and authorities to support timely resolution all design and other

deficiencies in design documentation identified during 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 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 approval of 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 is scheduled to be completed till the end of the outage 2019.

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 that will 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 of 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 work is classified as Augmented Quality in accordance with Krsko 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 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 with full Arc Admission with 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.

The Contractor shall analyze all cases of operation with »New HP Turbine« based on data about steam inlet parameters, Sava river cooling temperature through 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 optimum regime for operation with »New HP Turbine« taking into account all specific of NE 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 total gross electrical output for 7 MWe** of the Krško unit, and eliminate any current reliability concerns.
- b. To contribute to maximum overall availability and efficiency for the NSSS-turbine-generator combination.
- c. To provide **Installation in 18 days during the October, 2019 outage**, which means that work will be started on 2nd day of outage and finished on the 19th day of the outage
- d. To successfully completed Start-up test on 28th day of outage in October 2019
- e. To successfully completed Site Acceptance Test in October 2019
- f. Resistance of materials to erosion/corrosion and stress corrosion cracking and 12-years maintenance period
- g. Compatibility of new HP turbine with existing equipment and systems (LP Turbines, GN, TC, TD, TG, EX, DEH, HD ...) in NE Krško
- h. 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 NE Krško under power uprated conditions.
- i. To provide ease of maintenance (such as providing quick disconnect couplings) and inspection (such as no rotor bore) over a 40 year design life.

- j. 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.
- k. To eliminate or severely reduce wear due to moisture erosion.
- l. 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 a 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. Manufacture »New HP Turbine« for Krško. New HP rotor shall be Monoblock type.
- b. Assemble 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 ship »New HP Turbine« and equipment to Krško.

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 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 ship all new stationary parts to Krško.

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.

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 encompasses all torsional frequencies up to 110 Hz. It shall include the new HP, two new LP's, the Generator, and the Exciter 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 accuracy of the analytical method used (supported by previous experience) shall be sufficient to ensure that torsional vibration testing following the installation is not required. NE Krško will furnish to Contractor all information currently available on the torsional analysis.

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 NE 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

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, 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 configurations of all the systems, accessories and auxiliaries at the 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 conceptual design 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 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 NE Krško.
- b. Complete lubricating oil pumping system compatibility with the existing 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:
 - For measurement of turbine metal temperatures for the purpose of controlled starting.
 - For all main bearing metal.
 - 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 will perform an analysis and if necessary modify the NE Krško lifting beams.
- h. Turbine rotor couplings at the following locations:
 - Control parts to HP
 - HP to LP '1' or 'A' coupling
- 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, pumps, pads and alignment pins as necessary. The Contractor shall provide any required in-line coupling boring or reaming during installation.

5.4 System Outputs

- 5.4.1 The Contractor with Purchaser 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 One set of special tools and materials shall be furnished that are necessary for any components requiring field assembly/ disassembly.
- 5.5.2 All parts, spare parts and tools provided shall have identifiable nomenclature in English that is traceable to both drawings and spare parts lists.
- 5.5.3 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 existing NE Krško process information system shall be used. Calibration and accuracy requirements will be established on kick-off meeting between the Contractor and NE Krško.

5.7 Project Management & Project Control

- 5.7.1 The Contractor shall identify and describe the organization under which the work will be performed, identifying the resources (number and types of personnel) available to carry out the work associated with the scope of supply. The Contractor shall also identify the executive who will have the responsibility and authority for completion of the Scope of Work.
- 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:
 - a. Engineering the "New HP Turbine" project
 - b. Developing the project plan & schedule
 - c. Working with the Owner to approve the plan & schedule
 - d. Implementing this plan, ensuring that it is completed on schedule and within budget
 - e. Coordinating all "New HP Turbine" efforts onsite as well as offsite, 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 work. 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 2019 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. These personnel shall be defined as key personnel. These 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 of 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 Owner
 - Providing all approvals, consents, authorizations, and proposals
 - Transmitting all communications to the Owner
 - 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 Owner and the Contractor to review progress, establish and review schedule requirements, and discuss other items (modifications) concerning the status of the "New HP Turbine" work. The Contractor will be required by the Owner to provide representation at plant outage meetings. During outages there are typically 2 planning meetings per day and 2 status or problem meetings per day with the station management group. These meetings will be scheduled at the Owner's facilities and will be attended by the appropriate Owner and Contractor personnel. Meeting minutes may be taken by the Owner at his discretion.
- 5.7.8 From time to time throughout the duration of the "New HP Turbine" project, the Owner 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:
- Support the Owner's overall "New HP Turbine" Budget.
 - Integrated site-wide Outage Management for the NEK "New HP Turbine" outage.
 - 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 Owner prior to installation and use and must be compatible or transferrable to the Owner'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 supply. 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 of the turbine cylinder, to perform an ASME PTC-6-2004 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 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 Purchase Order is issued by Purchaser.

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/.

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
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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

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)
- 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 (Working 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 Prezem, skladiščenje, rokovanje in notranji transport (Storage, handling and internal transport)
- ADP 1.14.202 Normativi osebnih zaščitnih sredstev (Standards of personal protective equipment)
- ADP-1.1.128 Upoštevanje in dokumentiranje preventivnih ukrepov preprečitve vnosa tujkov (PVT) ob odprtih sistemih ali komponentah
- ADP-1.1.141 Ravnanje s težkimi bremenami v NEK
- ADP-1.6.701 Kontrolirani vstop nevarnih kemikalij v NEK

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
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- 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
- 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

8 IDENTIFICATION OF AFFECTED SYSTEM(S)

TU, TD, TG, MS, EX, DEH, 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.

NE 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 reheat 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.

NE 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) NE Krško have 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 year 2006, the turbine-generator is 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 Upated 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	3.81 cm Hg a
Speed		1,500 rpm
Number of FW heater extractions		6
% makeup		zero
Final feedwater temperature		219.8 °C

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

NOTE: NE Krško will provide available information upon request later. If further detailed information is necessary and NE Krško does not have it in its 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 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-... Proces Information Systems Diagrams

11 DOCUMENT SUBMITTAL

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

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

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

11.1 BID Phase

NOTE: During the bidding process the term Contractor shall be considered as Bidder.

The Bidder shall identify and provide below required “Bid Documentation” with all technical descriptions (Maximum offered MWe with MW Breakdown structure), 2019 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 modification.
- b. Detailed presentation of:
 - The change in the impulse pressure measurement, the new method of measuring turbine power and provide comparison between the new and the existing measurement.
 - 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 SEQUENTIAL valve modes.
- c. The Bidder shall supply a detailed description of how, why and where proposed performance improvements will be done
- d. Manufacturing experience and capabilities, including operating experiences and reference list for scope of work
- e. Organization chart for execution of work (+list of suppliers/subsuppliers)
- f. Key personnel description and resumes
- g. Preliminary detailed manufacture and overall project schedule
- h. Proposed schedule for manufacturing, transportation, preparation and removal/installation activities
- i. Proposed list of temporary/permanent activities on existing plant equipment, systems
- j. List and brief specification of major equipment to be brought on site
- k. List of potential subcontractors and description of work scope to be performed by each
- l. A description of the contractor’s proposed construction/implementation program
- m. A description of the insulation scope of work, type of the insulation
- n. A description of the duration of all work activities in Turbine building with an 2019 outage works duration presentation
- o. Estimate of the required numbers & types of the necessary equipment
- p. Estimate of the required amount for all consumables
- q. Bidder’s special requirements, if required
- r. Detailed description of proposed temporary enclosure

- s. List of recommended spare parts for purchased equipment
- t. Related drawings
- u. Preliminary PMM and PQP
- v. List of used standards
- w. Contractor's QA Manual

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

For each activity/service required to successfully complete the installation and test, each Bidder has to submit a 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

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 associations 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 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 valve, or by operation in SINGLE/SEQUENTIAL mode of operation.

Scope of Work for "New HP Turbine" Project is rather complex for NE 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. To solve this problem each Bidder shall provide his exact Manufacturing Part No. (not only item description) for each part of HP turbine which shall be replaced or installed as new to fulfill requirements specified under 3.0 of this Specification.

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 NE 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. Clearly demonstration the Bidder's knowledge of the scope of supply, discussing all of the condition 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 will list quantities that they proposes, and discuss contingency plans and actions in the event of equipment failures.
- j. Detailed description of the Scope included in the Bidder's price, to perform the thermal performance test, including a description of all supplied hardware, software and instrumentation
- k. Detailed description of the Optional Scope
- l. List of spare parts

Each Bidder shall indicate additional documentation it proposes 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 NE Krško shall be in the English language. SI units of measurement shall be used. If necessary, than 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 NE Krško requirements.

The Bidder shall comment in the special section of his Bid all requirements established in this Specification for which it was found that are not properly specified, are not very well defined, are not understandable or anyhow create a problem for him or caused that his Bid is less attractive to the Purchaser.

The Bidder shall explain any requirement for additional measuring or checking of NE Krško turbine. A detail measuring session if it will be necessary can be organized during the outage 2018. Execution of HP turbine replacement is planned for the outage 2019.

The Bidder shall furnish to NE Krško any special parameters or conditions applicable to the equipment provided or owned by NE 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 instruction about the preparation of the Bid is described in the document "Instructions to Bidders".

Within the proposal potential Contractor 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 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 understand the NEK requirements and 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 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.

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).

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 that shall 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.

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 cycle are implemented, 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 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 (6) months prior to site installation the Contractor shall develop in accordance to ESP-2.619 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, which shall 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 functional 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. 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 6 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 6 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/or approval:

- a) Project Management Manual
- b) Project Quality Plan
- c) Monthly Progress Report (for information)
- d) Walk-down report
- 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: AutoCAD©
- 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) The Documentation of the 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 carrying 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 prestablished acceptance criteria to satisfy 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 ASME PTC-6-2004 alternate nuclear test as guidance, and shall utilize as much of Krško's installed plant instrumentation as is 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 NE 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 each be done 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:

- Pre-installation PTC-6-2004 test conditions
- Post-installation PTC-6-2004 test conditions

- 12.6 Pre-installation testing will be performed one month prior to shutdown in outage 2019. NE 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 ASME PTC-6-2004 group 1 & 2 corrections, 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 no later than four months after the date of initial synchronization following installation of the equipment supplied under this contract. Again, measured electrical output will be corrected using the ASME PTC-6-2004 group 1 & 2 corrections, 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) with the new steam path based on better turbine efficiency of new HP turbine compare to an old HP turbine. Any anticipated changes in the guaranteed heat balance or performance data shall be brought to the immediate attention of NE 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:
- a. Turbine expansion line end points.
 - b. Extraction stage pressures versus throttle flow.
 - c. Exhaust pressure correction factors.
 - d. Gland leakages and mechanical losses.
 - e. Turbine stage moisture removal effectiveness.
 - f. Correction to expansion line end point for exhaust pressure.
 - g. 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 NE 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 NE Krško for all rotating and stationary components.

Data for HP Rotor should include, but is not limited to:

- a. Tensile strength
- b. Yield strength
- c. Percent Reduction in area
- d. Percent elongation
- e. Charpy impact strength as a function of temperature including values at the upper shelf temperature
- f. Fracture Appearance Transition Temperature (FATT)
- g. Chemical analysis, including all major alloying elements and these 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 had the same treatment as the all last stage blades.

The Contractor shall provide sample for white Babbitt. 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 should include but not be limited to:

- a. The water removal provisions at steam extraction locations.
- b. The 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 Contractor plan to use on the Krško site as: paints, solvents, chemicals..etc. Material Safety Data Sheet shall be provided. Also, the Contractor shall get advanced approval from NE Krško Chemistry Department (This is an obligation).

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 responsibility for compliance 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 NE 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 weld, 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 NE Krško.

Tools for base metal preparation and cleaning that are 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 a 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) a 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 unstabilized 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 indication 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 Measuring and testing or inspection equipment must have valid calibration certificate.

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 criterias.

15.2 INSPECTION

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

Inspection intervals shall be twelve (12) years. The Contractor shall furnish 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 these 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 qualification 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 services scope of supply 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 should take all responsibilities also for its subcontractor to include them 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 accomplish the New HP Turbine replacement project.

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

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 provided to maintain the cleanliness as high as possible during piping modification activities.

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

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

During removal/installation, cleaning shall be performed in accordance with written procedures and FME PLAN which have been reviewed and approved by NE 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 subsuppliers meet these same requirements for cleanliness.

18.1 Cleanliness

During removal of old turbine rotor and installation of “New HP Turbine”, cleaning shall be performed all the time inside the working area in turbine building in accordance with written FME procedures which have been reviewed and approved by the NE 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 subsuppliers.

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 safe shoes and clothes 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.

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

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

Surfaces of hardware shall be inspected for cleanliness during 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:

- 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 use of an expendable material whenever the chemical analyses exceed these limits.

Water leachable chlorides	100 ppm
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Halogenated compounds	1000 ppm
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Sulphur and its compounds	1000 ppm
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- 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 a surface preparation and coating procedure including identification of the coating system to be used to the Purchaser for approval. Requirements to apply protective coating systems to the equipment installed in the Turbine building of the NE 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 identification of the item is maintained by heat number, lot number, part number, serial number, or other appropriate means, either on the item or on records traceable to the item throughout installation, shipment, and use of the item.

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 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.

Requirements for equipment labeling before transportation will be defined later between Purchaser and Contractor based on Slovenian Customs & NE Krško Purchasing req's.

21 PACKAGING, HANDLING AND STORAGE

21.1 Packing and handling

The Contractor shall prepare, pack and load all materials and components in such manner 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 on open air at site shall be suitably protected from wheatear 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 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. 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 methods which ensure that harmful contaminants do not remain on any component surface in contact with process fluids.

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 NE 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 NE Krško facilities at site. This shall include as a minimum:

Coating 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 able to be removed 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 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.

A document must be supplied three hundred and sixty (360) days prior to shipment of the first of the new steam path components 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 outdoor and indoor 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 in advance 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 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 which will be used within New HP Turbine project.

As is required with NE 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 purchase order requirements. Applicable part

numbers and other item identification, qualification reports and the NEK purchase 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 it 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 Contractor shall not repair any parts until a detailed description of such repairs has been submitted in writing to NE Krško for review per Section 20 and 43, and written permission received from NE Krško prior to proceeding with such repairs. Contractor may proceed at its own risk to repair any parts pending NE Krško acceptance.

If material is improperly designed or fabricated, so that 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 NE Krško for review per Section 20 and 43. NE 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 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 purchase order 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 order shall be directly shipped from the Supplier/Manufacturer to NE Krško. 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 Purchase Order and Heater No.)

The Contractor shall include 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 document on submittal list which shall be revised/updated and all future updates shall be certified as

applicable to the equipment furnished to NE 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 items above, NEK will update 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 HP turbine.

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 agree, 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 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)	T0+1
2	Design Documents	T0+4
3	DMP (Design Modification Package approved by Purchaser.)	T0+13
4	IP (Installation Package approved by Purchaser)	T0 + 17 but not later than six (6) months before the installation
5	TW ,MSDS and LIST of SPARE PARTS (Transport weight, dimensions. And Material Safety Data Sheets and list of spare parts)	12 months prior to shipment
6	IM (Instruction Manual)	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	at least two (2) weeks before Physical Delivery
8	FAT Successfully completed Factory Acceptance Test	2 months before shipment but no later than 30.06.2019
9	Hardware delivery to NEK	At least two month before installation, but no later than 31.08.2019
10	Pre-installation test Pre installation performance testing	At least One month before Outage start
11	Installation	In 18 days during the October, 2019 outage, started on 2 nd day of outage 2019 and finished on the 19 th day of the outage 2019
12	SUP Successfully completed Start-up Test	Start-up finished on 28 th day of outage in October 2019
13	SAT Successfully completed Site Acceptance Test	October 2019
14	Post installation test Post installation performance testing on 100% power	One month after plant power up to 100%
15	TOP (Turn Over Package submittal to Purchaser)	three months after installation
16	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 needed to perform the scope of work specific to NEK. The usage 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) Provide 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) Provide location for one container/office near the HP Turbine construction site
- h) Provide two containers (offices) for construction team on container area (outside of technological area)

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

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.
- 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 all reproducible drawings and other documents such as any changes to plant procedures, equipment technical specifications, USAR updates, and reviewers checked drawings and documents over to the ING.

All documents have to have unique identification number with revision and need to be sorted into group and subgroup. 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 results of reviews, inspections, tests, audits, monitoring of work performance etc. Records shall, as a minimum, identify the inspector or data recorder, 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 Records are technically correct in accordance with applicable procedures.
- b. Ensure Records are complete including all attachments. 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 corrections to data have been made properly. Corrections to 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) is affected by a correction. This is not required for other information that is not considered 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 met:

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 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 4802 751
- E-mail: enver.gashi@nek.si

Franc Kranjc, Project Manager

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

Nataša Sagernik, Purchasing department

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

40 CONTRACTOR'S TECHNICAL APPROACH TO THE WORK

As a part of the NEK "Request for Proposal/ 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 work. The quotation should also indicate if similar project 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 work description and scope of supply) are specified in of this Specification. Additionally, this Specification also provides requirements which Contractor must follow.

