

NEK

Nuklearna elektrarna Krško
Vrbina 12
8270 Krško



TECHNICAL SPECIFICATION

Title:

REPLACEMENT OF BTRS CHILLER UNIT – TRAHCU01

KRŠKO NUCLEAR POWER PLANT

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1.0 SCOPE of WORK

Background

NEK intends to replace the existing BTRS Chiller unit – TRAHCU0, which is part of the CS chilled water loop. This loop cools the letdown chiller heat exchanger, circulates demineralised water and consists of a chiller unit, a surge tank, two chiller pumps, valves and associated controls, see Figure 1.

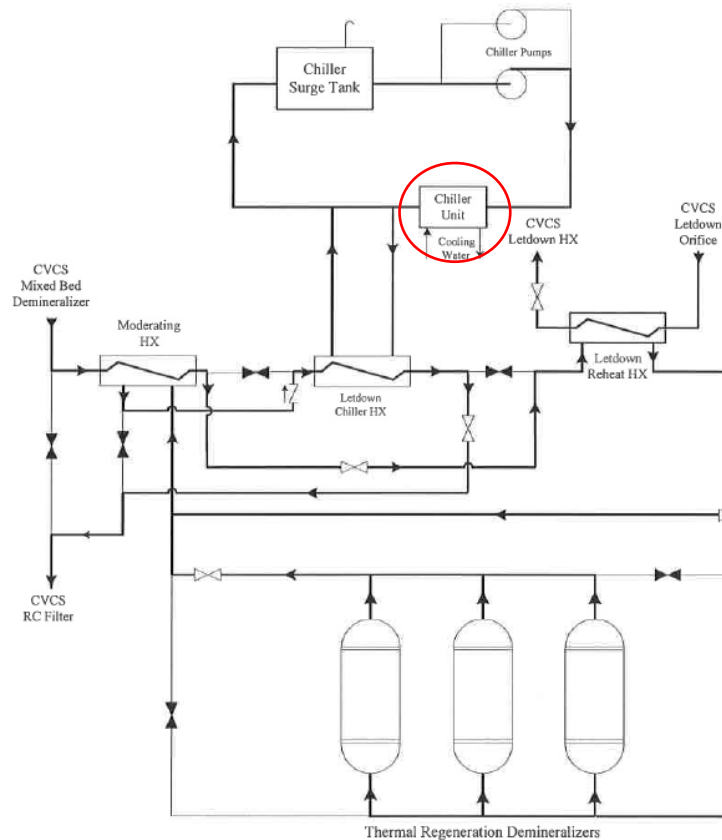


Figure 1: Boron Thermal Regeneration System (BTRS)

The chiller unit is a refrigeration unit cooled by essential service water. The unit uses a centrifugal-type compressor, which is controlled by the chiller water outlet temperature. The unit cycles, as necessary, to deliver 7° C water to the letdown chiller heat exchanger.

The purpose of the chiller unit is:

1. To cool down and keep the demineralizers at 10°C during storage of boron
2. To maintain an outlet temperature from the BTRS at or below 46.11°C during release of boron.

Case 1 above imposes the greatest load on the chiller unit and is therefore used for the design.

The existing chiller unit uses a centrifugal type of compressor, which is controlled by chiller water outlet temperature. It delivers chilled water at a temperature of 39°F (3.89°C), without any specific controls for freeze protection. It requires cooling water at a temperature that normally does not exceed 95°F (35°C). The chiller is controlled by a thermocouple in the chiller unit. During release of boron, the temperature of the chilled water is allowed to increase but the return water to the chiller unit must not exceed 105°F (40.56°C).

The chiller heat exchanger has a bypass so that the flow through this heat exchanger can be varied from no flow to the full chilled water flow. This bypass will also allow the chilled water loop to be cooled down to 39°F (3.89°C) prior to cooldown of the BTRS which will insure a more rapid cooldown rate of this system. The desired cooling capacity is adjusted by controlling the chilled water flow rate passed through the shell side of the letdown chiller heat exchanger.

The existing BTRS chiller unit has been in operation since the construction of the nuclear power plant Krško and has reached the end of its 40-year design life.

The purpose of this procurement specification is to define the purchaser's technical and commercial requirements for the purchase of the new BTRS Chiller unit.

Scope of the work

This Specification establishes the design, performance, manufacture, inspection, testing, packaging, shipping and installation requirements for the new BTRS Chiller Unit.

The Contractor shall be responsible for the design, procurement of materials, fabrication, testing, cleaning, shop painting, internal protection, packaging, shipping, installation support and all other items included in this Equipment Specification.

The Contractor is responsible for complying with all the detailed requirements set out in this specification. There shall be no deviations from this specification or its references without prior written approval from NEK.

Nothing in this specification shall relieve the Contractor of the responsibility for performing, in addition to the requirements of this specification, such analyses, tests, inspection and other activities which the Contractor considers necessary to insure that the design, material and workmanship are satisfactory for the service intended or as may be required by common usage or good practice.

Equipment and Services to be Furnished by the Supplier

The Supplier shall furnish a packaged chiller unit complete with evaporator, condenser, compressor unit, refrigerant piping, lubricating oil pump with heater and refrigerant separator, emergency oil system, liquid sight glasses, filter drier, refrigerant charging valve, manual shut off valves, relief valves, etc. and any other components which constitute a self-contained system for producing the maximum ice tonnage specified and maintaining the required chilled water temperature leaving the unit under various load conditions.

Instrumentation and controls required to achieve safe and reliable operation of the unit will be supplied mounted on the unit. A control panel with automatic capacity and safety controls shall also be supplied and provided with alarm functions to continuously monitor unit operation

Thermal insulation for the evaporator condenser and other necessary items shall be furnished provided the assembly or sub-assembly will remain intact during shipment, storage and installation. Any other insulation requirements should be identified and specified to NEK.

The refrigerant used shall be non-toxic and non-flammable, type R-134a.

The scope of supply per this specification also involves:

- Preparation of detailed fabrication schedule, written monthly status reports, and periodic schedule status.
- Design and Code calculations per ASME VIII Div. 1 requirements for pressure vessels.
- Design, fabrication, testing, certification and shipment of new BTRS Chiller unit (TRAHCU01), including all necessary quality coverage in accordance with design requirements contained in this Purchaser Specification, but not limited to, with the accessories, services and documentation detailed herein.
- Preparation of all drawings (mechanical, electrical/I&C) for new BTRS unit.
- Contractor shall provide any special requirements to allow the condenser to operate with service water which could vary in composition. Maximum acceptable solid particulate size should also be identified.
- All ASME Code certificates of materials, testing, and qualifications as specified Herein.
- Contractor shall prepare a Factory Acceptance Test (FAT) at his facility to demonstrate the performance and operability of the new BTRS Chiller unit for NEK. Each compressor assembly shall be proof tested at a minimum 204 psig (1406 kPa) and leak tested at 185 psig (1276 kPa) with a tracer gas mixture. NEK team shall witness FAT at Contractor facility. FAT shall also include complete electrical, I&C and functional testing.
- Entire chiller assembly shall be proof tested at 204 psig (1406 kPa) and leak tested at 185 psig (1276 kPa) with a tracer gas mixture on the refrigerant side. The water side of each heat exchanger shall be hydrostatically tested at 1.3 times rated working pressure.