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 duties 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 Proposal. 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 is maintained. NEK's right of access to the Contractor's Subcontractors' 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 Quotation.
- c) The Contractor's QA Program review and acceptance by the Purchaser shall be a prerequisite for selection of a Bidder as a 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 Proposal if not already submitted to NEK. Contractor shall notify Purchaser of any Level I QA Program changes that are issued during the conduct of the contract.
- 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 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 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 own 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 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 is established according to the manufacturer's standard, such a standard and reference testing procedure must be made available to NEK for inspection at least three (3) days before test execution. All provided documents must be in English. The standard shall be included in the list of all applicable standards with the Bid. 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 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 activities performed without proper notification is repeated for NEK Representative observation at the Contractor's expense.

When 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 agreed prior to performing tests and inspections. Non-acceptable results will be dispositioned and corrected, and the subject test repeated in accordance with 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 of the 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 order 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 the NEK for review and approval. 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, purchase order numbers, 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.

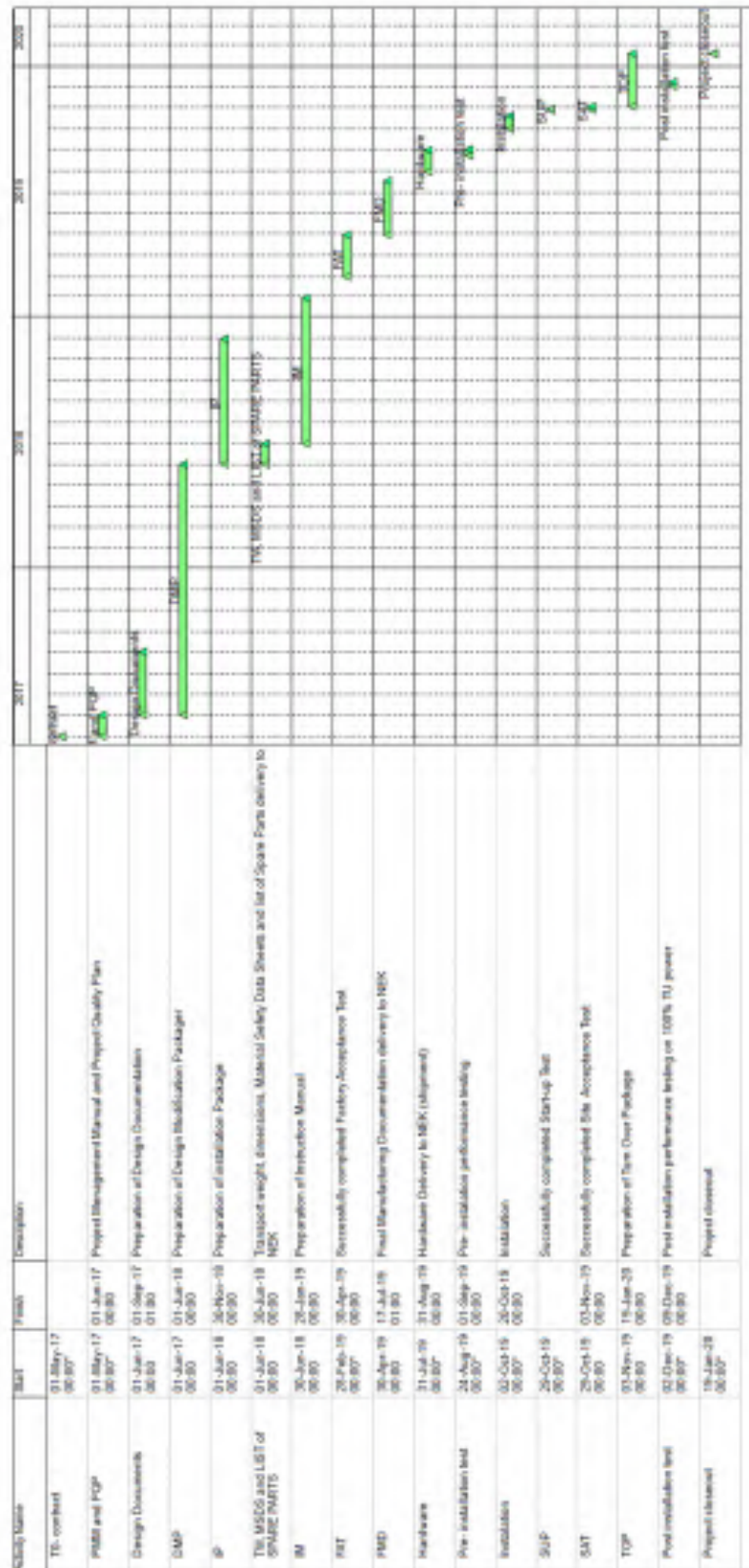
43.5.3 Deviation/Change Requests

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 written (status of information, complete, incomplete item, further evaluation required, for review, for approval...)
-

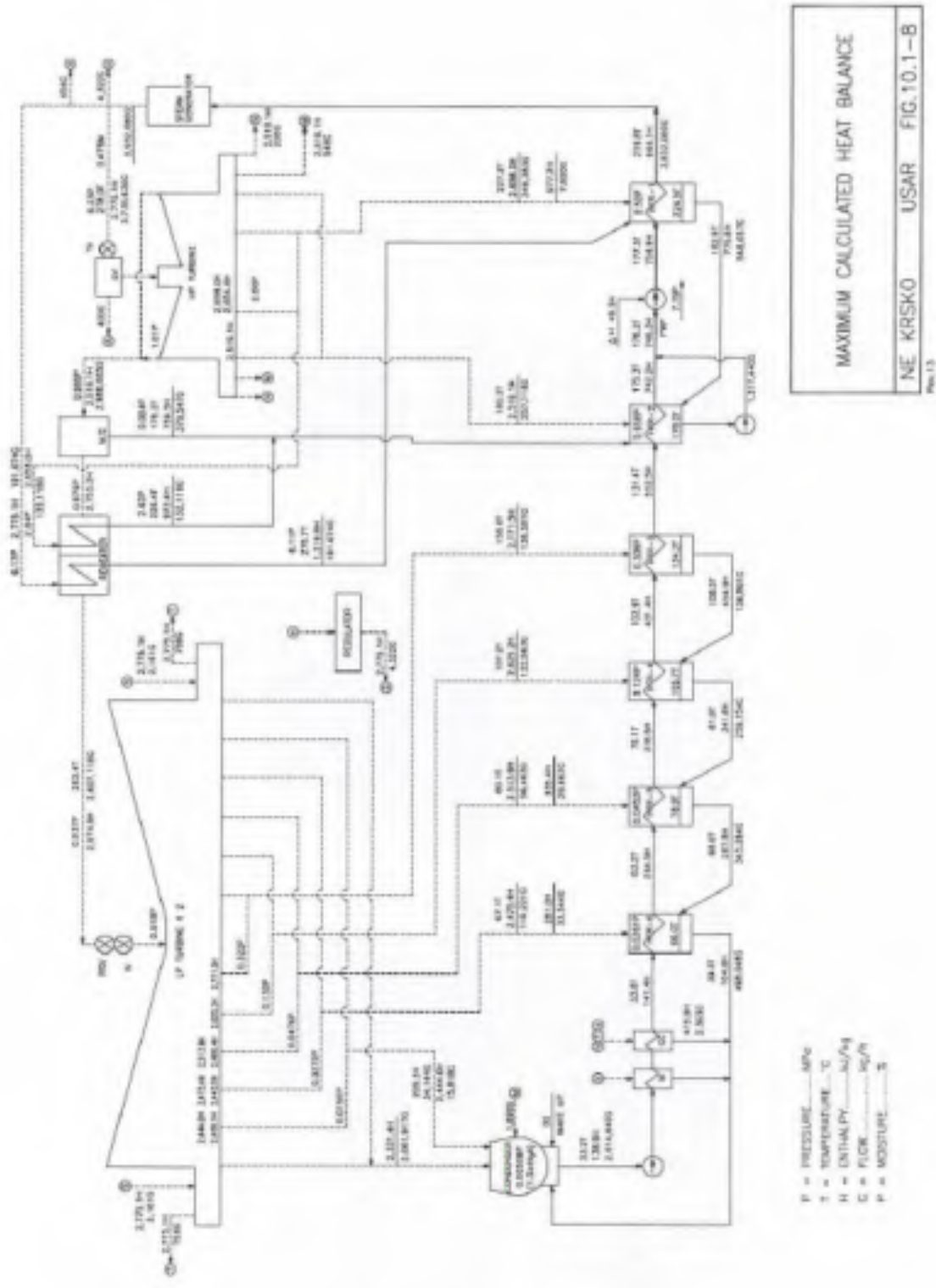
Appendix A

Table 45.1: Project schedule



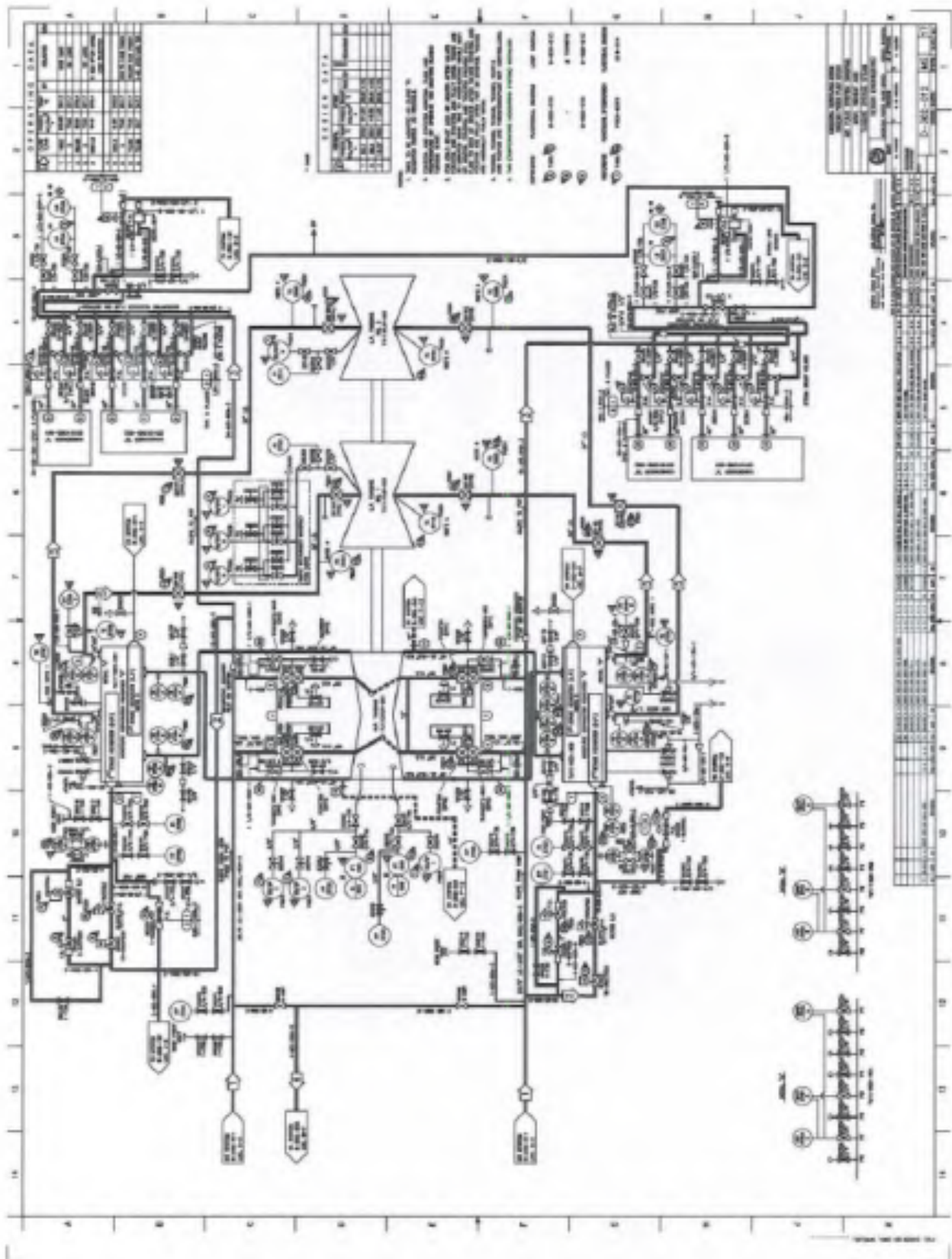
Appendix B

Maximum Calculated Heat Balance – USAR Fig.10.1-8



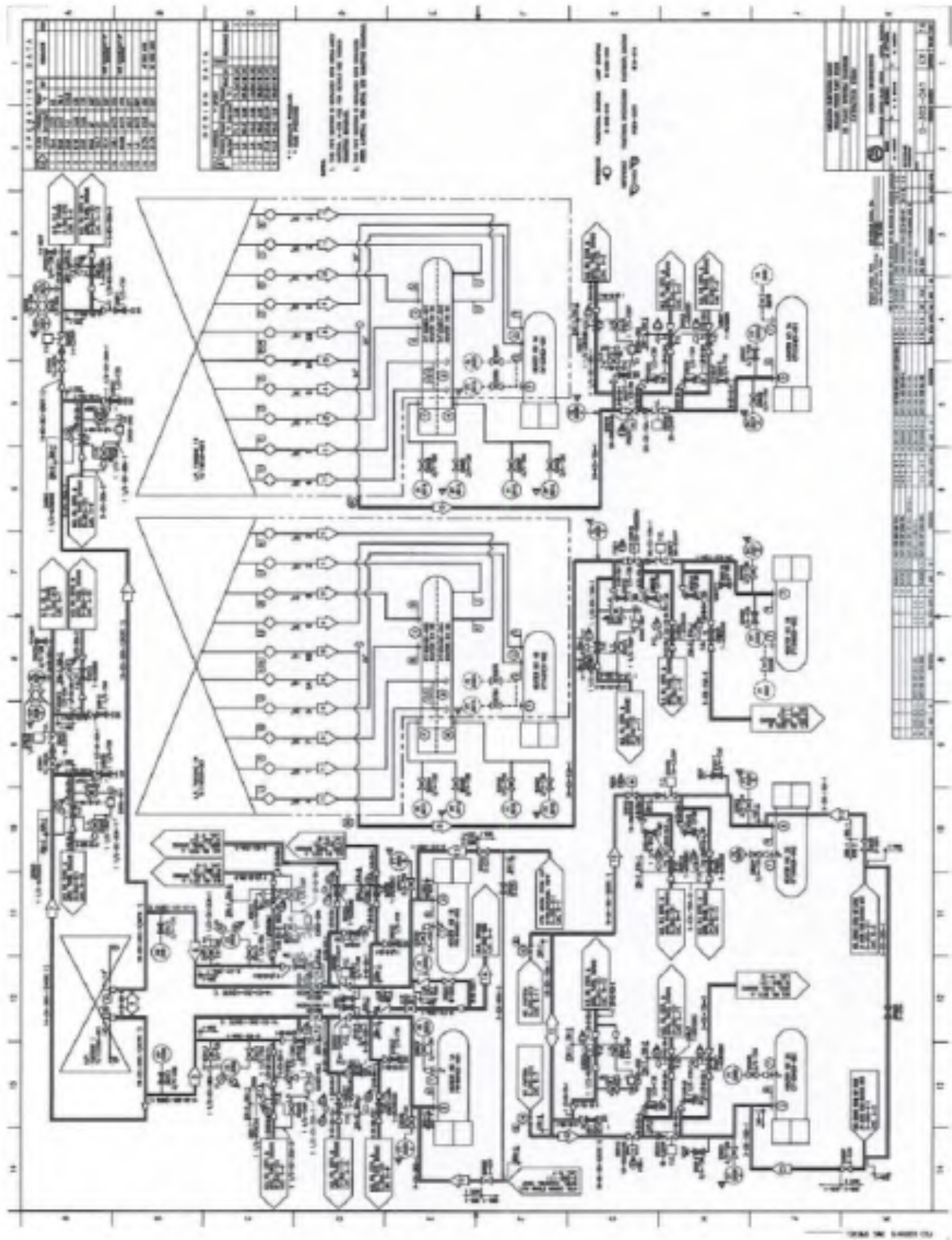
Appendix C:

Fluid System Diagrams: D-312-012 Main Reheat and Turbine Bypass Steam



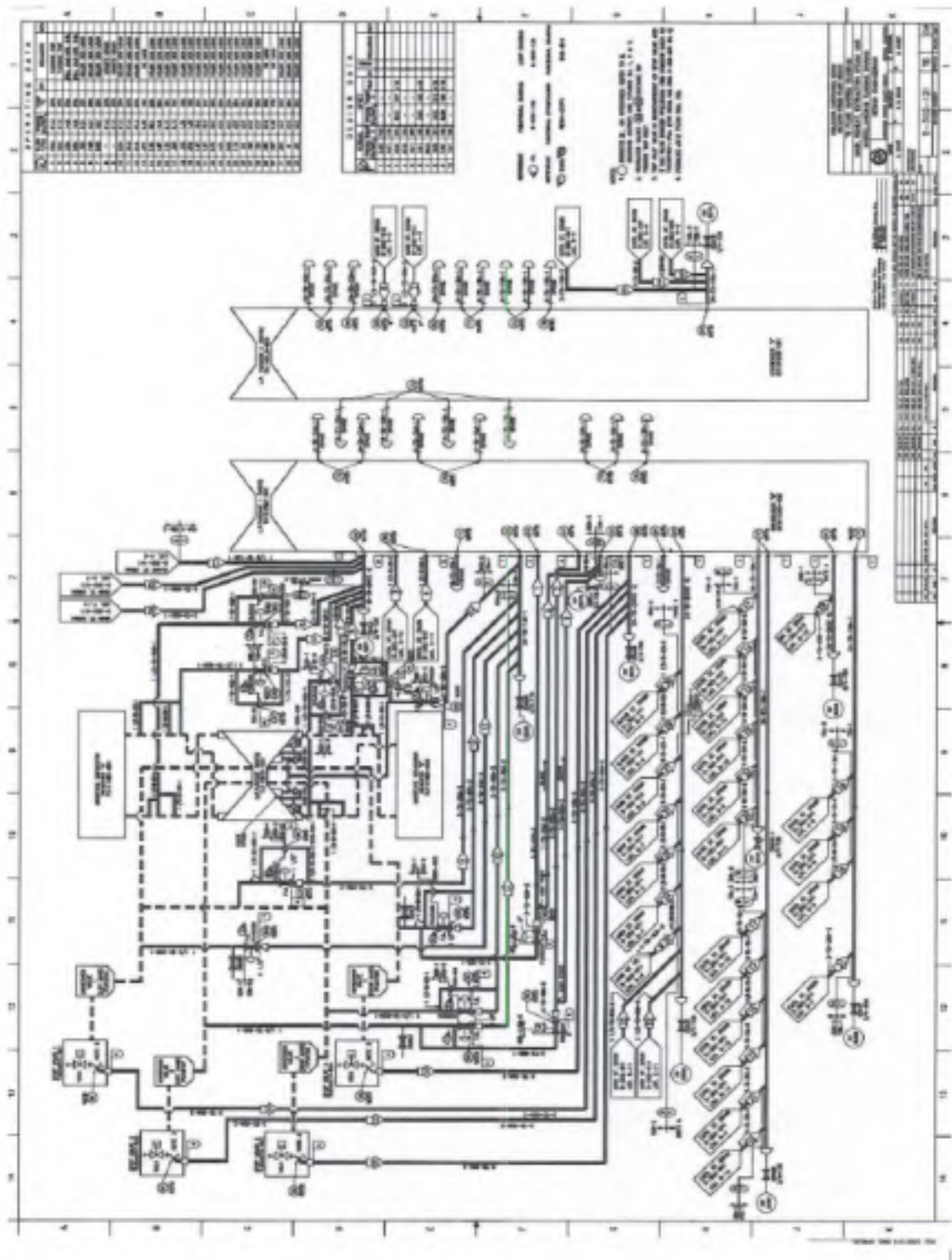
Appendix C:

Fluid System Diagrams: D-312-041 Extraction Steam



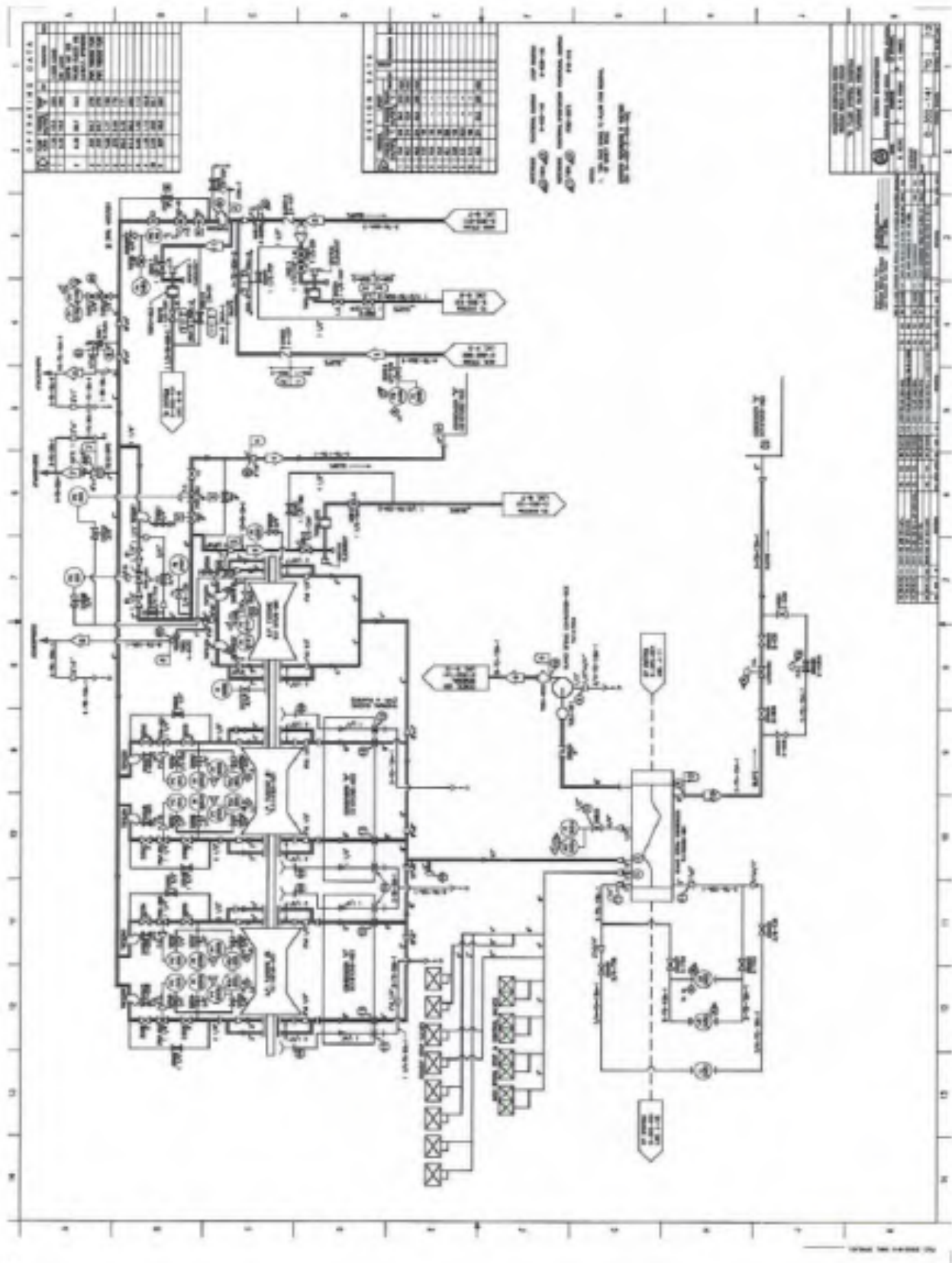
Appendix C:

Fluid System Diagrams: D-312-121 Main, Reheat, Extraction Steam and Misc. Turbine
Drains



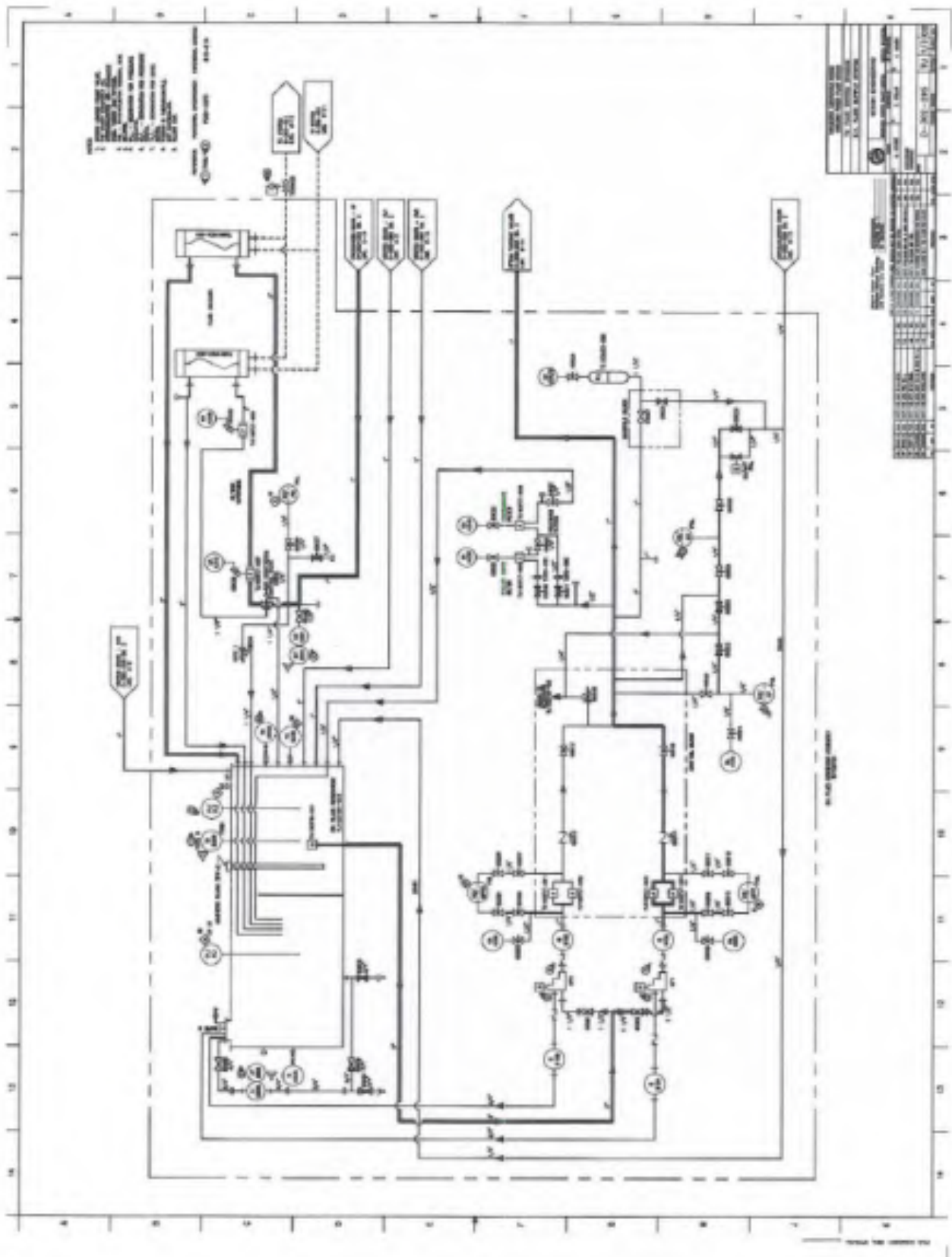
Appendix C:

Fluid System Diagrams: D-312-141 Turbine Gland Steam



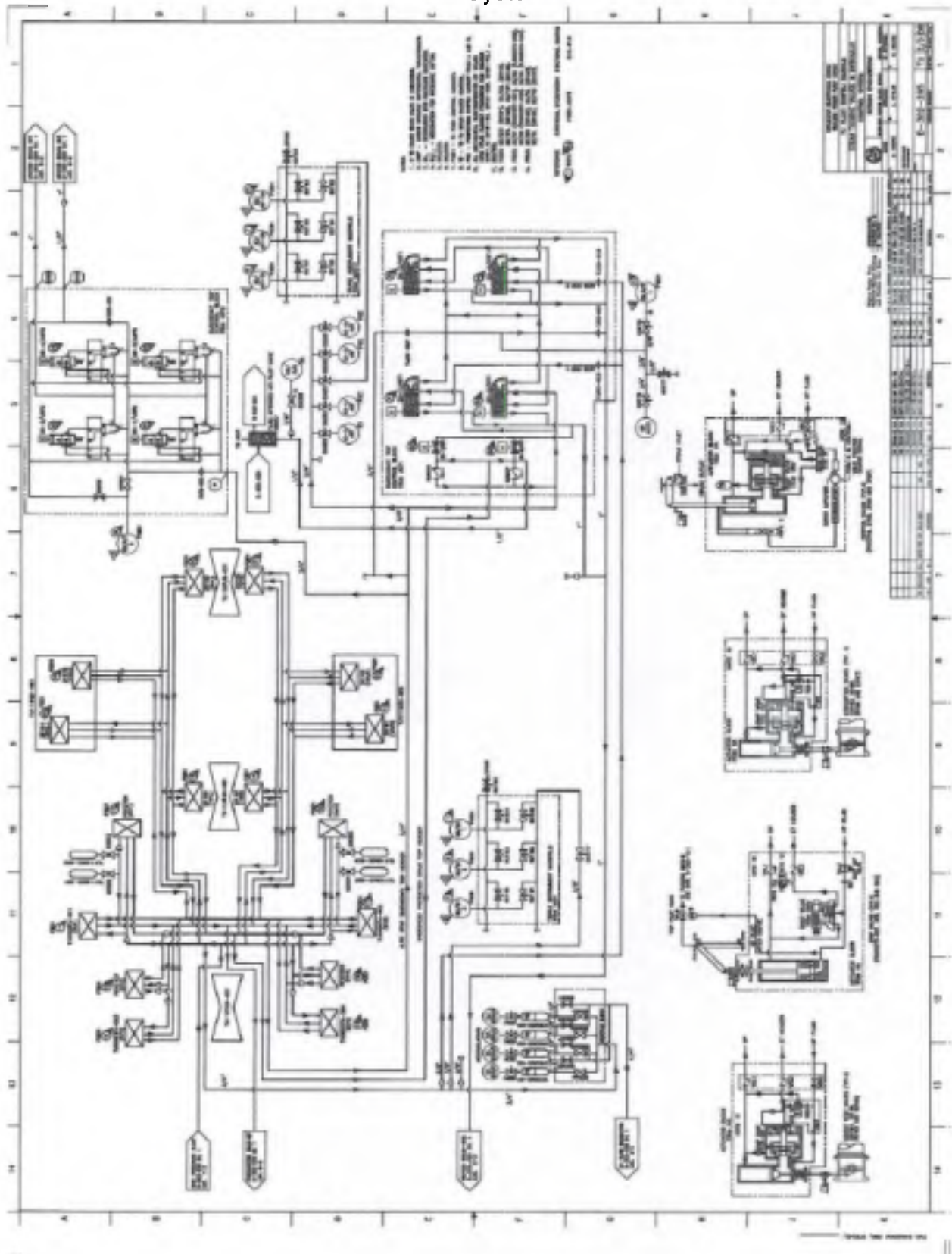
Appendix C:

Fluid System Diagrams: D-312-295 Sh.1: E.H. Fluid Supply System



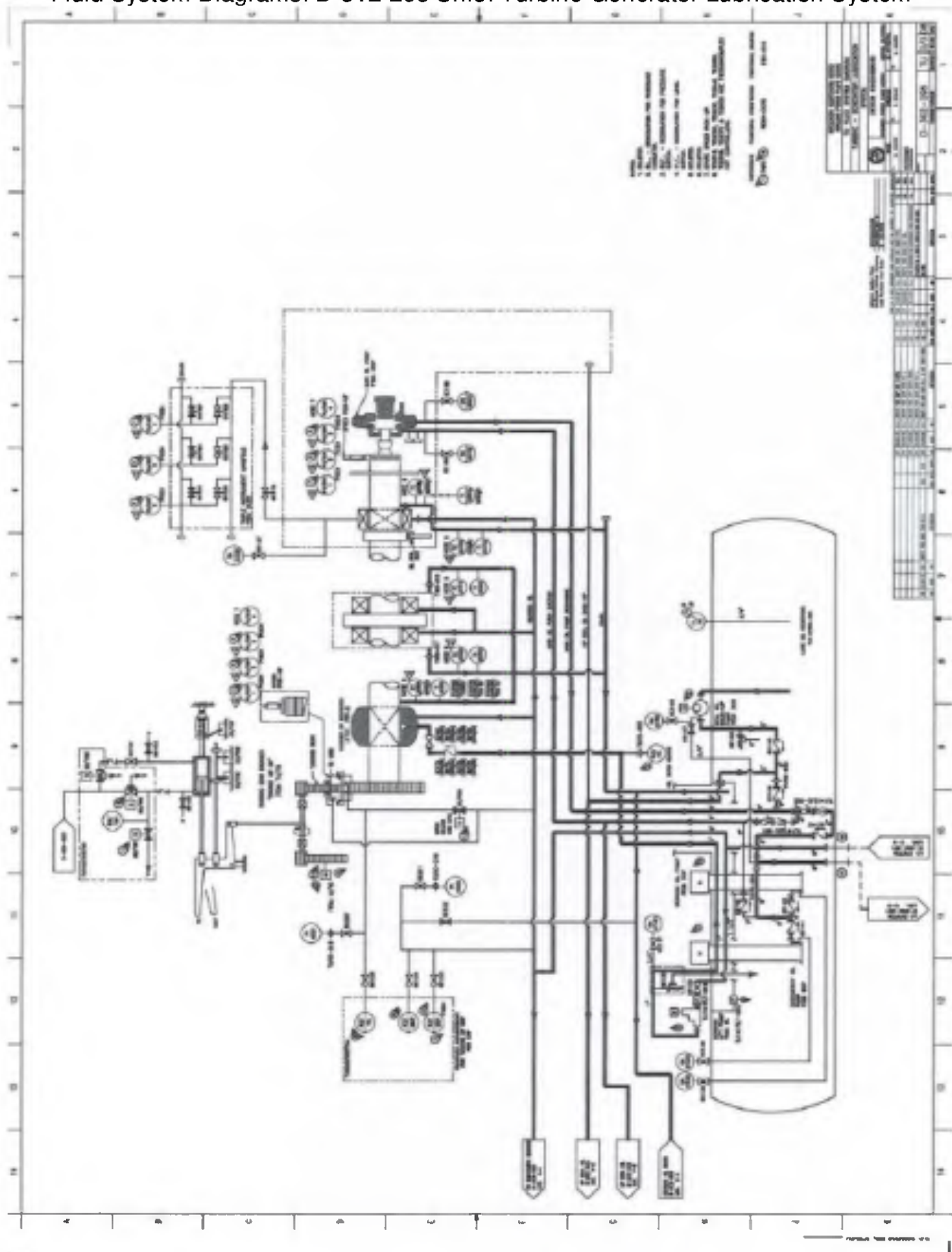
Appendix C:

Fluid System Diagrams: D-312-295 Sh.2: Steam Turbine Valves & Hydraulic Control System



Appendix C:

Fluid System Diagrams: D-312-295 Sh.3: Turbine Generator Lubrication System



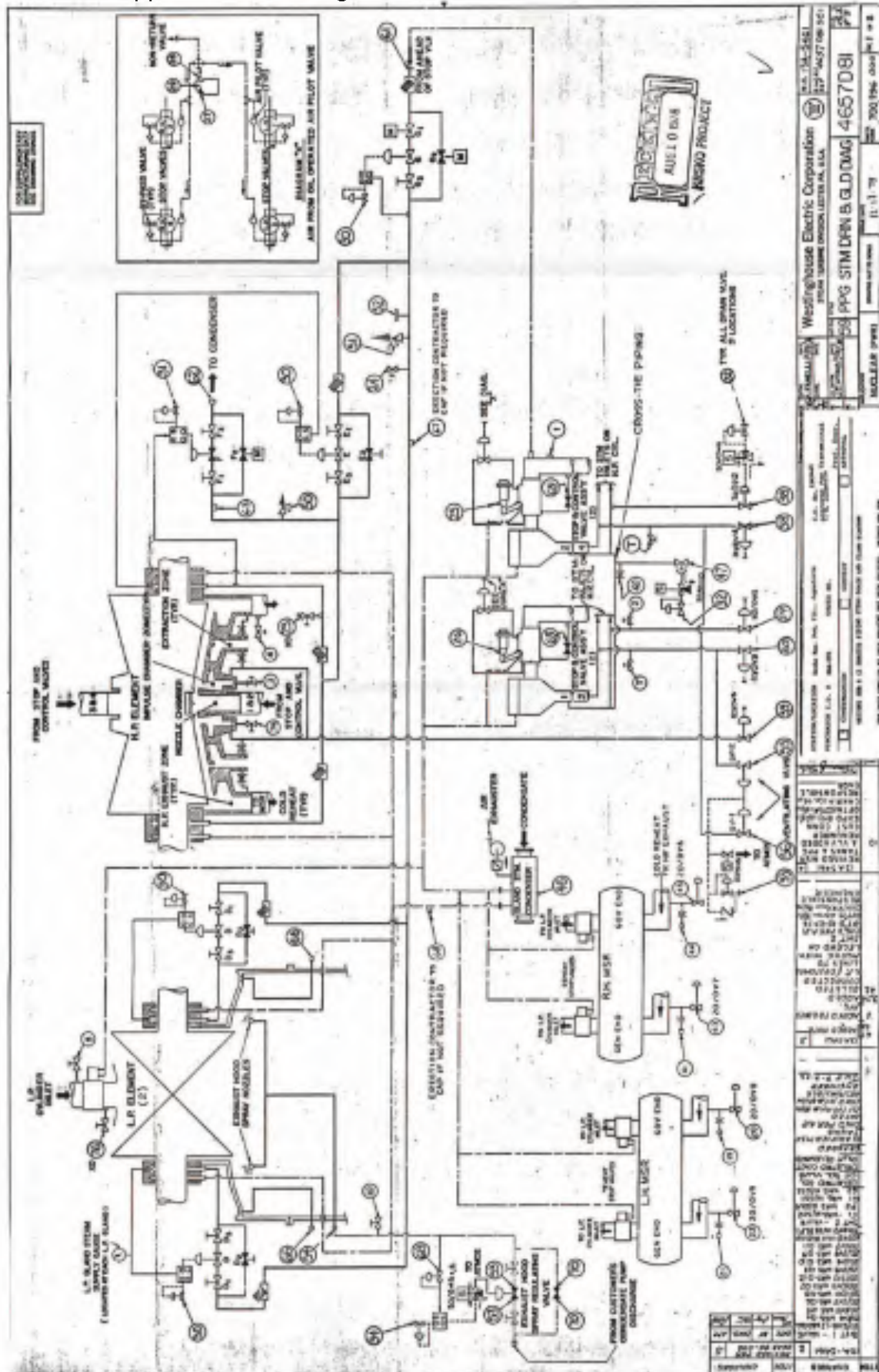
Appendix D: Picture 1: Turbine Drain and Turbine Gland piping 1

Westinghouse Electric Corporation Prime Movers, Laramie, WY, U.S.A.									
ITEM NO.	ITEM	DESCRIPTION	QTY	UNIT	PRICE	TOTAL	REMARKS	DATE	BY
1	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
2	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
3	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
4	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
5	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
6	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
7	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
8	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
9	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
10	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
11	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
12	1/2" SCH 40S	1/2" SCH 40S	1	FT	1.00	1.00			
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[illegible]

[illegible]

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



Technical drawing of a mechanical assembly, likely a pump or engine component, showing multiple views (front, side, and detail) with dimensions and annotations. The drawing is oriented vertically on the page.

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

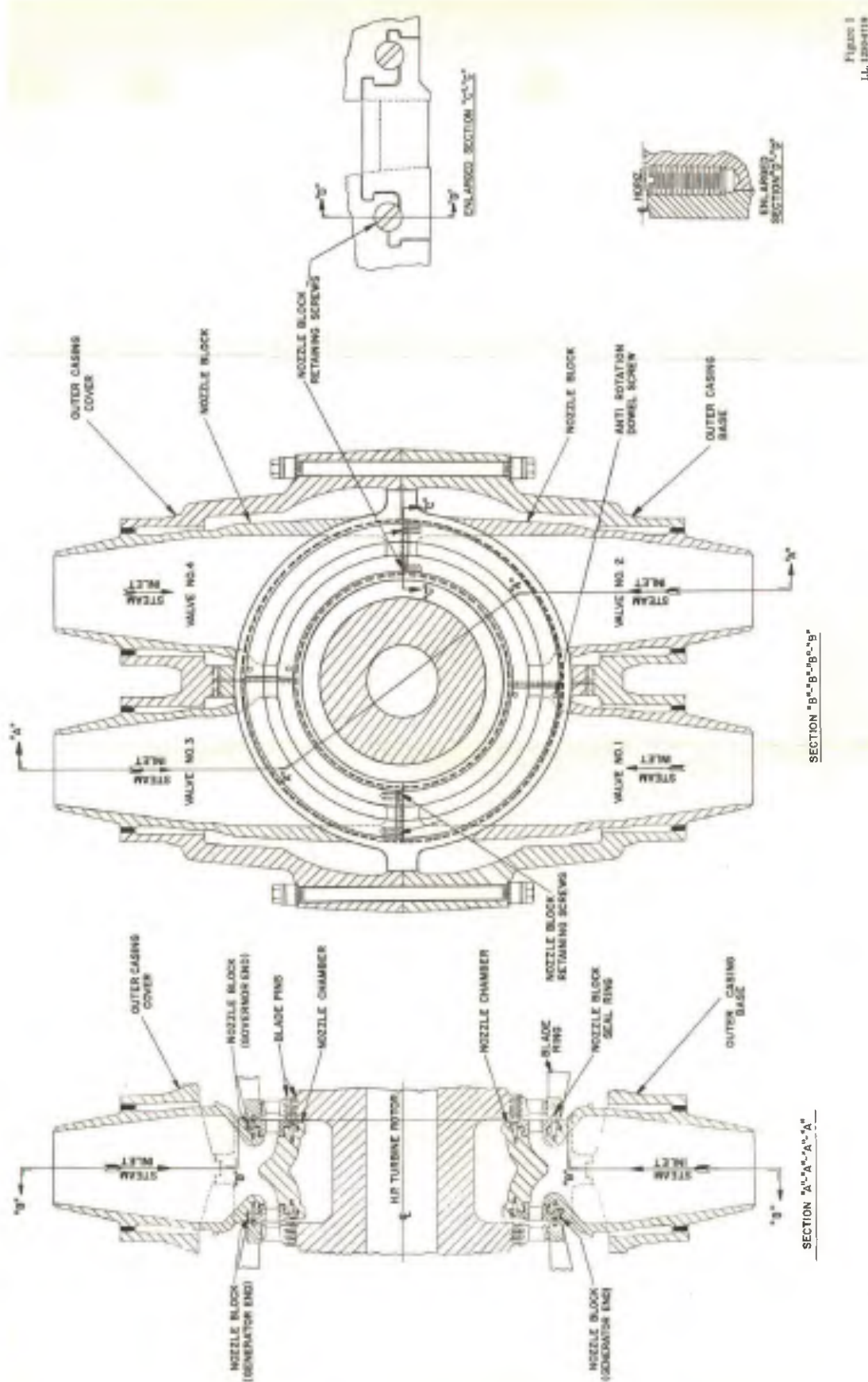
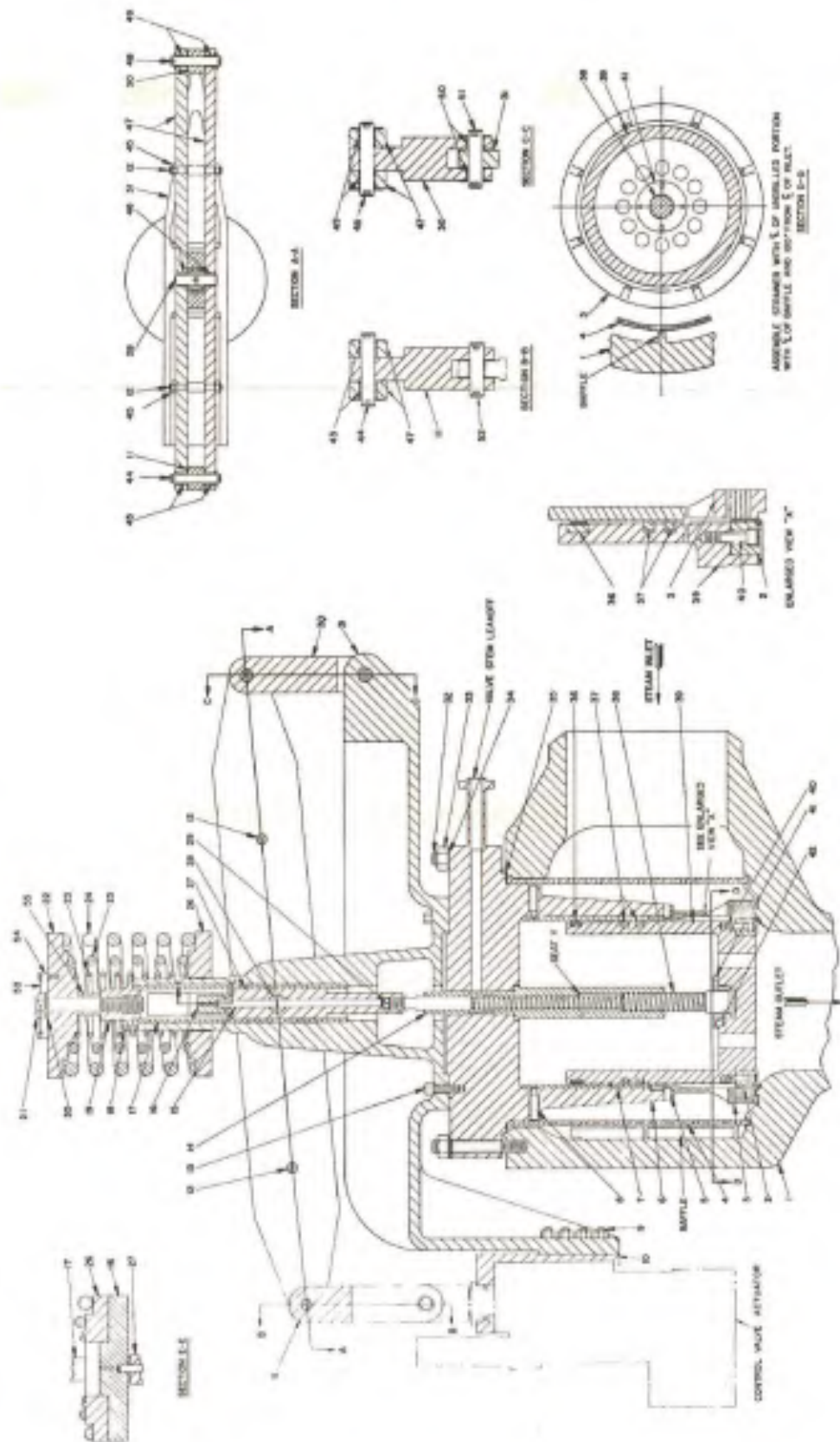
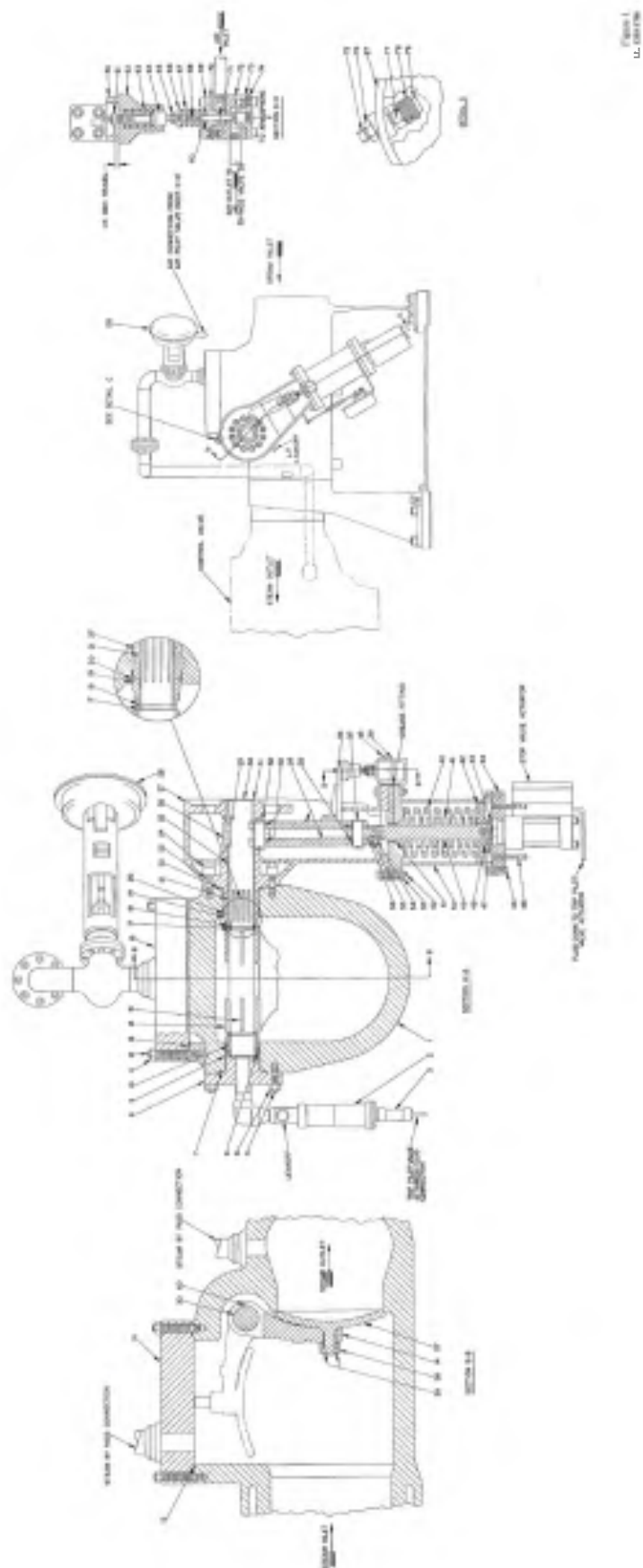


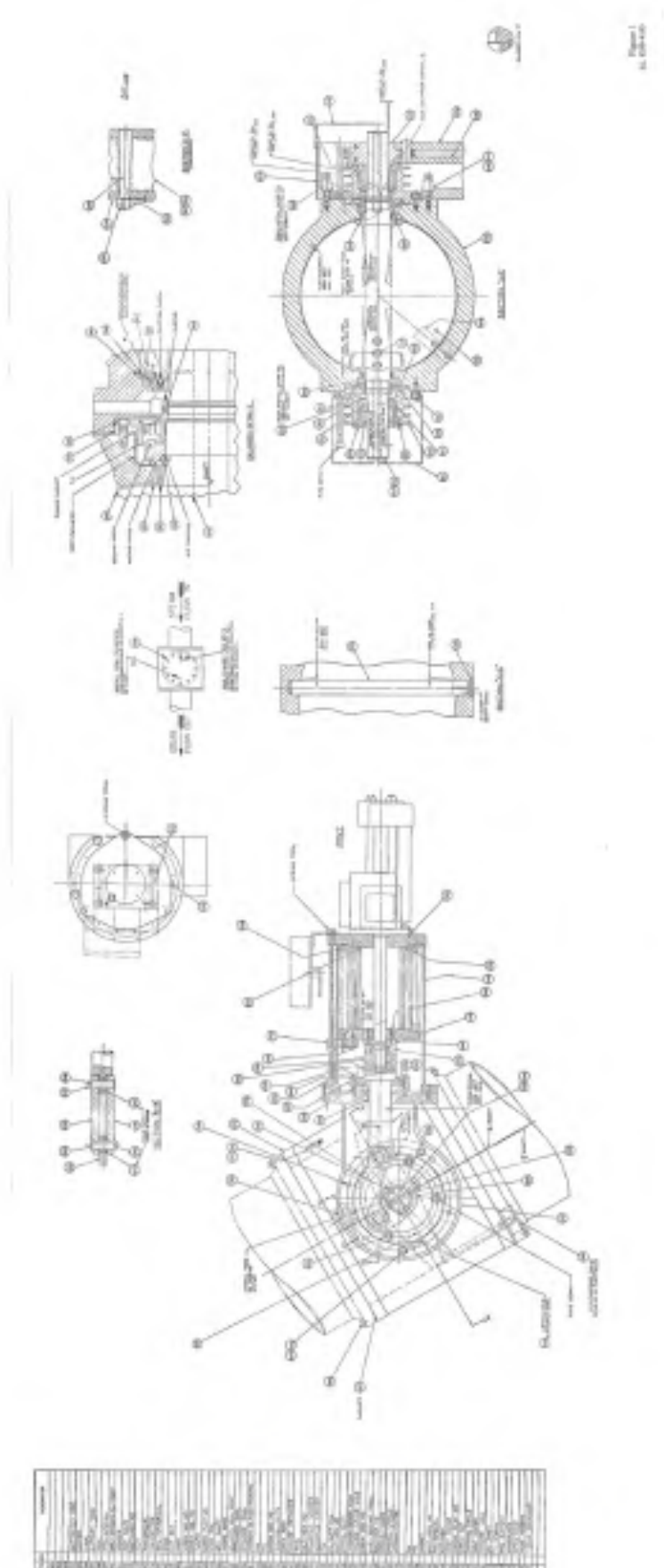
Figure 1
I.L. 1250-3785-A



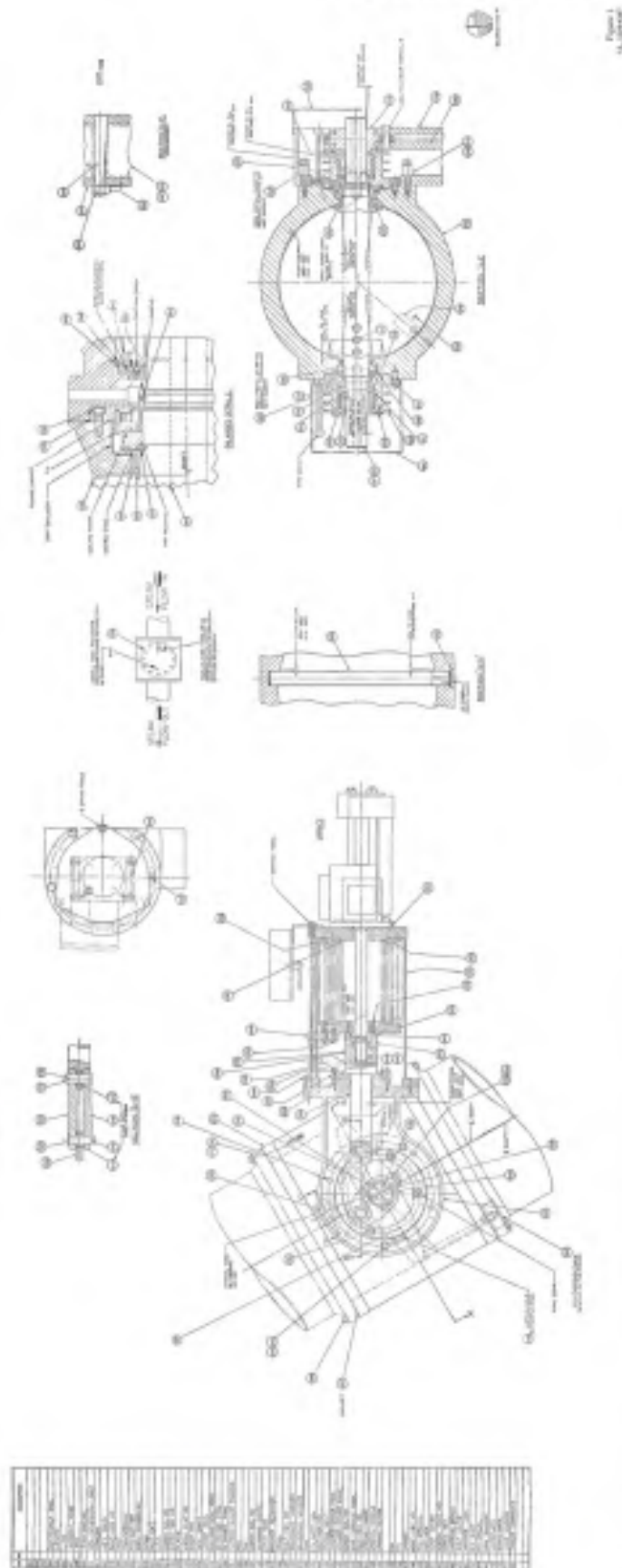
Appendix D: Figure 1 I.L. 1250-3786



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 E

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

Appendix G
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						
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						
Purchase order no						
Ref records Ref. document (OM; DWG; BOM)						

NOTE:

- 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's 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						
Purchase order no						
Ref records						

NOTE:

- Contractor shall provide all required information for equipment spare parts delivered within contracted scope of supply

NUCLEAR POWER PLANT KRŠKO

Project Modification _____

Project Name

Contractor Logo



PROJECT MANAGEMENT MANUAL (PMM)

Rev 0

	Name	Org. Unit	Signature	Date
Approved by (NEK):	_____	_____	_____	_____
Approved by (<i>Contractor</i>):	_____	_____	_____	_____
Reviewed by:	_____	_____	_____	_____

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4. ABBREVIATIONS, PURPOSE AND APPLICABILITY OF THE DOCUMENT

Abbreviation	Description
AC	Award of Contract
AIL	Action item list (list with major issues which need to be resolved)
Contract PM	Contract Project Manager
CHO	Change order
CPM	Commercial Project Manager
DCM	Document Control Management (by NEK)
DC	Document controller
DMP	Design modification package
DOR	Date of Release
IPS	Integrated Project Schedule
MPR	Monthly Project Report
MS	Microsoft (applicable in respective software products)
mths	months
NEK	Nuklearna Elektrarna Krsko
NPP	Nuclear power plant
OPS	Overall Project Schedule
PDR	Problem / Deficiency Report
PG	Power Generation
PM	Project Manager
PMM	Project Management Manual
PQP	Project Quality Plan
PQST	Project QST
PSC	Project Steering Committee
QA	Quality Assurance
QC	Quality Control
QIR	Quality incident report
QMM	Quality Management Manual
QST	Quality assurance specification turbo generators
SPWAR	System Performance Warranty Action Report
tbd	To be decided
TPM	Technical Project Manager
TTL	Technical Team Lead
wks	weeks

Workflow	predefined sequence of activities within the project-organization
WP	Work-package
PS	Project Scheduler

Enclosure 1: List of abbreviations and definitions

4.1. PURPOSE AND APPLICABILITY

The PMM serves as guidance for the project implementation from Award of contract until the end of warranty period. It does not limit nor change in any form contractual requirements.

The PMM is worked out in close cooperation between NEK and **Contractor** for ensuring a fertile, effective and efficient cooperation for achieving the projects goals for both parties benefit. The PMM is approved by **Contractor** and NEK Project Managers.

The PMM will be reviewed, which means changed and replenished, during the project course for following exemplary reasons:

- Some data is not yet available (e.g. certain handling procedures, FAT procedure). They will be referred to as soon as available.
- Changes in workflows or organization, especially the design of software which is used during the project for correspondence and filing (share-point-platform) often triggers new revisions because of customization.
- Contract/ scope changes (e.g. optional scope)

4.2. RELATION TO OTHER DOCUMENTS

The three most important guidelines for project implementation are the PMM, the PQP and the IPS.

All overall **Contractor** quality related issues are part of the offer as a QMM 602. The PQP (Project Quality Plan) is more project-specific and shows quality related activity during the entire project course with referenced procedures and standards. The PMM however shows document deliverables which are linked to the PQP. Referenced documents which are necessary for project controlling and implementation, e.g. Problem / deficiency reports, are explained and attached. Processes which are more into the details of non-conforming products are described in the PQP. The PDR and SPWAR can be seen as the main interface between the **Contractor** internal quality processes and NEK processes.

5. PROJECT DESCRIPTION

To be fulfilled by the Contractor

5.1. PROJECT SCOPE

To be fulfilled by the Contractor

The Scope of the project is described in SP-E-XXXXX in detail.

5.2. PHASES OF PROJECT

Single phases of the project are:

1. Design and Engineering
2. Material procurement (if applicable)
3. Manufacturing (if applicable)
4. Transport (if applicable)
5. Assembly at NEK-site (if applicable)
6. Lifting (if applicable)
7. Erection, Commissioning & Testing (if applicable)
8. Trial run (if applicable)
9. Hand-over
referring to documentation and other details (e.g. spare parts)
10. Warranty period (separately for main contract and CHO)

The project phases are visible in the monthly provided integrated project schedule, taking the above mentioned phases into account.

Appendix E

Category	Aspect	Improvement	Previous situation
Organization	Meetings of Project Steering Committee		
	PSC Members		
	Quality management within the project		
	Communication		
	Personnel, intercultural understanding		
Project management	Project management personnel and location of PMs		
	Requirement management		
	Outage planning		
Quality management	Understanding of quality requirements on both sides		
	Supplier management (control of suppliers)		

Enclosure 2: Project phases

6. PROJECT ORGANIZATION

6.1. PROJECT TEAMS

Enclosure 3: Project Team NEK

Enclosure 4: Project Team Contractor

Enclosure 5: Project Organizational - Chart Contractor

Enclosure 6: Project Organization - Chart NEK

6.1.1. SITE TEAM

During the implementation of the project, the Site Project Manager is the main point of contact for NEKs Project Manager and Site Manager. This revision of the PMM will be amended with details of the site team as well as the site organization as soon as the team is assigned.

6.2. PROJECT STEERING COMMITTEE

6.2.1. PURPOSE AND GOALS

The Project Steering Committee (PSC) supervises the work of the Project Management. The Project Management reports in regular PSC-meetings on project progress and critical issues if existing. It is comprised of management personnel from NEK and the Contractor as shown in below Enclosure 7: Project Steering Committee.

Enclosure 7: Project Steering Committee

6.2.2. PSC-MEETINGS

Meeting-Period: every 2-3 weeks. Initial meeting to be called by NEK, officially communicated approximately 2 weeks prior to the meeting date (please see Enclosure 8: Project-meetings and characteristics).

Appendix E

Agenda: To be created by NEK and the **Contractor** Project Managers. The proposal has to be sent to all members well in advance (two weeks) of the date for commenting and approval.

Location: The meeting will be hosted alternating by NEK and the **Contractor** on locations of their choice taking travel conditions and requirements for meeting purposes for all members into account.

Minutes of meeting: Minutes will be prepared by hosting PM directly in the meeting for common approval and signature afterwards. They will be signed by NEK and the **Contractor** managers.

6.3. PROJECT MEETINGS AND CONFERENCES

Name	Tasks and purposes	Owner	Attendants	Frequency	Invitation due date by owner
PSC meetings	Management review of project				
PM meetings	Regular meetings with Contractor and NEK PMs, held as telephone conferences or personal meetings according to needs. Project Management for Project-controlling and status updating				
Site Readiness Review Meeting	Preparation of outage. Verification that all requirements for successful outage are fulfilled.				
Safety meeting (site)	Safety controlling at site				
Job Mobilization meeting	Preparation of Outage work				
Bi-monthly quality telcon	Vendor quality and production schedule follow up. Coordination of WPs, PDRs and quality proceedings				
Technical Meetings	Discuss and solve technical problems				

Enclosure 8: Project-meetings and characteristics

6.4. SUB-CONTRACTING

Sub-contractors will be managed by team-members who are responsible for respective scope. A list of current subcontractors with contact and scope information can be found as Attachment 1: List of subcontractors and potential subcontractors, on page I.

Subcontractors are chosen in accordance with respective, applicable quality requirements (please compare PQP). NEK receives copies of technical specifications for subcontractors without commercial information. The **Contractor** intellectual property rights have to be protected and respected.

As per main contract, The **Contractor** shall notify to NEK the names of the subcontractors proposed to perform a part of the Scope of Supply and shall not award any principal part of the Scope of Supply to any subcontractor without prior written approval of NEK. The refusal should be justified by NEK. Full overall responsibility always remains on The **Contractor's** side concerning participation of Slovenian and non-Slovenian companies as The **Contractor's** subcontractors. Approval for hardware subcontractors which are listed in this revision of the PMM are deemed as "approved by NEK".

6.5. CORRESPONDENCE AND DOCUMENT TRANSMISSION

6.5.1. COMMUNICATION CHANNELS

Item/ topic	Formal transmittal	Medium/ format	Direct Addressee	Copy to
All commercial contractual matters (e.g. Invoices)	yes	Optional: Postal Letter Email with scanned letter		
All requests related to contractual obligations (Change-requests, Change-orders etc.)	yes			
Technical information with direct contractual relevance	yes	optional		
Technical information without direct contractual relevance	normally no	Email		
Results of technical information exchanges (e.g. design input)	yes	Email		
Project specific issues, deficiencies, non-conformances of any type (NCR, PDR, SPWAR) please see chapter 7.4	yes	Email, to be confirmed by receiver		

Enclosure 9: Correspondence requirements related to topic

Technical information with direct contractual relevance refers to input-data of high significance e.g. design data as input for calculations which determine design of components. All exchanged design input data or information must display its respective source.

Technical information without direct contractual relevance is related to e.g. explanations for understanding, comments if easily and quickly to implement and without high significance. Quickly to implement provides, that misunderstandings will be discovered quickly without causing damage. Providing the possibility of exchanging technical information without the obligation of formal record has the purpose to facilitating information flow.

All mentioned people might be temporarily replaced. Respective names have to be communicated to the other party according to the correspondence requirements.

Internal project correspondence box

The **Contractor** Share-point portal for the project, which hosts project related documents and information, provides a library for filing all email communication. Outgoing mails from the **Contractor** are copied to the box (cc). Incoming mails to the **Contractor** are forwarded from the account of the PM by using a MS-Outlook forwarding rule. Internal alerts will be implemented. The library and respective procedures ensure a high level of information-availability and security of communication within the project team.

6.5.2. PROJECT CORRESPONDENCE

Contractor and NEK use a specific tracking system for the correspondence within this project (i.e. Numbering system). The following basic rules will be followed when assigning letters, email, or file numbers:

YY-BBB-CCC-XXX, where:

- a. **YY** stands for project subject
- b. BBB three letters abbreviation for the sender (i.e. NEK)
- c. CCC three letters abbreviation for the receiver, (i.e. for the **Contractor**)
- d. XXX current number of the letter or email.

Formal coding of correspondence is used if content could need to be referenced, because of contractual relevance. To be transmitted formally: Invoicing, Non-conformance reports, PDRs, SPWARs, change-requests, change-orders, minutes of meetings except for informally handled minutes of PM-teleconfs.

Document which have to be provided by the **Contractor** to NEK in hardcopy or (vice versa) e.g. Drawings, Reports, Calculations, Lists etc. will be sent by post accompanied with a formal letter number. The accompanying letter for a transmittal will include the following data: Addresses of sender and receiver, name of sender PM with signature, date, purpose of transmittal (for approval <FA>, for commenting <FC>, for information <FI>). For attached documents: Document no, Document Rev., Document Title, Document Issuer, Document format, Document Type, Transmittal no.

A template can be found as Attachment 7: Transmittal Sheet, page VII.

In the further course of the project the **Contractor** may be granted access to certain parts of NEK Share-point portal through which documents could be provided during the commenting and review processing.

6.5.3. AUTHORIZED PERSONS

Transmittals are normally sent by the Project managers. Other **Contractor** persons entitled are: Technical Project manager, Quality Manager, Documentation Control and others, who are entitled by the PM. Transmittals which contain final contractual deliverables from the **Contractor** to NEK as per contract, are send by the Local PM or entitled persons from the **Contractor** who is the contract partner of NEK.

6.5.4. EXTERNAL SHAREPOINT PAGE

NEK established an external data storage page which the **Contractor** can access. If **Contractor** personnel need access to that page, respective instructions will be provided by NEK engineer. Respective persons will then be enrolled as users and can access the page via user login and Tokencode provided via RSA SECURID.

The page is used to provide files which exceed normal file sizes which can be transmitted via email. The party which provides documents to the other party uses an official transmittal mail (numbered) to inform the other party about the upload and the location where the file is stored (most convenient is sending a link with the transmittal mail).

The URL for the page is:

To be filled later by NEK

6.6. IT-TOOLS AND SOFTWARE

Software shown in, Enclosure 10: List of software for project management, will (some optional) be used within the project implementation with regard to project management and communication on technical matters.

To be filled by the Contractor

Enclosure 10: List of software for project management

7. PROJECT CONTROLLING

7.1. PROJECT PLANNING AND SCHEDULING

7.1.1. TYPES OF SCHEDULES

An **overall integrated project schedule** for the complete project from contract signing until end of warranty was developed. The planning unit for this overall schedule is “day”. This schedule refers to the project phases described in section 5.2 Phases of project, p.2.