- Compressor assembly shall undergo a mechanical run-in test to verify vibration levels, oil pressures, and temperatures are within acceptable limits.
- Prior to shipment, the chiller automated controls test shall be executed to check for proper wiring and ensure correct controls operation.
- On chillers with unit-mounted compressor motor a factory installed star/delta starter, as standard to limit electrical inrush current, shall be installed and shall be factory wired and tested together to verify proper operation prior to shipment.
- Unit shall be shipped with all refrigerant piping and control wiring factory installed.
- Unit shall be shipped charged with oil and full charge of refrigerant or a nitrogen holding charge as specified on the equipment schedule.
- Unit shall be shipped with firmly attached labels that indicate name of manufacturer, chiller model number, chiller serial number, and refrigerant used.
- If the chiller is to be exported, the unit shall be sufficiently protected from the factory against sea water corrosion to be suitable for shipment in a standard open top, ocean shipping container.
- After delivery, Contractor shall support Purchaser during installation work and support at start-up service (SAT/SUP). The chiller manufacturer shall provide a factory trained representative, employed by the chiller manufacturer, to perform the start-up procedures as outlined in the Start-up, Operation and Maintenance manual provided by the chiller manufacturer.
- Contractor shall be responsible for transportation of new BTRS chiller unit to its final location – CCB94.
- Manufacturer shall supply the following literature:
 - a. Start-up, operation and maintenance instructions.
 - b. Installation instructions.
 - c. Field wiring diagrams.
 - d. One complete set of certified drawings.
- Recommended spare parts for at least five years of operation and service support for five years.
- A three-way regulating valve for controlling the condenser (SW) intake water temperature shall be provided. The unit shall be capable of modulating this valve.
- An external flow switch for monitoring condenser water flow shall be provided to detect low or no flow conditions through the condenser.

2.0 DEFINITIONS

ASME	American Society of Mechanical Engineers
ANSI	American National Standard Institute
Contractor	shall mean a company that is fully qualified to conform to requirements of this specification
MECL	Master Equipment Component List
NEK	Nuclear power plant Krško
Purchaser	shall mean Nuklearna Elektrarna Krško/ Krško Nuclear Power Plant
QA	Quality Assurance

RE	Responsible Engineer
Sub-contractor	an organization, different from the Contractor that the Contractor may use to provide service or materials which the Contractor will use to fulfil in part, his requirements of the purchase order or Contract

3.0 CODES, STANDARDS AND REGULATORY REQUIREMENTS

The water-cooled new chiller TRAHCU01 shall be designed, manufactured, tested and documented primarily in accordance with applicable United States (US) codes and standards, consistent with the original design basis of the Krško Nuclear Power Plant and existing installed equipment.

Where required for installation and operation in the Republic of Slovenia and the European Union, compliance with applicable EU directives shall also be ensured, without compromising compatibility with existing NEK systems.

Any deviations from the codes and standards listed herein shall be subject to NEK review and approval.

Primary Codes and Standards – (Design Basis)

a. Pressure Equipment and Piping

Pressure-retaining components of the chiller, including evaporator, condenser, refrigerant piping and associated pressure parts, shall be designed in accordance with:

- ASME Boiler and Pressure Vessel Code (BPVC)
 - Section VIII, Division 1 – Pressure Vessels
 - Section II - Material Specifications
 - Section V - Nondestructive Examinations
 - Section IX - Welding and Brazing Qualifications
- ASME B31.5 – Refrigeration Piping and Heat Transfer Components
- ASME B31.1 – for Pressure Piping
- ASME B16 series, including:
 - ASME / ANSI B16.5 – Pipe Flanges and Flanged Fittings (mandatory for all process and cooling water connections to ensure compatibility with existing NEK piping systems)
 - ANSI B16.25, Butt weld connections

Materials, allowable stresses, fabrication, welding, inspection and testing shall comply with the above ASME requirements.

b. Refrigeration and HVAC Safety

- ASHRAE 15 – Safety Standard for Refrigeration Systems
- ASHRAE 34 – Designation and Safety Classification of Refrigerants

- AHRI 550/590 – Performance Rating of Water-Chilling Packages
- Equipment and installation shall be in compliance with ANSI/ASHRAE (American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers) 15 (latest edition).
- Cooler and condenser refrigerant side shall include ASME “U” stamp and nameplate certifying compliance with ASME Section VIII, Division 1 code for unfired pressure vessels.

The chiller shall be rated and tested in accordance with AHRI requirements.

c. Electrical and Control Equipment

- UL 1995 – Safety of Heating and Cooling Equipment
- Applicable ANSI / IEEE standards for industrial electrical equipment and control systems

Electrical equipment shall be suitable for NEK site power supply and environmental conditions.

d. Mechanical Design and Machinery Safety

- ANSI / ISO 12100 – Safety of machinery – Risk assessment and risk reduction
- Applicable ANSI and ASME standards for rotating machinery, vibration limits and mechanical integrity.

e. Seismic and Structural Requirements

The chiller is classified as non-safety related equipment; however:

- Structural the design of the equipment shall be such that there is no loss of function or anchorage during and after the OBE seismic event.
- The earthquake loading is represented by OBE floor response spectra defined in SP-S702, rev. 11, for Auxiliary Building, Elevation 100, (Figures A37, A38). Note that AB Elevation 100 is the lowest elevation defined in SP-S702, applicable to SSC in the Auxiliary Building and the Component Cooling Building. The 2 % damping value shall be considered applicable to mechanical equipment, such as pressure vessels, heat exchangers, and pump and valve bodies.
- Note that the skid's structural base elements should be designed to accommodate applicable OBE loads. Note also that anchorage to the concrete is out of scope.
- For a new unit, codes and standards as defined in NEK's Seismic Qualification Program, ED-18, shall be used (e.g., IEEE 344, 2004 or later edition).
- In addition to above, supplier shall provide:
 - total operating weight,
 - center of gravity,
 - anchorage forces for OBE seismic load combination.

f. Secondary Requirements – EU Compliance

In addition to the US-based design, the chiller shall comply with applicable EU regulatory requirements necessary for installation and operation in Slovenia (EU), including:

Unit construction shall comply with European directives:

- Pressure equipment shall comply with PED 2014/68/EU
- CE marking shall be applied only where required by PED

4.0 SUPPLEMENTAL DATA

Attachment 1: Existing WNES CHILLER UNIT OUTLINE – drawing 650J416

Attachment 2: Existing Heat Exchanger Specification sheet – TC235 Evaporator

Attachment 3: Existing Heat Exchanger Specification sheet – KB198 Condenser

Attachment 4: E-304-251, ESSENTIAL SERVICE WATER-COMPONENT COOLING BUILDING PLANS EL. 94.210 AND 100.00.