7.1.2. UPDATING AND FOLLOW-UP

The **overall integrated project schedule** is updated regularly and is provided to NEK each month for project reporting. The contract dates in the original contract schedule are valid throughout the project as per contract. However a **Contractor** baseline is to be communicated to NEK for official approval, showing the current status of the baseline dates. Explanations on deviations shall be included (e.g. reason, background, consequences). An approved schedule gets a formal major revision number. Schedules for each monthly update only get minor revision numbers (separated by a dot behind the major revision number). Details of schedule documentation are determined (within contract range) by the assigned project scheduler, however. Changes in the schedule dates between two monthly reports are outlined. Input-information is retrieved from various partners (internal and external) by adequate tools / programs as digital information or via direct communication, e.g. phone supported by online-conferencing.

7.1.3. PROJECT SCHEDULE FEATURES

The **Contractor** schedule has the following features:

- Critical path logic diagram for all work activities prior to the outage
- Identify the duration of these activities
- Indicate changes in the critical path during the job
- Allocate major resources where they are most needed
- Provide updated progress and activity reports during the project
- Accept, change and update as frequently as monthly (project schedule), to evaluate scope and/or schedule changes as they occur

7.2. PROJECT REPORTING

The **Contractor** provides written status reports on a monthly basis for the work being performed. These reports will contain brief information but will convey all necessary information to the NEK Project Manager for evaluation the overall status and progress of the project.

The overall status of the work reports include:

1. Overall status of the project
2. Accomplishments from the previous report issued.
3. Technical, quality, management or other concerns, or emerging issues that could impact schedule, costs, or quality of work.
4. Work-arounds, or planned remedial actions and "path-forward" to ensure milestone dates are met.
5. Four (4) week look-ahead, including the dates of measuring, testing and inspections of the equipment per the QST.
6. Overall project management assessment.
7. Project Schedule (overall view of the IPS)

Please see Attachment 2: Content of Project Reports, page I. Monthly Project Reports (MPR) will be provided approximately each 1st to 5th day of the month and report on the past months issues.

7.3. ACTION ITEM HANDLING AND ISSUE TRACKING

An Action Item list is administrated as a living document by the **Contractor** (assigned person). This document is attached to the monthly progress report with its current status. The document will be update for action item tracking in PM-telcons.

Updates can be made available more often to NEK if necessary and if feasible with reasonable effort. Each time an Action item comes up it will be included into the AIL (Action item list). It can be communicated on an informal way (phone, email, direct verbal communication etc.) or formally, if necessary. To ensure proper recording and traceability it will come up in the monthly report next following the first occurrence and be discussed/ tracked in regular progress meetings until being closed which will be declared in mutual agreement.

7.4. CONTROLLING OF PROJECT SPECIFIC ISSUES, DEFICIENCIES AND NON-CONFORMANCES

The project specific issue and deficiency controlling is specified for two periods: (a) from project beginning until SAT completion period and (b) after the SAT completion until end of warranty period.

7.4.1. PROBLEM/ DEFICIENCY REPORT (PDR)

Applicability: The PDR is used for problems/deficiencies or technical issues in the project period from project beginning until SAT completion. Furthermore all deviations from the contractual documents are handled by PDRs, including Technical Specification SP-Exxxx rev.0, if not requiring contract amendments (to be mutually agreed). Both sides, i.e. NEK and Contractor can initiate a PDR for addressing problems/deficiencies, technical issues or deviations to the other party. In the PDR it is shown by whom it was initiated.

If a technical issue and/or problem/deficiency are discovered by Contractor or its subcontractors, Contractor internally uses its standard issue reporting and issue resolution/disposition tools. These are described in the PQP. In case a PDR needs to be issued to NEK, the internal form will not be attached to the PDR but its content will be entered in respective PDR fields and send to NEK officially. Contractor is permitted to hide proprietary/confidential information.

In case that NEK detects a technical issue or problem/deficiency, it is reported to Contractor using the same PDR form with the only difference that it will be identified in the document head that it is initiated by NEK. Respectively NEK is author of included comments. For tracking purposes, the PDR form will have its unique PDR number and priority assignment. Numbering will be consecutively regardless by whom it was initiated. The basic workflow outlined as shown below applies.

Basic workflow for PDR, e.g. initiated by NEK:

- Detection of problem/deficiency or technical issue or other deviation
- Rating (priority, A,B,C or D)
- Communicating to Contractor responsible
- Confirmation of reception to be sent to NEK
- Assigning capable personnel for resolving Contractor
- Including issue in the "Action item list" with category PDR, due date according to priority Contractor
- Workflow for PDR to be followed (share-point workflow: message, confirmation, status reporting). Contacting NEK personnel if necessary for resolution.
- Starting related Contractor internal quality workflows (such as PCM depending on issue, please see PQP)
- Follow up until resolution. Quality –controlled documentation
- Communication in Project reports.

Appendix E

PDR Priority	Required response time	Sender	Receiver at Contractor	Communication (all to be applied)	AIL priority
A	< 2 days	NEK PM	XXXX	Email with high priority Phone-call (reaching one of the receivers personally) Formal letter (sent or handed over)	High
B	< 5 working days			Email with high priority Phone-call (reaching one of the receivers personally) Formal letter (sent or handed over)	High
C	< 2 wks			Email with normal priority Formal letter (sent or handed over)	Normal
D	< 4 wks			Email with normal priority Formal letter (sent or handed over)	Normal

Enclosure 11: PDR priorities and handling

The following are the available priority assignments:

PDR Priority A: The issue needs urgent (within two days as maximum) response from Contractor/NEK technical personnel. System performance is degraded and ongoing (test) activity cannot be completed or the tasks that were planned to follow cannot be executed.

PDR Priority B: The issue needs prompt response (within five working days as maximum). Considering some plan adjustments and rescheduling, part of the planned and scheduled work can be continued but not with the full system performance and not with the full system functionality as designed. If the issue is not resolved within the available time, (FAT & SAT) activities will have to be rescheduled for some another time.

PDR Priority C: The identified issue has no influence on ongoing activities and no influence on scope of work that is in progress. However, the system demonstrates obvious technical issue or deficiency that has to be resolved. The major part of problems, deviations and/or deficiencies that would belong to this priority group that are issues related to the manufacture and or assembly of the generator and related components. The appropriate time window for resolution of problems / deficiencies from the Priority 3 group is up to two weeks.

PDR Priority D: Minor issues that do not affect system functionality and system performance (equipment, cable, materials, inconsistencies in non-essential documentation). Those problems, deviations and/or deficiencies cannot be seen by the NEK operators. The problem resolution should be achieved within 4 weeks.

All PDR's of priority 1 and 2 shall be closed while small number of the lower priority (3 & 4) PDRs (less than twenty) may still be open before taking-over the unit by NEK and starting the warranty period.

7.4.2. SYSTEM PERFORMANCE / WARRANTY ACTION REQUEST (SPWAR)

The SPWAR is used for all respective issues coming up between SAT completion and end of Warranty period, i.e. project phase-groups E (please see paragraph 7.4.1 Problem/ Deficiency Report (PDR)).

For any technical issues and/or deficiencies in the works subject to warranty service discovered by NEK during the warranty period, NEK uses the form SPWAR provided in Attachment 5: System performance / Warranty Action Request (SPWAR), page I, to capture such findings. For tracking purposes, the SPWAR form will have its unique SPWAR number and priority assignment. The available priority assignments are shown in 7.4.1, (please compare PDR).

SPWAR Priority	Required response time	Sender	Responsible Persons at <i>Contractor</i>	Modalities	AIL priority
A	< 2 days	NEK PM	<i>xxxxxx</i>	Unit performance seriously degraded or system inoperable	High
B	< 5 working days			Unit performance below design requirements and/ or part of the unit unavailable	High
C	no later than next maintenance outage			System performance/ functionality not significantly affected. Minor adjustments required.	Normal
D	< 4 wks			All minor issues that do not affect system functionality/ performance. Not visible for NEK operators / maintenance personnel	Normal

Enclosure 12: SPWAR Priorities and modalities

7.4.3. NONCONFORMING PRODUCT

Handling of nonconforming products and related procedures are included or respectively referenced in the PQP.

8. PROJECT CHANGE MANAGEMENT

8.1. CONTROL OF DESIGN AND DEVELOPMENT CHANGES

All changes of the contractual requirements triggered by NEK are performed according to the Contract Section XXX. For those triggered by Contractor section XXX applies.

No.	Action	Responsibility
SCOPE IDENTIFIED IN ADVANCE OF OUTAGE		
1	Identify scope change which is outside of the existing contract.	NEK + Contractor
2	Agree on scope to be quoted by Contractor and DOR	NEK + Contractor
3	Submit offer for additional scope to be provided	Contractor
4	Review offer and provide feedback to Contractor	NEK
5	Finalize scope, schedule, DOR and final price of additional scope	NEK + Contractor
6	Issue contract modification to Contractor for additional scope	NEK
7	Contractor to provide scope as defined in the contract change modification	Contractor
SCOPE IDENTIFIED DURING OUTAGE		
1	Identify scope change which is outside of the contract scope of supply	NEK + Contractor
2	Agree on scope to be quoted by Contractor and DOR	NEK + Contractor
3	Provide budget estimate for the work to be performed	Contractor
4	NEK to sign authorization for extra work to be performed	NEK
5	Perform work as needed to prevent adverse effects to the outage schedule.	Contractor
6	Provide finalized offer to NEK for work performed	Contractor
7	Issue contract modification to Contractor for additional work performed	NEK

Enclosure 13: Division of responsibility on scope changes

Appendix E

No.	Action	Responsibility
SCOPE IDENTIFIED IN ADVANCE OF OUTAGE		
1	Identify scope change which is outside of the existing contract.	NEK + Contractor
2	Agree on scope to be quoted by Contractor and DOR	NEK + Contractor
3	Submit offer for additional scope to be provided	Contractor
4	Review offer and provide feedback to Contractor	NEK
5	Finalize scope, schedule, DOR and final price of additional scope	NEK + Contractor
6	Issue contract modification to Contractor for additional scope	NEK
7	Contractor to provide scope as defined in the contract change modification	Contractor
SCOPE IDENTIFIED DURING OUTAGE		
1	Identify scope change which is outside of the contract scope of supply	NEK + Contractor
2	Agree on scope to be quoted by Contractor and DOR	NEK + Contractor
3	Provide budget estimate for the work to be performed	Contractor
4	NEK to sign authorization for extra work to be performed	NEK
5	Perform work as needed to prevent adverse effects to the outage schedule.	Contractor
6	Provide finalized offer to NEK for work performed	Contractor
7	Issue contract modification to Contractor for additional work performed	NEK

Enclosure 13: Division of responsibility on scope changes shows the workflows for changes on design and development. Workflow starts with the identification of the matter and respective necessity. Different activities have to be performed by NEK or/and Contractor to reach the final contractual fixed change as outlined in above show table.

9. QUALITY ASSURANCE

The QA and QC approach is described according to applicable sections in SP-Exxxx and applicable sections in QS 610 from NEK in the separate PQP (Project Quality Plan) for the project. The Project Quality Plan is briefly described in 4.2, p. 6. In some areas property rights from Contractor have to be regarded, especially for some detailed technical procedures which will be addressed in the PQP. Contractor standard procedures will not be changed. To ensure project specific implementation, work packages which are basis for processing activities related to procedures may be changed.

There are three major QSTs for the project which are applicable on: (a) Phases 1,2,3,4, i.e. from design and manufacturing until end of transport (b) for Assembly at site (Krsko NPP) and lifting, which are Phase 5 and 6 and (c) for Installation and commissioning.

The part of the PQP for installation and commissioning requires detailed work-packages and work-plans which are to be developed according to document delivery schedule (please see section 11, page 21). Therefore this part of the PQP is only crucially covered at the project start. A list of testing procedures from **Contractor** is being administrated and updated during the project. To each procedure, its number, title, revision and owner are displayed.

10. SITE WORK

10.1. PLANNING

For planning of site work work-packages, work-plans and a respective outage are issued according to the document delivery schedule.

10.2. LOGISTICS

The amount of new equipment, materials and personnel, as well as old equipment handling during the project, requires close cooperation between **Contractor's** site management/logistics personnel with NEK security and receiving personnel.

Logistics coordination entails:

- receipt of equipment (forms, data, security issues etc.)
- development of the laydown plan
- pre-job set-up
- inspection and staging of material (tagging, protocols etc.)

Detailed workflows and interfaces will be identified in respective procedures. Since content of procedures is mostly confidential and intellectual property, contractual agreements on this matter apply. Confidential procedures could be looked at. Copies cannot be provided.

11. DOCUMENT DELIVERABLES AND TRANSMITTAL SCHEDULE

11.1. DRAWING AND DOCUMENT NUMBERING SYSTEM

Drawings and documents which are included in the DMP use the NEK DCM numbering system. Documents will also show **Contractor** document numbers in respective fields for document control and designation.

11.2. DOCUMENT STATUS (**CONTRACTOR**)

- Preliminary release
Documents which are provided to NEK for review will have the status “preliminary release”. This means that responsible **Contractor** personnel have approved the preliminary release to NEK.
- Final release
As soon as comments by NEK have been regarded and all issues are clarified/ solved, the documents will be sent to NEK for approval in the status of “final release”. The highest status for documents which were commented and the very comments replied by **Contractor**, is final release.
- Approved for construction
After having received written approval, all applicable documents will get the status approved for construction. This applies for NEK and **Contractor** documents. Approval of documents is to be made visible by stamping the hardcopy of the document.

11.3. DOCUMENT REVIEW BY NEK

11.3.1. PROCESS

Contractor will provide documents for review in electronic form to NEK. With the goal to make review effective and efficient NEK accepts marked up drafts, which should however be self-explaining and adequate.

Documents which are provided to NEK by **Contractor** for review in the status of preliminary release should be returned to **Contractor** redlined, red-circled or anyhow highlighted with accompanying comments explaining the matter of concern and change request. NEK returns the transmittal sheet (please see) with respective remarks and assigns the NEK approval status to the document. NEK provides comments to **Contractor** documents in pdf files with the “commenting” function (“note” or “text box”).

Contractor replies to comments using the “reply to” function directly assigned to the comment of NEK.

After a document was rejected, **Contractor** provides the next higher revision with NEK comments applied as well as the commented file with replies to the comments. The respective file shall be added a “_c” after NEK incorporated comments and an additional “-r_” when being replied by **Contractor**. Respective letters are added each time when commenting / replying is performed.

11.3.2. NEK APPROVAL STATUS

- Approval status “rejected”
This status constitutes that the provided document does not meet the contractual requirements as per NEK perspective.

- Approval status “approved with comments”
If NEK has comments on provided documents, they can be “approved” with comments if the significance of the comments is low, i.e. not affecting **Contractor** procurement specifications negatively with regard to fulfillment of final contract requirements or in general not affecting schedule, costs and technical solution.
Respective comments shall be corrected by **Contractor** as soon as feasible and reasonable, but for sure well before issuing of the final DMP so that any aspects of the comments will be regarded. This document status constitutes that the content of the document is in compliance with the contractual requirement and justifies invoicing if an installment is associated with.
- Approval status “approved”
The final status constitutes that the document is in full compliance with contractual requirements. No further changes are needed on the document itself (however the document might have to be adopted during further processing within the DMP/ instruction book incorporation).

11.4. DOCUMENT TRANSMITTAL SCHEDULE

The applicable document transmittal schedule for the **Name of the project** is shown in SP-Exxxx, as Attachment x, page xx.

12. PROVISIONAL ACCEPTANCE PARAMETERS

Respective parameters are provided in SAT procedure.

13. ATTACHMENTS

Attachment 1: List of subcontractors and potential subcontractors

Attachment 2: Content of Project Reports

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Attachment 3: Project Schedule

Attachment 4: Problem/ Deficiency Report (PDR)

NUCLEAR POWER PLANT KRŠKO PROJECT



PDR – Problem/Deficiency Report

Contractor
Logo

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

Initiated by NEK ☐ / Contractor ☐

NEK/XXX: PDR Issue	
PROBLEM TITLE:	
Affected Components:	
Reference documents:	

NEK/Contractor: Scenario Identification

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

Identified by:

NEK/Contractor: Description of the Problem or Deficiency

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

Contractor: Troubleshooting and Problem/Deficiency Root Cause Explanation

Troubleshooting and Explanation Provided by: Date (dd/mm/yy):

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

Corrective Action Description:

Corrective Action Performed by: Date (dd/mm/yy):

Contractor Track Changes			
References:			
Other Applicable Documentation			
References and Attachments:			

NEK: Resolution and/or Answer Acceptance

NEK Comments:

Accepted by: Date (dd/mm/yy):

Attachment 5: System performance / Warranty Action Request (SPWAR)

NUCLEAR POWER PLANT KRŠKO PROJECT



SPWAR – System Performance/Warranty Action Request

CONTRACTOR
LOGO

SPWAR No. (nnn):	Priority (1-4):	SPWR Issue date (dd/mm/yy):

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

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

NEK: Scenario Identification

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

Identified by:

NEK: Description of the Problem or Deficiency

Problem/deficiency existence verified and approved by:	Date (dd/mm/yy):	Problem is repeatable:	YES <input type="checkbox"/>	NO <input type="checkbox"/>	N/A <input type="checkbox"/>
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Contractor: Troubleshooting and Problem/Deficiency Root Cause Explanation

Troubleshooting and Explanation Provided by: Date (dd/mm/yy):

Contractor: Corrective Action Description, Corrective Action Tracking Log and Tracking References

Corrective Action Description:

Corrective Action Performed by: Date (dd/mm/yy):

Contractor: Track Changes			
References:			
Other Applicable Documentation			
References and Attachments:			

NEK: Resolution and/or Answer Acceptance

NEK Comments:

Accepted by:

Date (dd/mm/yy):

Template file: SPWAR.docx

Page 1 of 2

Attachment 6: Work-package content

WORK PACKAGE CONTENTS

- Activity Identification Number(s)
- Technical Information
 - Drawings
 - Process specifications
 - Field procedures
 - Availability Information Bulletins (AIB's)
 - Operation and Maintenance Memos (OMM's)
 - Action Items List (AIL) = List of open points (LOP)
- Contingency Plans
- Special Tool Requirements
- Safety Requirements
- QA/QC Checklists - hold/verification points for work in progress
- Data Sheets - recording work performed and inspection findings
- Attachments - including special materials

Attachment 7: Transmittal Sheet

Attachment 8: Document-Cover-Sheet



NUCLEAR POWER PLANT KRŠKO

Nuklearna Elektrarna Krško MASTER DOCUMENT	
Date Received:	07 -03- 2013
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QA SPECIFICATION

GENERIC QUALITY ASSURANCE PROGRAM REQUIREMENTS

QS-610, Rev. 1

Safety Related

Prepared by:


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Datum: 04/03/2013

Reviewed by:


Igor Fifnja, QA Superintendent

Datum: 05/03/2013

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Darko Kavšek,
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Datum: 5/03/2013



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1.0

GENERAL

- 1.1 This specification establishes the requirements for Supplier's QA program that shall apply to all activities affecting the quality of the supplied equipment, materials, or services.
- 1.2 Supplier shall ensure that its Subsuppliers conform to the applicable requirements of this specification.
- 1.3 For Safety Related products and services (SR), Supplier shall ensure compliance with the requirements of Title 10, Code of Federal Regulations, Part 50, Appendix B (10CFR50, Appendix B), "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants", ANSI/ASME N45.2-1977, "Quality Assurance Program Requirements for Nuclear Facilities"; ASME NQA-1-2008, Addenda 2009/2011, "Quality Assurance Requirements for Nuclear Facility Applications"; IAEA GS-R-3, "The Management System for Facilities and Activities"; and all other codes or standards referenced herein and in the purchase order.
- 1.4 For SR ASME Code Section III components, Supplier shall ensure compliance with the requirements of ASME Code Section III, NCA-4000 "Quality Assurance" and NCA-3800 "Metallic Material Organization's Quality System Program".
- 1.5 The reporting and posting requirements of Title 10, Code of Federal Regulations, Part 21 (10CFR21), "Reporting of Defects and Noncompliance", shall apply for SR products and services.
- 1.6 For Non-Safety Related products and services with Augmented Quality requirements (AQ), Supplier shall ensure compliance with the requirements of international standards as ISO 9001, "Quality management systems – Requirements" or ISO/IEC 17025, "General requirements for the competence of testing and calibration laboratories" or other relevant recognized standards. Additional QA requirements to the Supplier commercial QA Program shall be specified and selected in accordance with this Quality Specification and scope of supply referenced in the purchase order.
- 1.7 The Purchaser shall have the right of access to enter the premises of the Supplier to witness inspection/test activities or to conduct surveillances or quality assurance audits. This right shall extend to the Subsuppliers and will be coordinated through the Supplier.

2.0 DEFINITIONS

- 2.0 Definitions shall be as stated in ANSI N45.2.10-1973, "Quality Assurance Terms and Definitions" and in other standards referenced herein.
- 2.1 PURCHASER - Utility issuing the purchase order.
- 2.2 SUPPLIER - The person or organization to whom a purchase order from the Purchaser has been issued.



2.3 **SUBSUPPLIER** - The person or organization that furnishes items and services to the Supplier that will be used to complete the Purchaser's purchase order requirements.

2.4 **ABBREVIATIONS:**

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
CFR	Code of Federal Regulation, USA
ISO	International Organization for Standardization
NEK	Nuclear Power Plant Krško
NRC	Nuclear Regulatory Commission, USA
QA	Quality Assurance
SR	Safety Related
USA	United States of America

3.0 DOCUMENTS FOR SUBMISSION

- 3.1 The Supplier shall submit a full description of its QA program, proposed for the scope of work to be performed, as controlled copy document, for the Purchaser's review and acceptance/approval.
- 3.2 If the Purchaser has already approved the Supplier's QA program, it does not have to be submitted for acceptance/approval. However, if the Purchaser's copy of the QA program is not current, all portions of the program that have been revised since the Purchaser's previous approval shall be submitted for review and acceptance/approval.

4.0 QUALITY ASSURANCE PROGRAM REQUIREMENTS

Supplier shall develop and implement a QA program consistent with the requirements defined herein and in the purchase order. As a minimum, the program shall encompass the following quality assurance criteria.

4.1 Organization

The organizational structure, functional responsibilities, levels of authority and lines of communication for personnel performing activities affecting quality shall be documented in organizational charts and written procedures.

- 4.1.1 Quality Assurance and Quality Control inspection and audit personnel shall have sufficient and well-defined responsibility, authority, and organizational freedom to identify and evaluate quality problems, to require implementation of approved corrective action, and to verify implementation



of corrective actions. Such persons or organizations shall report to a management level so that required authority and organizational freedom are provided, including sufficient independence from cost and schedule considerations.

- 4.1.2 Personnel responsible for verifying if Supplier's work conforms to established requirements shall not have direct responsibility for the work being performed.
- 4.1.3 Where more than one organization is involved in the execution of activities, the responsibilities, interfaces, and authority of each organization shall be clearly defined and documented. The external interfaces between organizations and the internal interfaces between organizational units, and changes thereto, shall be documented.

4.2 QA Program

The documented QA program shall be planned, implemented, and maintained to identify the items and services to which it applies and to comply with requirements of the relevant Code and/or Standard (See Appendix A).

- 4.2.1 The program shall provide for planning and accomplishing activities which affect quality under suitably controlled conditions. Controlled conditions include the use of appropriate equipment, suitable environmental conditions for accomplishing the activity, and assurance that prerequisites for the given activity have been satisfied.
- 4.2.2 The program shall provide for any special controls, processes, test equipment, tools, and skills necessary to attain the required quality and provide for verification of quality by inspection and test, as necessary.
- 4.2.3 The program shall provide for indoctrination and training of personnel, who is performing activities affecting quality, to ensure that suitable proficiency is achieved and maintained.
- 4.2.4 The Supplier's management shall regularly review the status and adequacy of the documented QA program.
- 4.2.5 For items which are supplied to the Purchaser as "Commercial Grade," the Supplier's program, as a minimum, shall contain procedures, processes, etc., necessary to ensure the Purchaser that the items being supplied meet industry standards, purchase order requirements, and performance or technical requirements specified in the Suppliers catalog.

4.3 Design Control

The Supplier's program for controlling design activities shall satisfy the requirements of ANSI N45.2.11-1974, "Quality Assurance Requirements for the Design of Nuclear Power Plants," or requirements of relevant Code and Standard (See Appendix A), and shall include as a minimum, the following:



- 4.3.1 Design activities shall be prescribed and accomplished in accordance with procedures of a type sufficient to ensure that applicable design inputs are correctly translated into specifications, drawings, procedures, or instructions.
- 4.3.2 Interface between organizations performing work, affecting quality of design, shall be identified in writing and shall include those organizations that provide criteria, design, specifications, and technical direction.
- 4.3.3 Applicable design inputs, such as design bases, regulatory requirements, codes and standards, shall be identified, documented, and their selection reviewed and approved. Changes from specified design inputs, including the reasons for the changes, shall be identified, approved, documented, and controlled.
- 4.3.4 Documentation of design/analysis shall be verifiable and include the following:
1. The objective of the analysis,
 2. Design inputs and their sources,
 3. Results of reference document searches or other applicable background data,
 4. Assumptions with indication of those that must be verified as the design proceeds,
 5. Computer calculations, including computer type, computer program identification, revision, inputs, evidence of, or reference to computer program verification, and the bases, or reference thereto, supporting the application of the computer program to the specific problem,
 6. Independent review and approval.
- 4.3.5 Design verification methods shall be established to provide assurance that the design meets the specified design inputs. Acceptable verification methods include design reviews, alternate calculations, and qualification testing.
- 4.3.6 Design verification shall be performed by individuals or groups other than those who performed the original design. This verification may be performed by the originator's supervisor, if the supervisor is the only individual in the organization competent to perform the verification, and the need is documented and approved in advance by the supervisor's management.
- 4.3.7 Changes to design documents shall be reviewed and approved by the same organizations that performed the original review and approval, unless other organizations are specifically designated. This shall ensure that the impact of the change is carefully considered, required actions documented, and



information concerning the change transmitted to the affected persons and organizations.

- 4.3.8 When material substitutions or modifications in the design are made, Supplier shall:
1. Review prior design qualification tests to determine any adverse effect,
 2. Evaluate whether or not new qualification tests are required,
 3. Provide documented justification for not having to perform new qualification tests.
- 4.3.9 The software design process is documented, approved by the responsible design organization, and controlled in accordance with criteria defined in ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications", Part I: Requirement 3, Section 800 – Software Design Control, Part II: Subpart 2.7, or equal standard.
- 4.3.10 To procure and utilize a Commercial Grade items and services for nuclear power plants pursuant to 10CFR21, dedication activities and controls shall be implemented in accordance with ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications", Subpart 2.14 to ensure the item or service is adequate for its intended safety function.

4.4 Procurement Document Control

The Supplier's program for controlling procurement documents of items and services, which are not considered to be Commercial Grade, shall satisfy the requirements of ANSI N45.2.13-1976, "Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants" or requirements of relevant Code and Standard (See Appendix A), and shall include as a minimum, the following:

- 4.4.1 Applicable design bases, quality assurance requirements, and other requirements necessary to ensure adequate quality shall be included or referenced in documents for procurement of items and services.
- 4.4.2 Procurement documents shall require Subsuppliers to have a QA program consistent with the applicable requirements of this specification.
- 4.4.3. The procurement documents shall provide for access to the Subsupplier's facilities and records for inspection or audit by Supplier's and Purchaser's representatives.
- 4.4.4. Procurement documents shall identify the documentation required to be submitted.
- 4.4.5. Procurement documents shall include the Purchaser's requirements for reporting and approving dispositions of nonconformances.



- 4.4.6. A review of the procurement documents shall be performed to ensure that the documents include appropriate technical and quality requirements.
- 4.4.7. Procurement document changes that affect technical or quality requirements shall be subject to the same degree of control as used in preparing the original document.
- 4.4.8. Procurement documents for Safety-Related equipment or services shall include statement informing Subsuppliers of their responsibility to report any defect of basic component in accordance with 10CFR21 Requirements.
- 4.4.9. Procurement documents shall include the Purchaser's requirements for ordering materials, parts or components from original Subsuppliers/Manufacturers and/or authorized distributors, to prevent supply of counterfeit/fraudulent material, items or components.

4.5 Instructions, Procedures, and Drawings

- 4.5.1 The Supplier shall ensure that all activities affecting quality and services are prescribed by and performed in accordance with documented instructions, procedures, or drawings that include or reference appropriate quantitative or qualitative criteria for determining that prescribed activities have been satisfactorily accomplished.
- 4.5.2 The need for and level of detail in written procedures or instructions shall be determined based upon complexity of the task, the significance of the item or activity, work environment, and worker proficiency and capability (education, training, experience).

4.6 Document Control

The Supplier shall ensure that quality-related documents, including changes, are reviewed for adequacy, approved for release by authorized personnel, and properly distributed to and used at locations where the prescribed activity is performed.

- 4.6.1 Document changes shall be reviewed and approved by the same organization that performed the original review and approval, unless other organizations are specifically designated.
- 4.6.2 Procedures governing document control shall be established and provide for:
 - 1. The identification of controlled documents,
 - 2. The specified distribution of controlled documents for use at the appropriate location,
 - 3. The identification of individuals responsible for the preparation, review, approval, and distribution of controlled documents,



4. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless other organizations are specifically designated,
5. The review of controlled documents for adequacy, completeness, and approval prior to distribution,
6. A method to ensure the correct documents are being used.

4.7 Control of Purchased Items and Services

The Supplier's program for controlling purchased items and services shall satisfy the requirements of ANSI N45.2.13-1976, "Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants" or requirements of relevant Code and Standard (See Appendix A), and shall include as a minimum, the following:

- 4.7.1 The selection of Subsuppliers shall be based on evaluation of their capability to provide items or services in accordance with the requirements of the procurement documents.
- 4.7.2. Methods to be utilized in evaluation of Subsuppliers, and the results therefrom shall be documented and shall include the following:
 1. Evaluating the Subsupplier's history of providing a product which performs satisfactorily in actual use.
 2. Determining the Subsupplier's technical and quality capability by a review of its QA program and a direct evaluation of its facilities and the QA program implementation.
 3. Verifying if Subsupplier possesses an ASME Certificate of Authorization for the items/services, or other relevant Certificate/Accreditation related to the scope of supply.
- 4.7.3. Procedures shall be established and implemented for verification activities (surveillance, receipt inspection, and audit) as appropriate, to ensure conformance of procured items and services to identified requirements.
- 4.7.4. Where acceptance is based on certifications from Subsuppliers, the Supplier shall validate the certifications via surveillance, audit and/or independent testing.
- 4.7.5 When Commercial Grade items or services are utilized in SR applications, the dedicating entity shall apply requirements in accordance with ASME NQA-1, "Quality Assurance Requirements for Nuclear Facility Applications", Subpart 2.14, "Quality Assurance Requirements for Commercial Grade Items and Services" to ensure the item or service is adequate for its intended safety function. The Supplier shall:



1. Identify the critical characteristics (form, fit, function, material and process) of the commercial grade items and the methods for verifying that these critical characteristics have been met.
2. Establish and document measures to ensure that any changes (by Subsuppliers) in materials, product, design or manufacturing are identified and evaluated.

4.8 Identification and Control of Items

Supplier shall establish and document measures to identify and control materials, parts and components. These measures shall prevent the use of an incorrect or defective item, and suspicious (including counterfeit/fraudulent) material, parts or components that may not be as ordered. Items for production shall be identified (batch, lot, component, part) from the initial receipt and fabrication of items up to and including installation and use. This identification shall relate an item to an applicable design or other pertinent specifying document.

- 4.8.1 Traceability for these items shall be maintained with records and/or markings. Physical identification shall be used to the maximum extent possible, but if physical identification on the item is impractical or insufficient, physical segregation, procedural control or other appropriate means shall be used. Identification markings shall be applied using materials and methods that provide a clear and legible identification and do not degrade the function or service life of the item. Markings shall be transferred to each part of an item when subdivided and shall not be obliterated or hidden by surface treatment or coating unless other means of identification are substituted.

4.9 Control of Special Processes

Supplier shall establish and document measures to ensure that special processes, including welding, heat treating, cleaning, coating and nondestructive examination, are accomplished under controlled conditions in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

- 4.9.1 Special process personnel, procedures, and equipment shall be qualified and comply with the requirements of applicable codes and standards. For special processes not covered by existing codes or standards, or where item quality requirements exceed the requirements of established codes or standards, the necessary qualifications of personnel, procedures, or equipment shall be defined.
- 4.9.2 All personnel performing nondestructive examination shall be qualified and certified in accordance with Recommended Practice ASNT SNT-TC-1A "Personnel Qualification and Certification in Nondestructive Testing" or shall be qualified in accordance with requirements of relevant Code and Standard (See Appendix A).



- 4.9.3 Documentation shall be maintained for currently qualified personnel, processes, or equipment in accordance with the requirements of pertinent codes and standards.

4.10 Inspection

The Supplier shall ensure that activities affecting quality are inspected for conformance to the documented instructions, procedures, and drawings used in the accomplishment of the activity.

- 4.10.1 Inspection activities shall be performed by persons other than those who performed the activity being inspected. Such persons shall not report directly to the immediate supervisors who are responsible for the work being inspected.
- 4.10.2 Inspection and test personnel shall be appropriately qualified. The program for qualifying inspection and test personnel shall be in accordance with the requirements of ANSI/ASME N45.2.6-1978, "Qualifications of Inspection, Examination, and Test Personnel for Nuclear Power Plants" or requirements of relevant Code and Standard (See Appendix A), and shall satisfy, as a minimum, the following:
1. Provisions shall be made for the indoctrination of inspection and test personnel as to the technical objectives of the work, the codes and standards that are to be used, and the quality assurance elements that are to be employed.
 2. The need for formal training programs shall be determined, and such training activities shall be conducted, as required, to qualify inspection and test personnel.
 3. Any special physical characteristics needed in order to perform inspection and test activities shall be identified. Inspection and test personnel requiring these characteristics shall have them verified by examination at intervals which shall not exceed one year.
 4. The capabilities of inspection and test personnel shall be initially determined by an evaluation of the individual's education, experience training, test results, or proficiency demonstration.
 5. The job performance of inspection and test personnel shall be reevaluated at periodic intervals not to exceed three years. Reevaluation shall be performed by evidence of continued satisfactory performance or redetermination of capability in accordance with item 4, above.
 6. Inspection and test personnel who have not performed inspection/test activities for a period of one year shall be reevaluated in accordance with item 4, above.