Attachment 5: Krško NPP / Floor Response Spectra (figure A37 ad A38).

5.0 DOCUMENT SUBMITTAL

All documents (including drawing, specifications ...) submitted shall be in the form of hard copies and electronic media.

Electronic media shall be in a format fully compatible with following software:

Word Processing:	Word
Computer-aided Drafting:	AutoCAD

All the submitted documents shall bear at least following identification:

- Supplier's Name
- Date of issue
- Document number
- Revision number
- Construction Code
- NEK's Order Number
- NEK'S Spec Number

The Supplier shall assure that the various types of documents (drawings, engineering calculation, vendor technical manuals, parts classification, equipment and material certification, and test data) that are submitted accurately reflect the equipment that is furnished to NEK.

The Supplier shall furnish the following documentation and data for new BTRS Chiller unit:

- A certified complete outline drawings showing all dimensions, arrangements weights, pull space, nozzle sizes and orientation, designation and size of all connections. This should include all service requirements, e.g. cooling water flow conditions, chilled water flow conditions, etc. An outline drawing is required for each separate item supplied for installation in the plant piping system.

- ASME-coded pressure vessel assembly and detail drawings. These should identify procedures and materials used and show the welded joints.
- A certified engineering flow diagram showing pipe sizes with instrumentation and control features.
- A certified electrical schematic wiring diagram for the chiller unit showing all components and identifying field connections.
- Outline drawing and wiring diagram for starter cabinet showing all necessary dimensions and bolting details for installation in the plant. Component layout, field connections, and cable entry locations shall be identified.
- Interconnecting wiring diagram giving wiring requirements between the chiller unit, the starting cabinet, and the source. All terminals and wire numbers shall be identified for installation.
- The copy of procedures for welding and the copy of non-destructive test procedures.
- Detailed description of delivered equipment including updated Heat Exchanger Tube Bundle in Attachment 1.
- A list of recommended spare parts.
- Completed Heat Exchangers Specification Sheets for Condenser and Evaporator.
- Completed Motor Data Specification Sheets.
- Packaging, shipping methods and recommendations for short and long-term storage.
- A complete list of sub-vendors showing the equipment each is supplying.
- A copy of I&C Specification Sheets
- A copy of Process Thermal Design Calculation
- A copy of ASME Code Vessel Calculations and Design Information
- A copy of Seismic Calculation
- Approved instruction Manual for the new BTRS Chiller Unit.
- A copy of Performance Test Data – from FAT
- A copy of the QA data package prior to shipping the equipment. QA data package (Manufacturer Equipment Data Report) shall cover (at least) following:
 - Final inspection report, Quality release
 - Certificate of Compliance, Manufacturer data report (form U for heat exchangers)
 - Material List, Material certificates
 - Welding book, Welders list and performance qualification-welding material certificates, Heat treatment
 - Completed Test Inspection Plan, NDE test report, Dimensional inspection reports, Other tests
 - Nonconformance reports, Witnessing report
 - Drawings

6.0 DESIGN REQUIREMENTS AND DESIGN INPUTS

6.1 Design Parameters

Chiller packages required by this specification shall be designed as a "Standard Unit" which can be installed and operated in any Nuclear Power Plant where prevailing

climatic conditions and available service water conditions depend on geographic location. The chiller unit shall be designed to produce the ice tonnage and maintain the required chilled water temperature, as specified in paragraph 7.0 of this specification.

6.2 Design Basis

- The design of the chiller unit is based on the classification of equipment defined as Non-Nuclear Safety (NNS). The chilled water handled by the unit is non-radioactive demineralized water with added corrosion inhibitor circulating within a closed water loop. Chilled water is used to regulate the temperature of a stream of reactor coolant water by flowing through the shell side of a Chiller Heat Exchanger and returning to a chilled water surge tank. It is then pumped back to the chiller unit.
- Chiller operating is allowed only with refrigerant R-134a.
- Machine (unit) frame shall include heat exchangers and compressors in a self-supporting structure.
- Refrigerant circuit components shall include: compressor, oil separator, high and low side pressure, relief devices, economizer, filter driers, moisture indicating sight glasses, long stroke electronic expansion device, and complete operating charge of both refrigerant R134a and compressor oil.
- Flanged Water-cooled condenser pipe connections (inlet – outlet) shall be on the opposite side to allow connection of existing plant SW cooling piping. See attachment 1 for inlet and outlet configuration. Existing SW piping dimensions on the inlet and outlet sides is 6". Per line spec. 6-SW-15B-1 (Spec. SP-G360) this piping is carbon steel (A-53, schedule 40). The flanges on this SW piping are made of SA-105 material, rated 150 lb, and are designed per ANSI B16.5. Flanges on the new BTRS condenser inlet and outlet sides shall be of the same design to allow their connection with plant piping.
- Flanged Evaporator pipe connections shall be on the same side as on the existing BTRS chiller configuration (see attachment 1). Existing CZ piping dimensions on the inlet and outlet sides is 6". Per line spec. 6-CS-152N (Spec. SP-G528) this piping is carbon steel (SA-106, schedule 40). The flanges on this CS piping are made of SA-105 material, rated 150 lb, and are designed per ANSI B16.5. Flanges on the new BTRS condenser inlet and outlet sides shall be of the same design to allow connection to plant piping.
- All interface piping 2" and below shall be square ended for socket welding. But welded connections shall be prepared in accordance with ANSI B16.25.
- Connections which must be broken for servicing and maintaining components shall be flanged (e.g. heat exchangers, relief valves etc.). A Victaulic coupling can be provided in the compressor suction between the evaporator and compressor inlet.

- Unit shall be equipped with a single condenser. Condenser shall be manufactured by the chiller manufacturer.
- Condenser shall be of shell and tube type construction, each in separate shells. Units shall be fabricated with high-performance tubing, minimum 1/4-in. (6-mm) steel shell and tube sheets with fabricated steel waterboxes. Waterboxes shall have vents, drains, and covers to permit tube cleaning within the space shown on the drawings. A thermistor-type temperature sensor with quick-connects shall be factory-installed in each water nozzle.
- Single pass or 2-passes design shall be possible.
- The condenser shall be mechanically cleanable shell and tube type with removable heads.
- Tubes shall be internally and externally grooved, seamless-copper, and shall be rolled into tube sheets.
- The condenser shall have a drain and vent in each head. Chiller shall have only one water inlet & outlet connection with Victaulic couplings to avoid vibrations transmission and to accommodate minor pipework misalignment.
- Design shall incorporate either 1 or 2 independent refrigerant circuits and the oil separator.
- Tubes shall be individually replaceable from either end of the heat exchanger without affecting the strength and durability of the tube sheet and without causing leakage in adjacent tubes.
- Water-cooled condenser and Evaporator tube material shall preferably be of stainless steel or copper, high-efficiency type, with integral internal and external enhancement unless otherwise noted. Tubes shall be nominal 3/4-in. or 1-in. OD with nominal wall thickness of 0.025 in. measured at the root of the fin at the enhanced areas and nominal wall thickness of 0.049 in. where the tubes are in contact with the end tube sheets unless otherwise noted. Tubes shall be rolled into tube sheets and shall be individually replaceable. Tube sheet holes shall be double grooved for joint structural integrity.
- The condenser shell shall include a FLASC (flash subcooler) which cools the condensed liquid refrigerant to a reduced temperature, thereby increasing the refrigeration cycle efficiency.
- Unit shall be equipped with a single flooded evaporator. Evaporator shall be manufactured by the chiller manufacturer.
- The evaporator shall be mechanically cleanable, shell and-tube type with removable heads. Tubes shall be internally and externally grooved, seamless-copper, and shall be rolled into tube sheets. Shell shall be insulated with 19 mm closed-cell foam with a maximum K factor of 0.28. Evaporator thermal insulation shall be factory fitted.