7. Inspection and test personnel shall be certified based on their qualifications. The certification shall be documented in an appropriate form including, as a minimum, the following information:
 - a. Employer's name,
 - b. Identification of the person being certified,
 - c. Activities certified to perform,
 - d. Basis used for certification (one or more of the following):
 - i) Records of education, experience, and training,
 - ii) Test results, where applicable,
 - iii) Results of capability demonstration,
 - e. Results of periodic evaluations,
 - f. Results of physical examinations, when required,
 - g. Signature of employer's designated representative who is responsible for such certification,
 - h. Date of certification and date of certification expiration.
- 4.10.3 Written procedures shall require that inspections are performed according to instructions or checklists that are based on the instructions, procedures, and drawings used in accomplishing the inspected activity. Inspection procedures shall also require documentation of the qualitative or quantitative results of the specific parameters being inspected.
- 4.10.4 Examinations, measurements, or tests of items processed shall be performed for each work operation, where necessary to ensure quality. Where a sample is used to verify acceptability of a batch of items, the sampling procedure shall be based on recognized standard practices and adequately justify the sample size and selection process.
- 4.10.5 If inspection of processed items is impossible or disadvantageous, indirect control by monitoring processing methods, equipment, and personnel shall be provided. Process monitoring shall be performed by qualified personnel or qualified automated means. Both inspection and process monitoring shall be provided when control is inadequate without both.
- 4.10.6 Witness/hold points imposed by the Purchaser shall be indicated in appropriate documents.
- 4.10.7 Final inspection shall include a records review of the process results and resolution of nonconformances identified by prior inspection. Completed items shall be inspected for completeness, marking, calibration,



adjustments, protection from damage, or other characteristics as required, to verify the quality and conformance of the item according to specified requirements. The acceptance of the item shall be approved by authorized personnel. Any modifications, repairs, or replacements of items performed subsequent to final inspection shall require reinspection or retest, as appropriate, to verify acceptability.

4.11 Test Control

The Supplier shall establish a test program to identify and document all testing required, demonstrating that the equipment will perform satisfactorily in service. All testing shall be performed in accordance with written test procedures that incorporate all requirements and test limits specified in the design documents.

- 4.11.1 Test procedures shall ensure that prerequisite such as calibrated instrumentation, appropriate equipment, qualified personnel, condition of test equipment and the item to be tested, suitable environmental conditions, and provisions for data acquisition, are met.
- 4.11.2 Test requirements, results, and acceptance criteria shall be documented and evaluated by authorized personnel to ensure that all requirements have been satisfied.
- 4.11.3 Equipment that fails testing shall be dispositioned to ensure appropriate corrective action and retest. If dispositioned as "use as is," adequate justification shall be documented.
- 4.11.4 Test personnel shall be qualified in accordance with the requirements of paragraph 4.10.2 of this specification.
- 4.11.5 Computer program test procedures shall provide for demonstrating the adherence of the computer program to documented requirements.
 - 1. For computer programs used in design activities, computer program test procedures shall provide for assuring that the computer program produces correct results.
 - 2. For computer programs used for operational control, computer program test procedures shall provide for demonstrating required performance over the range of operation of the controlled function or process.
 - 3. The procedures shall also provide for evaluating technical adequacy through comparison of test results from alternative methods such as hand calculation, calculations using comparable proven programs, or empirical data and information from technical literature.
 - 4. In-use test procedures shall be developed and documented to permit confirmation of acceptable performance of the computer program in the operating system. In-use test procedures shall be performed after the computer program is installed on a different computer, or when there are significant changes in the operating system.



5. Periodic in-use manual or automatic self-check-in-use tests shall be prescribed and performed for those computer programs in which computer program errors, data errors, computer hardware failures, or instrument drift can affect required performance.
6. Test procedures or plans shall specify the following, as applicable:
 - a. Required tests and test sequence,
 - b. Required ranges of input parameters,
 - c. Identification of the stages at which testing is required,
 - d. Criteria for establishing test cases,
 - e. Requirements for testing logic branches,
 - f. Requirements for hardware integration,
 - g. Anticipated output values,
 - h. Acceptance criteria,
 - i. Reports, records, standard formatting, and conventions.
7. Test results shall be documented and maintained. Test results shall be evaluated by the responsible authority to ensure that test requirements have been satisfied.

4.12 Control of Measuring and Test Equipment

The Supplier 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. Measuring and test equipment shall be controlled, calibrated, adjusted, and maintained at prescribed intervals against certified equipment having known valid relationships to nationally recognized standards. If no national standard exists, the basis for calibration shall be documented.

- 4.12.1 Documentation shall be maintained that provides the following information for measuring and test equipment used in activities affecting quality:
 1. The identification of the items.
 2. As-found calibration data or conditions.
 3. As-left calibration data or conditions.
 4. A list of the standards used to perform the calibration.



5. A statement or information that standards or equipment are traceable to the National Bureau of Standards or accepted values of natural physical constraints.
 6. Calibration requirements that were not met.
 7. Signature of the person within the calibrator's organization who is responsible for the quality of the service provided.
- 4.12.2 Suppliers of external calibration services shall be periodically evaluated. Exceptions to this requirement are laboratories accredited by National Accreditation Body in accordance with national standards.
 - 4.12.3 When measuring and test equipment is out-of-calibration, the validity of previous inspection or test results and of the acceptability of items previously inspected or tested shall be evaluated and documented.
 - 4.12.4 Inspection, measuring, or test equipment consistently found to be out-of-calibration shall be repaired or replaced.
 - 4.12.5 Records shall be maintained and equipment suitably marked to indicate calibration status.
 - 4.12.6 Measuring and test equipment shall be properly handled and stored to maintain accuracy.
 - 4.12.7 Measuring and test equipment shall be used and calibrated in environments that are controlled to the extent necessary to ensure that the required accuracy and precision are maintained.

4.13 Handling, Storage, and Shipping

The Supplier's program for handling, storage, cleaning, packaging, shipping, and preservation of items shall be controlled to prevent damage or loss and to minimize deterioration. These activities shall satisfy the requirements of ANSI/ASME N45.2.2-1978, "Packaging, Shipping, Receiving, Storage, and Handling of Items for Nuclear Power Plants" or requirements of relevant Code and Standard (See Appendix A), and shall include, as a minimum, the following:

- 4.13.1. When required for critical, sensitive, perishable, or high-value items, specific procedures for handling, storage, packaging, shipping, and preservation shall be used.
- 4.13.2. Item shall be stored within a fire resistant, weathertight, and well ventilated building or equivalent enclosure and shall be placed on skids or shoring to permit air circulation.
- 4.13.3 A preventive maintenance program for item in storage shall be maintained.
- 4.13.4 Item shall be suitably packaged to protect against detrimental contamination and physical damage during shipping. Caps and plugs shall be used to seal



openings with sensitive internal surfaces and to protect threads and weld end preparations.

- 4.13.4 When required, special equipment (such as containers, shock absorbers, and accelerometers) and special protective environment (such as inert gas atmosphere, specific moisture content levels, and temperature levels) shall be specified and provided and their existence verified.
- 4.13.5 Special handling tools and equipment shall be utilized and controlled where necessary to ensure safe and adequate handling. Special handling tools and equipment shall be inspected and tested in accordance with procedures at specified time intervals or prior to use.
- 4.13.6 Marking or labeling shall be utilized as necessary to adequately maintain and preserve the item, including indication of the presence of special environments or the need for special controls.

4.14 Inspection, Test, and Operating Status

The Supplier shall establish measures to identify the status of inspection and test activities either on the items or in documents traceable to the items. These measures are necessary to ensure that required inspections and tests are performed and to ensure that items that have not passed the required inspections and tests are not inadvertently used.

- 4.14.1 Status shall be maintained through indicators such as physical location and tags, markings, shop travelers, stamps, inspection records, or other suitable means.
- 4.14.2 The authority for application and removal of tags, markings, labels, and stamps shall be specified.

4.15 Control of Nonconforming Items

The Supplier shall ensure that items, services, or activities that do not conform to requirements are identified, documented, evaluated and dispositioned (use-as-is, rework, repair, or reject) in accordance with documented procedures.

- 4.15.1 Written procedures shall define the responsibility and authority of those personnel involved in issuing and dispositioning nonconforming items or conditions.
- 4.15.2 Procedures shall provide for evaluation of nonconforming items or conditions for reportability in accordance with 10CFR21. For Safety Related items and/or services ordered from the USA, Supplier and Subsupplier reporting pursuant to 10CFR21 shall be made to the NRC and NEK. For Safety Related items and/or services supplied from outside the USA, Supplier and Subsupplier shall be subject to the reporting pursuant to 10CFR21 to the NEK, only.



- 4.15.3 Written descriptions of nonconformances dispositioned “use-as-is” or “repair” shall include appropriate technical justification to substantiate the disposition and shall be submitted to the Purchaser for review and acceptance of those changes affecting customer design requirements.
- 4.15.4 Repaired and reworked items shall be reexamined in accordance with applicable procedures and with the original acceptance criteria. Repaired items can be reexamined in accordance with alternate acceptance criteria, if disposition has been approved by the Purchaser.
- 4.15.5 When a nonconforming item has been dispositioned as “reject”, controls shall be implemented and adequate records shall be maintained to verify the item has not been used.
- 4.15.6 Nonconforming items shall be segregated, when practical, by placing items in clearly identified and designated hold areas until properly dispositioned. When size, weight, or access limitations preclude segregation, other precautions shall be employed to prevent inadvertent use of the item.
- 4.15.7 Nonconforming items shall not be shipped or installed without the prior written approval of the Purchaser's responsible personnel.

4.16 Corrective Action

The Supplier shall ensure that conditions adverse to quality are promptly identified and corrected.

- 4.16.1 In the case of significant conditions adverse to quality, the cause of the condition shall be determined and corrective action taken to preclude recurrence.
- 4.16.2 The identification of significant conditions adverse to quality, the cause of the conditions, and the corrective action taken shall be documented and reported to appropriate levels of management. Follow-up action shall be taken to verify completion of corrective action.
- 4.16.3 Review of corrective actions shall be performed to determine if they were timely and effectively implemented.

4.17 Quality Assurance Records

The Supplier shall establish procedures to identify the specific records that will be generated and maintained and to prescribe their retention periods and storage requirements.

- 4.17.1 Records shall include drawings, specifications, purchase documents, work orders, material certifications, calculations, inspection and test reports, work procedures, nonconformance and corrective action reports, audit reports, software design verification and computer program testing records, personnel, process, and equipment qualification records.



- 4.17.2 Inspection, test, and work performance monitoring records shall indicate the nature of observations, the acceptable limits of parameters checked, the qualitative or quantitative results, the actions taken in connection with any identified deficiencies, the date of the observation, and the identity of personnel involved.
- 4.17.3 Required records shall be legible, identifiable, and retrievable.
- 4.17.4 A system for controlling and monitoring legibility and accuracy for radiograph reproductions shall be included in the quality assurance program. This system shall include procedures for exposure, scanning, focusing, contrast, resolution, and distinguishing film artifacts.
- 4.17.5 All maintained records shall have clear identification markings that can be traced to a specific job or item and shall be entered into a system that provides for timely retrieval.
- 4.17.6 Records retention periods and storage requirements shall satisfy the requirements of ANSI/ASME N45.2.9-1979, "Requirements for Collection, Storage, and Maintenance of Quality Assurance Records for Nuclear Power Plants" or requirements of relevant Code and Standard (See Appendix A), or the Supplier shall, as a minimum, transmit identifiable and reproducible copies of all records as delineated by Purchaser at the time of shipment.

4.18 Audits

The Supplier shall establish a system of audits to ensure compliance with all aspects of the quality assurance program and to determine its effectiveness. Written procedures and controls shall comply with the requirements of ANSI/ASME N45.2.12-1977, "Requirements for Auditing of Quality Assurance Programs for Nuclear Power Plants" or requirements of relevant Code and Standard (See Appendix A), and shall include, as a minimum, the following:

- 4.18.1 Audits shall be scheduled at a frequency commensurate with the status and importance of the activity.
- 4.18.2 An audit plan which identifies the audit scope, requirements, audit personnel, activities to be audited, organizations to be notified, applicable documents scheduled and audit procedures or checklists shall be developed and documented for each audit.
- 4.18.3 Auditors shall not have any direct responsibility for performance of the activities they audit.
- 4.18.4 Audit team shall be identified prior to the beginning of the audit, consisting of one or more auditors, and shall include an individual, who is a qualified Lead Auditor, appointed to lead the team.
- 4.18.5 Audits shall be performed in accordance with written procedures or checklist.



- 4.18.6 Audit results shall be documented by the auditing personnel and shall be reviewed by management responsible for the area audited. Conditions requiring prompt corrective action shall be reported immediately to management of the audited organization.
- 4.18.7 Audit reports shall be signed by the audit team leader and shall include the following information:
1. Description of the audit scope.
 2. Identification of the auditors.
 3. Identification of persons contacted during audit activities.
 4. Summary of audit results.
 5. A statement on the effectiveness of the program elements which were audited.
 6. Description of each reported adverse audit finding in sufficient detail to enable corrective action to be taken by the audited organization.
- 4.18.8 Follow-up action shall be taken to verify that corrective action is implemented as scheduled.
- 4.18.9 Audit records shall be maintained and shall include audit plans, audit reports, written replies, and the record of completion of corrective action.
- 4.18.10 Lead Auditors shall be qualified in accordance with the requirements of ANSI/ASME N45.2.23-1978, "Qualification of Quality Assurance Program Audit Personnel for the Nuclear Power Plants", or requirements of relevant Code and Standard (See Appendix A), and shall satisfy, as a minimum, the following requirements:
1. Lead Auditors shall be trained to the extent necessary to ensure their competence in auditing skills. Training in the following areas shall be given based upon management evaluation of the needs of each Lead Auditor: nuclear-related codes, standards and regulations; general structure of quality assurance programs; auditing techniques of examining, evaluating, and reporting; and audit planning.
 2. Initial qualification of Lead Auditors shall be determined according to the individual's education, experience, training, auditing skills, and capabilities.
 3. Lead Auditors shall pass an examination which shall evaluate their competence in auditing skills.
 4. The proficiency of each Lead Auditor shall be assessed by management on an annual basis. Based on this assessment, management may extend the qualification, require retraining or require requalification.
 5. The qualification of Lead Auditors shall be certified in writing in an appropriate form, including the following information:



- a. Employer's name,
 - b. Lead Auditor's name,
 - c. Date of certification or recertification,
 - d. Basis for qualification (i.e., education, experience, training, examination, etc.),
 - e. Signature of employee's designated representative who is responsible for this certification.
6. Records for each Lead Auditor shall be maintained and updated annually.



Attachment A
QA Program Requirements - Cross Reference Table

QA PROGRAM ELEMENTS	SAFETY RELATED ITEMS NON ASME CODE	SAFETY RELATED ITEMS ASME CODE		AUGMENTED QUALITY ITEMS	
	10CFR50 App.B ASME NQA-1/ANSI N45.2	ASME III NCA-4000	ASME III NCA-3800	ISO 9001	ISO 17025
1.0 GENERAL					
1.1; 1.2; 1.7	X	X	X	X	X
1.3	X				
1.4		X	X		
1.5	X	X	X		
1.6				X	X
2.0 DEFINITIONS	X	X	X	X	X
3.0 DOCUMENTS FOR SUBMISSION	X	X	X	X	X
4.0 QA PROGRAM REQUIREMENTS					
4.1 Organization	X	X	X	X	X
4.2 QA Program	X	X	X	X	X
4.3 Design Control					
4.3.1 – 4.3.9	X	X	X	X	
4.3.10	X	X	X		
4.4 Procurement					
4.4.1 – 4.4.7; 4.4.9	X	X	X	X	X
4.4.8	X	X	X		
4.5 Instructions, Procedures, and Drawings	X	X	X	X	X
4.6 Document Control	X	X	X	X	X
4.7 Control of Purchased Items and Services					
4.7.1 – 4.7.4	X	X	X	X	X
4.7.5	X	X	X		



Attachment A
QA Program Requirements - Cross Reference Table

QA PROGRAM ELEMENTS	SAFETY RELATED ITEMS NON ASME CODE	SAFETY RELATED ITEMS ASME CODE		AUGMENTED QUALITY ITEMS	
	10CFR50 App.B ASME NQA-1/ANSI N45.2	ASME III NCA-4000	ASME III NCA-3800	ISO 9001*	ISO 17025
4.8 Identification and Control of Items	X	X	X	X	X
4.9 Control of Special Processes	X	X	X	X	X
4.10 Inspection	X	X	X	X	X
4.11 Test Control	X	X	X	X	X
4.12 Control of Measuring and Test Equipment	X	X	X	X	X
4.13 Handling, Storage, and Shipping	X	X	X	X	X
4.14 Inspection, Test, and Operating Status	X	X	X	X	X
4.15 Control of Nonconforming Items					
4.15.1; 4.15.3 – 4.15.7	X	X	X	X	X
4.15.2	X	X	X		
4.16 Corrective Action	X	X	X	X	X
4.17 Quality Assurance Records	X	X	X	X	X
4.18 Audits	X	X	X	X	X

Note: * To compare requirements of ASME NQA-1 and ISO 9001 for QA Program differences identification use ASME NQA-1b-2011, Part IV, Subpart 4.3 "Application Guidance on the Use of the ISO 9001:2008, Quality Management Systems Standard for Compliance With NQA1-2008, Part I, With the NQA-1a-2009 Addenda"