- The evaporator shall have a drain and vent in each head. Chiller shall have only one water inlet & outlet connection with Victaulic couplings to avoid vibrations transmission and to accommodate minor pipework misalignment.
- The evaporator shall incorporate an indirect refrigerant level control system (based on the continuous measurement of the approach value) to ensure optimum heat transfer performance under all load conditions.
- Evaporator shall be fitted with electronic auto setting water flow switch. Paddle switches or differential pressure switches shall not be acceptable.
- Cooler (evaporator) shall be of shell and tube type construction, each in separate shells. Units shall be fabricated with high-performance tubing, minimum 1/4-in. (6-mm) steel shell and tube sheets with fabricated steel waterboxes.
- Cooler (evaporator) shall be designed to prevent liquid refrigerant from entering the compressor.
- A reseating type pressure relief valve shall be installed on each heat exchanger. If a nonreseating type is used, a backup reseating type shall be installed in series.
- The evaporator and condenser shall have adequate thermal insulation. Unit manufacturer shall insulate the cooler shell, economizer low side compressor suction elbow, motor shell, and motor cooling lines. Insulation shall be 3/4-in. (19-mm) thick with a thermal conductivity not exceeding 0.28 (Btu in.)/hr ft² F [(0.0404 • W)/(m • °C)] and shall conform to UL standard 94, classification 94 HBF.
- Unit shall have semi-hermetic twin-screw compressors with internal relief valve and check valve to avoid reverse rotation on shut down.
- Compressor shall be equipped with a discharge shut-off valve. The discharge shall also be equipped with a muffler to reduce discharge gas pulsations. Compressor bearings shall be designed for minimum 73000 hours at maximum operating conditions.
- Capacity control shall be provided by a slide valve. Compressor capacity control shall be stepless from 100% to 15% load. Compressor shall start in unloaded condition.
- Motor shall be cooled by suction gas and protected through a dedicated electronic board against the following: thermal overload by internal winding temperature sensors, electrical overload and short circuit by dedicated fuses (one per phase), reverse rotation, loss of phase, undervoltage and power supply failure.
- Lubrication oil system shall include pre-filter and external filter capable of filtration to 5 microns. The oil filter line shall be equipped with service shut off valves for easy filter replacement. The oil separator, shall be integrated in the condenser design and shall not require oil pump. The oil separator shall include an oil level safety switch.

- Refrigerant Flow Control
 - To maintain optimal part load efficiency, the refrigerant expansion device to the cooler and as applicable to the economizer, shall use a variable metering valve, such as a float or actuated valve. To ensure good operating performance, the valve design will prevent refrigerant gas from the condenser from passing to the cooler or economizer at full or part load.
 - By maintaining a liquid seal at the flow valve, bypassed hot gas from the condenser to the cooler is eliminated. The float valve chamber shall have a bolted access cover to allow field inspection and the float valve shall be field serviceable.
- A fouling factor of 0.001 shall be applied to the condenser and 0,0005 to the evaporator.
- Pipe, fittings and flanges shall be furnished in accordance with ANSI B31.1.
- The Contractor shall provide allowable nozzle loads of the new Chiller unit to allow the evaluation of piping connections to chiller nozzles.
- Vibration Isolation:
Chiller manufacturer shall furnish neoprene isolator pads for mounting equipment on a level concrete surface.
- Manufacturer shall furnish hinges on waterboxes to facilitate tube cleaning.
- Location of Chiller Unit: Component Cooling Building, room 02, equipment elevation 96,23 m
- Water-cooled Condenser Construction Design Pressure:
 - Shell side: 180 psi
 - Tube side: 150 psi
- Water-cooled Condenser Construction Design Temperature: 300°F
- Evaporator Construction Design Pressure:
 - Shell side: 150 psi
 - Tube side: 150 psi
- Evaporator Construction Design Temperature: 200°F
- **Power box**
 - Unit shall operate at 400 Volts (+/- 10%), 3-phases, 50 Hertz power supply without neutral
 - Maximum Unit Power Input: 190kW
 - Maximum Unit Current: 350A
 - Maximum Unit Startup Current: 1200A
 - Power connection terminal blocks shall be capable of accommodating cables / wires with cross section up to 240mm² (500MCM) per phase

- Control circuit voltage shall be 24 V maximum, supplied by a factory-installed transformer
- Unit shall be supplied with factory-installed main circuit breaker/isolator and motor protection devices
- Unit shall have single point power connection
- Unit shall have a factory installed star/delta starter as standard to limit electrical inrush current
- Power control box is painted with hinged and gasket sealed doors and is protected to IP23

– **Controls**

Unit control shall include as a minimum:

- Unit control shall include as a minimum: microprocessor with non-volatile memory, picture guided unit/operator interface, the LOCAL/OFF/REMOTE/CCN selector and at least a 7 inches coloured touch-screen display with multiple language capability
- Pressure sensors shall be installed to measure suction, discharge, and oil pressure
- Temperature probes shall be installed to read cooler/condenser entering and leaving temperatures.
- Control unit shall store technical documentation, drawings and spare parts list specific to each unit
- A communication over RS485 (MODBUS) must be available to access to the unit parameters and errors – connection to plant information system (PIS)
- The default standard display screen shall simultaneously indicate the following minimum information:
 - date and time of day
 - system status messages
 - chiller operating hours
 - entering chilled water temperature
 - leaving chilled water temperature
 - evaporator refrigerant temperature
 - entering condenser water temperature
 - leaving condenser water temperature
 - condenser refrigerant temperature
 - oil supply pressure
 - oil sump temperature
 - percent motor rated load amps (RLA)
- In addition to the default screen, status screens shall be accessible to view the status of every point monitored by the control center including:
 - evaporator pressure
 - condenser pressure
 - bearing oil supply temperature
 - compressor discharge temperature
 - motor winding temperature
 - number of compressor starts
 - control point settings
 - discrete output status of various devices
 - compressor motor starter status

- optional spare input channels
 - current and voltage for each phase
 - frequency
- The controls shall provide a password protected service function which allows authorized individuals to view an alarm history file which shall contain the last alarm/alert messages with time and date stamp. These messages shall be displayed in text form, not codes.
- Unit shall be capable of performing the following functions:
 - Electronic expansion valve control optimizing evaporator refrigerant charge while ensuring minimum refrigerant superheat and optimum subcooling at condenser outlet
 - Capacity control based on leaving chilled fluid temperature
 - Limitation of the chilled fluid-temperature pull-down rate at start-up to an adjustable range of 0.1°C to 1.1°C per minute to prevent excessive demand spikes at start-up
 - Control system shall allow a quick test of all machine elements to verify the correct operation of every switch, circuit breaker, contactor etc. before the chiller is started
 - Control shall have black box function which permit to store data set of at least 20 variables with interval of X seconds, during XX minutes preceding the alarm and X minutes following the alarm event. The black box recording capability shall permit recording for 20 events and once the threshold is reached new data shall over-write the oldest ones
 - Delayed start/stop of the Unit shall be incorporated into the control system logic due to possible external errors (no condenser flow, etc...)
- The controls shall be capable of being configured to soft stop the compressor. When the stop button is pressed or remote contacts open with this feature active, the guide vanes shall close to a configured amperage level and the machine shall then shut down. The display shall indicate “shutdown in progress.”
- Unit shall automatically shut down when any of the following conditions occur: (Each of these protective limits shall require manual reset and cause an alarm message to be displayed on the control panel screen, informing the operator of the cause of the shutdown):
 - motor overcurrent
 - over voltage
 - under voltage
 - single cycle dropout
 - bearing oil high temperature
 - low evaporator refrigerant temperature
 - high condenser pressure
 - high motor temperature
 - high compressor discharge temperature
 - low oil pressure
 - prolonged surge
 - loss of cooler water flow
 - loss of condenser water flow
 - starter fault

- External connections (to other plant systems) – not limited to:
 - Remote on/off (DI)
 - Unit in Alarm (DO)
 - Unit in LOCAL operation mode (DO)
 - Unit running (DO)
 - 3-way Valve regulator (AO) 0-10V (control for low cond. temperature)
 - Programmable Inputs and Outputs (contacts):
 - 8 DIs
 - 8 DOs
- **Safeties**

Control system shall provide the unit with protection against the following:

 - Reverse rotation
 - Low chilled water temperature
 - Low oil pressure (per compressor)
 - Current imbalance
 - Compressor thermal overload
 - High pressure (with automatic compressor unloading in case of excessive condensing temperature)
 - Electrical overload and short circuit
 - Loss of phase, undervoltage and power supply failure
 - High motor temperature
 - Low evaporator refrigerant temperature

Control shall provide separate general alert (minor incident) and alarm (circuit down) remote indication.

7.0 PERFORMANCE REQUIREMENTS

Operating nominal capacity and temperatures of existing BTRS chiller unit are listed below:

Water-cooled Condenser:

- Fluid circulated on the tube side: **Sava River water**
- Tube side Water inlet temp.: 95°F
- Tube side Water outlet temp.: 105.7°F
- Operating pressure (Tube side): 150 psi
- Flow (Tube side): 414 gpm
- Fluid circulated on shell side: refrigerant type **R-134 a**
- Shell side fluid inlet temp.: 115.7°F
- Shell side fluid outlet temp.: 105.7°F
- Operating Pressure (Shell side): 148 psi

Evaporator:

- Fluid circulated on the tube side: **Chilled DD water**
- Tube side Water inlet temp.: 48.6°F
- Tube side Water outlet temp.: 39°F
- Flow (Tube side): 352 gpm

- Fluid circulated on shell side: refrigerant type **R-134 a**
- Shell side fluid inlet temp.: 35.9°F
- Shell side fluid outlet temp.: 37.9.7°F
- Operating Pressure (Shell side): 33.3 psi

8.0 MATERIAL REQUIREMENTS

- Materials used in the manufacture of the equipment shall be compatible with the process fluids used and shall be chosen to ensure reliable operation for the life of the equipment. Consideration shall be given to galling, corrosion, erosion, wear, weldability and other conditions associated with materials application.
- Welding materials used for production shall comply with the requirements of ASME Section VIII Division I, those of ASME Section IX, and the applicable qualified welding procedure specification.
- All materials to be used in the manufacturing of heat exchanger tube bundle, whether pressure boundary or otherwise, shall meet the quality standards of this specification. If the Contractor proposes any deviations from this policy, such deviations, with properly detailed justifications, shall be submitted with the proposal clearly marked as deviations from this specification for PURCHASER review and formal concurrence.

9.0 FABRICATION and ASSEMBLY

- **Dimensions and Tolerances**

Dimensions and tolerances referenced on the Contractor's drawing are controlled and shall be maintained. The Purchaser will have the right to verify all dimensions at the Contractor 's plant prior to shipment. This dimensional verification does not relieve the Contractor from his responsibility to meet dimensional requirements within the stated tolerance.

- **Cleanliness and Preparation**

Organic carbon and elements such as lead, antimony, sulfur, mercury and their components shall be eliminated as possible base metal contaminating sources during manufacture and fabrication of austenitic stainless-steel materials. Contractor shall assure that these elements and their compounds shall not exceed the maximum limits provided in Section 12.

These contaminating sources may come about by improper selection of lubricants, mallets, U-tube manometers, NDE test materials and instruments, markers, and packaging materials.

Water used for cleaning and hydro testing of tubes during manufacturing process shall be demineralized water meeting the following conductivities:

- Final Rinse: 50 Micromhos
- Hydrotest: 10 Micromhos

- **Alignment and Fixturing**

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

If it is necessary to use temporary attachments, they shall be of the same material as the base material to which they are attached, or base metal match-up may be achieved by buttering, the temporary attachments shall be removed by grinding or thermal cutting. If thermal cutting is used, the attachment shall be cut no closer than ¼" from the member and the balance removed by grinding. After removal, the area shall be MT or PT inspected. In all cases, the method or alignment shall not result in deformation of the component.

- **Welding and PWHT**

Welding, weld procedures, and welder qualifications shall be in accordance with the ASME VIII Div.1 and the requirements of this specification. Weld filler material shall be in accordance with ASME II and IX, and the requirements of this specification. WPS and PQR shall be submitted, along with post weld heat treatment (PWHT) procedures, for approval prior to initiating welding. Welders' qualification records shall be retained in the Contractor's shop and made available for Purchaser review upon request. However, a list of welders which were engaged in fabrication with reference data shall be submitted within the final data package. The filler material control, storage, and handling program shall be submitted for approval. Drawings showing fabrication for welding shall indicate the joints, together with joint geometry.

Weld surfaces shall be suitable for the NDE to be performed.

UT and radiographic examination results, where required, shall be submitted to the Purchaser in the fabrication document package.

Tack welds to be incorporated into the final weld shall be deposited with contour suitable for fusion with the root pass. The contour may be achieved by grinding if necessary. When tack weld are to become part of finished weld, they shall be performed by a qualified welder and visually examined, and defective welds shall be removed.

All arc strikes shall be removed and the areas ground to a smooth contour. Ground shall not reduce section thickness below required thickness. The areas shall then be PT or MT inspected.

10.0 INSPECTION AND TESTS

The Contractor shall ensure that equipment furnished under this specification conforms to the procurement requirements stated below. The Contractor shall satisfy the test and inspection requirements of ASME Code and other applicable documents.

Nothing in this specification shall relieve the Contractor from performing, in addition to the requirements of this specification, 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 practice.

An inspection report shall be prepared by the Contractor for each required NDE and shall include the following addition to the information required by ASME VIII Div.

1:

- a. Manufacturer's name
- b. Purchase order number
- c. Purchaser's identification
- d. Name of part and part identification number
- e. Method and procedure used
- f. NDE product batch numbers, where applicable
- g. Calibration records of equipment used
- h. Scope of inspection
- i. Results of examination
- j. Personnel qualifications

- **Non-destructive Test and Inspections requirements**

NDE shall be performed by personnel and certified in accordance with the edition of SNT-TC-1A valid for the agreed ASME Code edition.

The Contractor shall submit all applicable non-destructive testing procedures, including examination report forms, for information prior implementation. In addition, if work including non-destructive examinations is performed by subcontractors, the subcontractor's procedures shall also be reviewed and approved by the Purchaser. The Contractor shall submit these procedures to the Purchaser after its own review and approval.

The Contractor shall submit procedures and techniques for performing both surface (liquid penetrant) and volumetric examination (radiographic, ultrasonic and eddy current) for the Purchaser's approval prior to use. The Purchaser will establish a hold point to verify technique at the start of production testing and may witness production tests randomly.

- **Hydro tests**

Hydro testing (tube and shell side) shall be performed on all coded vessels in accordance with the requirements of Section VIII of ASME Vessel Code. Test procedure shall be submitted for the Purchaser's approval prior to use.

The Contractor shall plug no tubes before testing without prior written approval by the Purchaser. The Authorized Inspection shall witness tests in the scope of her/his responsibilities.

- **Performance Testing**

Factory Acceptance Testing (FAT) shall be conducted on assembled unit prior shipping release. This test shall demonstrate the ability of the unit to meet design capacity and operate unattended. All safety features and alarms shall be demonstrated. All instrumentation shall be calibrated and electrical systems checked prior testing.

The test procedure, including test setup and instrumentation, shall be submitted for approval to NEK. NEK personnel intend to witness this testing.

- **Dimensional Check**

The equipment shall be dimensionally checked to ensure that they conform to the drawings released for manufacturing. The Contractor shall the complete and furnish to the Purchaser “as-built” drawings showing the actual dimensions of WP and BR heat exchanger tube bundles.

11.0 QUALIFICATION, PARTS CLASSIFICATION AND DOCUMENT TRACEABILITY

Documentation of Supplier Qualifications is required with the proposal.

- a) A copy of ASME B&PV Certificate of Authorization and certified statement by the Supplier that certificate is current and valid.
- b) A list of the Supplier’s design, fabrication, testing and inspection facilities.
- c) A reference list of similar products fabricated.

12.0 CLEANING

The Contractor shall establish cleanliness program(s) and maintain cleanliness throughout manufacturing, fabrication, assembly, testing and inspection of the heat exchanger tube bundle. The Contractor shall be responsible to ensure that the same requirements for cleanliness are applied by its (potential) Sub-suppliers.

Parts of the tube bundle which will be inaccessible after assembly, shall be cleaned by an approved method during assembly.

The Contractor shall also ensure that the clean condition of such parts is maintained during all the following phases of fabrication, handing, and testing.

The inside of heat exchanger tubing shall be cleaned by blowing a solvent soaked felt plug through each tube. This shall be performed after welding and rolling.

The final cleaning shall ensure an effective component cleaning without damage to the surface and no adverse impact to the mechanical and/or metallurgical properties of the material.

After flushing and/or hydro-testing the heat exchanger tube bundle shall be thoroughly dried. It is recommended that the Contractor use forced filtered warm air to ensure complete drying.

The cleaning and drying specification and procedures shall provide the details of the cleaning and drying methods and materials which are to be used and shall be submitted to the Purchaser for information. The Contractor shall use N2 purge on the shell side and tube side for preservation purposes.

- **Cleanliness Requirements**

All materials used shall be thoroughly cleaned of all foreign matter, metal chips, weld spatter, slag, oils, lubricants, preservatives, blasting materials, dirt, scale, excessive oxide, and other foreign materials during the fabrication process.

Cleanliness shall be assured in compliance with ANSI N45.2.1 class B requirements and shall including flushing details during the fabrication process. Demineralized water shall be used for final cleaning or rinsing of the heat exchanger internals. Demineralized water quality for this specification is defined as follows:

Conductivity at 25°C	(μS/cm)	< 3
pH at 25°C		5.5 to 8
Chloride, Fluoride and Sulfide	(ppm)	< 1
Silica	(ppm)	< 0,05
Turbidity	(Jackson Turbidity Unit)	< 1

All conditions, except for silica and turbidity, are satisfied if the 25°C water conductivity is less than 1 μS/cm.

13.0 CORROSION PROTECTION/COATING

Contractor shall use the requirements as specified in NEK Specification SP-A3000 (SERVICE LEVEL II COATINGS INSIDE NEK TECHNOLOGICAL AREA).

14.0 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 eyeglasses 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.

15.0 PACKAGING, HANDLING AND STORAGE

Equipment shall be packed and prepared for shipment and storage in accordance with the manufacturer's standards and procedures. The packaging procedure shall take into account the method of transportation to be used, as well as the 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 nozzle weld joint preparation area. Internals shall be protected against moisture during shipment and storage by suitable means.

Equipment and spare parts shall be packed in a manner to insure safe arrival at the jobsite and protection during long-term storage.

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

Prior to shipment, the Supplier shall contact the Purchaser's Representative to confirm shipping arrangements.

16.0 NONCONFORMING MATERIALS

Any deviations or design changes which are not fully in accordance with the technical or quality assurance requirements of the procurement documents and which the Contractor desires to accept shall be approved by NEK. Any such deviation request shall be made in writing prior to disposition by means of Deviation /Change Request Form submitted to NEK for approval prior to continuing work.

Nonconformance with specification requirements and applicable codes and standards invoked by this specification will not be accepted until approved by NEK. When such a condition exists, Contractor shall initiate Nonconformance Report (NCR) using the Vendor's standard nonconformance document, which identifies the nonconformance and the Vendor's proposed disposition.

The Contractor shall:

1. Segregate the nonconformance item to prevent any further processing which may result in a change of the nonconformance as identified.
2. Make the NCR available to the responsible NEK inspector for review to ensure the nonconformance is completely identified and accurately stated.
3. Transmit NCR with recommended disposition to NEK in an expeditious manner. The Contractor shall provide technical justification for the recommended dispositions.

The requirements of the specification are binding; no deviations are acceptable without the prior consent of NEK.

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

Once the item is identified with NCR, the NCR shall remain assigned to that item permanently and NEK shall be advised of the originating NCR. Further manufacturing after detection of nonconformance, prior to Purchaser's approval shall be at the Contractor's risk.

17.0 RECORDS

A record system shall be establish 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, 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 the Purchaser.

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

- Assure Records are technically correct in accordance with applicable procedures
- Assure Records are complete including all attachments. Records shall be reviewed to assure all required data, i.e., signatures, dates, etc., have been completed or marked not applicable (N/A) as required
- Assure corrections to data have properly been made. Corrections to data shall include the date and the identification of the person authorized to make the

correction. 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

- Assure that records are legible - can be clearly read.

The Contractor shall provide all procedures, drawings, checklists, test results, measurements, etc.

18.0 OTHER RESPONSIBILITIES

18.1 Contractors Responsibility

The Contractor shall furnish adequate information for the Purchaser to evaluate the Contractor's proposed design. Should the Contractor propose to purchase from other Contractors any equipment, material, or service specified herein, the Contractor shall identify to the Purchaser the Subcontractor and the specific components they need to provide. If the proposed Subcontractor will manufacture any of the items covered by the specification completely or perform sufficient fabrication of the items which require presence of the Purchaser's Shop Inspector (PSI) in the Subcontractors shop, the Contractor shall identify the Subcontractor to the Purchaser.

The Contractor or his agent shall perform inspections and/or witness tests at the Subcontractor facilities. The presence of PSI does not relieve the Contractor of his responsibilities to meet the requirements of this specification. The Contractor shall be completely responsible for the design and performance of the heaters. The Contractor shall review all relevant data of existing heat exchanger tube bundle, redesign and fabricate any changes required, and guarantee the performance of heaters' required by this specification. The Contractor shall be fully responsible to ensure that his work, and the work of any sub-Contractor, is of high quality in every respect of workmanship throughout and fully complies with this specification. If any requirement of this specification is determined by the Contractor to be technically incorrect or technically unsuitable, or that conformance would diminish the Contractors responsibility or the product performance after installation; then the Contractor shall transmit such objections in writing to PURCHASER within forty-eight hours of discovery or with the proposal.

In all respects, equipment supplied in response to this specification shall incorporate normally accepted industry practice of engineering, design, and workmanship. It is not the intent of this specification to specify all details of design and construction. The equipment shall be constructed and equipped with accessories in accordance with this specification and with Contractor's standard practices when such practices do not conflict with this specification. The Contractor shall guarantee the performance of the new heat exchanger to conform to the values specified by the Contractor and listed in Attachment 1.

18.2 Purchaser's Responsibilities

The Purchaser will evaluate technical part of the offers in conjunction with completeness of the required documents and solutions evident from these documents.

Following the evaluation the Purchaser will select the Contractor who best conforms to the Purchaser's requirements.

18.3 Bidder's Responsibility

The Bidder shall furnish an adequate amount of information to the Purchaser to evaluate the Bidder's proposed design. Should the Bidder propose to purchase from other Contractors any equipment, material, or service specified herein, the Bidder shall identify to the Purchaser the Sub-contractor and the specific components they need to provide.

If the proposed sub-contractor will manufacture any of the items covered by the specification completely or perform sufficient fabrication of the items which require presence of the NEK Representative in the sub-contractors shop, the Contractor shall identify the Sub-contractor to the Purchaser.

The Purchaser expects the following technical documents submitted with the Offer:

- a. The Bidder shall submit a detailed description of how he proposes to meet the requirements of this specification, including drawings which show basic design features. Submittals shall include a description of the chiller unit including control panel and electrical motor starter. A description of safety features and instrumentation shall be provided. This shot will be supplemented by a schematic flow diagram of the chiller system showing all instrumentation and control features.
- b. Preliminary outline dimensions suitable for arranging space in the plant for the equipment, including (a) overall dimensions, (b) pull space, (c) weight, (d) nozzle sizes, (e) nozzle orientation, (f) electrical connections, (g) supports and (h) other interfaces.
- c. Proof of reliable operation of commercial equipment under similar or identical conditions as specified herein.
- d. Proposed packaging and packing methods.
- e. Copy of ASME Certificate of Authorization
- f. List of Contractors' design, fabrication and inspection facilities.
- g. A Bill of Material with ASME (or ASTM) material designation for major components.
- h. A reference list of similar products fabricated in last ten years.
- i. Contractor's Quality Control System Manual (See 20.0)
- j. Manufacturing and inspection plan see 20.1.4 and 31.0.
- k. A General Drawings showing, overall dimensions, sections, details
- l. A list of specific exceptions to the specification with a written justification for each exception.
- m. All other documents as required by this specification to be submitted with proposal.

The Bidder' proposal shall include his reasons to every and all section either as general statement or specific comments or either. The Bidder is not hindered to submit any additional documents to ensure completeness of the offer.

19.0 RIGHT OF ACCESS

- **Purchaser's Right of Access**

The Purchaser's Representative shall be allowed access to areas where design, fabrication and assembly of WP and BR tube bundles, sub-components will take place, such as shops, working areas and engineering offices of the Contractor and its Sub-contractors at any time for the purpose of auditing.

Such Purchaser's visits to the Contractor's or its Sub-contractor's facilities will include review of documentary evidence of activities affecting quality and witnessing the activities at the shop floor in accordance with the agreed scope per the Manufacturing and Inspection Plan. The Contractor shall at no additional expense provide Purchaser an office at the Contractor's facility for period of his presence during inspection. A copy machine, computer support and phone (internet, e-mail) connections shall be at Purchaser's disposal.

- **Availability of Records**

The Contractor shall make available a complete set of all schedules, drawings, specifications, work, inspection and quality control procedures, copies of all contracts and purchase orders, quality assurance records, test reports, free of charge in his office.

20.0 QA PROGRAM REQUIREMENTS

Water-cooled chillers within the scope of the AHRI (Air-Conditioning, Heating, and Refrigeration Institute) Water-Cooled Chiller certification program are certified in accordance with the AHRI Water-Cooled Water-Chilling and Heat Pump Water-Heating Packages Certification Program, which is based on AHRI Standard 550/590 (I-P) and AHRI Standard 551/591 (SI).

The Contractor shall have a quality system commensurate to requirements of the ASME Sec. VIII Division 1 for pressure vessels installed in chillers and shall be a valid ASME U-stamp holder.

The Contractor is to be qualified for the scope of the Contract. Purchaser will supervise the activities within the scope of supply per this Specification.

The qualified contractor shall have quality system program which meets requirements for the AQ items per Attachment A in the NEK Quality Specification QS-610 (Attached to Bidding Documentation).

20.1 QA Program Manual

Submittal of the Bidders QA Program is a prerequisite for selection of the Bidders as a Contractor. The Contractor has the responsibility for QA activities for all work pursuant to this Specification. All technical and quality requirements shall be met. The Contractor shall implement and maintain this program while carry out the requirements of this specification.

20.1.2 Contractor's Responsibilities for Sub-contractors

The Contractor shall ensure that all potential Sub-contractors meet the applicable requirements of the specification.

The specification requirements for procedure submittals shall apply to Sub-Contractors for operations or services not performed by the Contractor. The Contractor shall first review Sub-contractor's procedures to ensure compliance with specification requirements, submit these procedures, and obtain the Purchaser's approval in writing prior to performance of Sub-contractor's work. The Contractor's procedure may be used at the Sub-contractors facilities if necessary.

The Contractor shall ensure that the Sub-contractor is aware of all testing the Sub-contractor will be required to perform, and shall identify activities that require the presence of the NEK Representative. The Contractor shall ensure that the NEK Representative has the right of access to Sub-contractors' facilities and documents needed to perform inspections or witness tests. The Contractor shall retain full responsibility of the subcontractor work, supervise quality and document such facts in the Final Documentation Package.

20.1.3 Preproduction Review Meeting

Prior to ordering of materials or starting of fabrication, the Contractor shall review the purchase order, specification, other contractual documents, and its Quality Program with the Purchaser's Responsible Engineer and the QA representative. The Contractor shall demonstrate its understanding of the technical and Quality requirements in the specification and present its methods of complying with those requirements.

The Contractor, immediately after award of NEK purchase order, shall perform a complete review of the specification and take timely action to ensure that the necessary procedures and provisions are established in accordance with the CONTRACT DOCUMENTS and applicable codes and standards. Where there are unique requirements which require special equipment, specially trained personnel, procedures for process control, process or personnel qualifications, or other actions to control quality, they shall be provided, documented and planned as necessary into travelers, process sheets, work instructions and inspection plans (i.e., painting, welding, testing, cleaning, NDE, etc.).

The Contractor shall cooperate with the Purchaser's representatives in scheduling various inspections and tests during manufacture, cleaning, and preparation for shipment. The Purchaser will confirm which tests or inspections the Purchaser's

representatives will witness. This meeting will normally be held at the Contractor's facilities.

20.1.4 Manufacturing and Inspection Plan

The Contractor shall provide manufacturing and inspection plans for review and approval prior to start of manufacturing. The Manufacturing and Inspection Plans shall cover all relevant ASME inspection requirements and other deriving from this specification and by it quoted relevant rules and regulations. It shall outline the manufacturing and production sequence and specific pre-planned Contractor inspections that are required to be performed. Based on the above information, Purchaser will determine his own witness and hold points.

The Contractor shall update the Manufacturing and Inspection Plan and submit copies thereof to the Purchaser for final approval. There may be more Manufacturing and Inspection Plans when it is practical to keep control over subitems or work on different locations.

The Purchaser will utilize the plan and requirements of this specification to establish notification for witness and/or hold points for surveillance or Purchaser's approval, in accordance with Subsections 20.2.1 and 20.2.2.

20.2 Material Control and Identification

The Contractor shall establish and maintain a system for the identification and control of materials, parts, and components, including tubing and partially fabricated assemblies and availability to recognize counterfeit items. These measures shall ensure that identification of the item is maintained by part number, serial number, or other appropriate means, on the item and on the records traceable to the item through fabrication, shipment, and use of the item.

These identification and control measures shall be designed to:

- prevent the use of incorrect, defective material, parts, and components, and
- provide traceability of all parts and components to specific manufacturer, heat number, lot number, material test reports and to the Purchase Order Number.

In the event of defective material, parts and components, records must include the ultimate disposition of the component to ensure incorrect or defective material is destroyed.

20.3 Inspections

20.3.1 Notification Points

The Purchaser shall have the right to establish notification points for which the Contractor shall give prior notification to the Purchaser. In addition, the Purchaser may establish temporary notification points if necessary to ensure resolution of temporary quality problems. Notification points for agreed witness and hold point inspections, or any other activities that require Contractor's presence, require receipt of notification at least ten (10) working days in advance of the scheduled time of performance, unless otherwise agreed. Alternatively, if there is a resident

NEK Representative, schedules may be submitted in advance to the NEK Representative identifying the activities which have been designated as notification points in the Manufacturing and Inspection Plan.

The Purchaser may require that activities performed without proper notification be repeated for NEK Representative observation at the Contractor's expense.

20.3.2 Witness and Hold Points

The NEK Representative will witness agreed activities according to Manufacturing and Inspection Plan or will authorize the Contractor to proceed without Purchaser's witnessing of the activities.

Mandatory hold points are considered to be those tests, inspections, or operations which require NEK Representative presence and beyond which operations shall not proceed without written consent of the Purchaser.

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

20.3.3 Stop Work Action

When the Purchaser's Inspector is concerned about some marginal condition found by the tests and inspections specified herein, the Purchaser's Inspector shall have the right to call for an appropriate supplementary nondestructive test. The cost of the test, and the effect if any on the schedule, shall be ascertained in advance. If the test shows the component is in compliance with this specification, the cost of the test will be borne by the Purchaser. If the test shows the component is not in compliance with this specification, the Contractor shall bear the cost of the test, and shall rectify the situation to the satisfaction of the Purchaser's Inspector with no additional cost to the Purchaser.

The Purchaser will orally notify, and confirm in writing, to the Contractor any situation where, in the judgment of the Purchaser, the Contractor or Contractor's sub suppliers are performing work contrary to the conditions and terms of the procurement documents, or where continued operations could cause damage to preclude further inspection of or render remedial action ineffective for any product or service.

If, after this notification by the Purchaser, the Contractor does not commence appropriate corrective action, the Purchaser, by acting through channels previously established, will initiate work stop action on the specified product or services and so notify the Contractor in writing.

Upon receipt of notification to Stop Work from the Purchaser, the Contractor and the Contractor's sub suppliers shall cease operations, including shipments, on any specified product or service to the extent stipulated in the Stop Work notification.

Resumption of operations shall not be undertaken until the Contractor has obtained a written authorization from the Purchaser. The written authorization to resume further operations will be granted only after receipt and approval of the Contractor's written commitment to correct those conditions itemized in the notification to Stop Work.

20.3.4 Contractor's Responsibility

It is not intended that the NEK Representative will relieve the Contractor in any way whatsoever of its obligation to maintain an adequate test, inspection, and documentation program, or of any obligation under this specification.

20.4 Release for Shipment

Equipment or material shall NOT be shipped unless a Quality Release (QR) has been issued by the Purchaser's Inspector and affixed thereto or a Waiver of Inspection (WOI) has been issued by Purchaser's designated quality assurance interface. If the requirement for a QR is waived, shipment shall be made with all documents distributed in accordance with the requirements of the specification. A copy of the WOI must become part of the documentation package and accompany the shipment.

Prior to each shipment, the Contractor shall submit to the Purchaser's Inspector the documentation packages as required by the specification consisting of the records applicable to the shipment, which records shall be loose-leaf bound and appropriately identified for reference and use.

The Purchaser's Inspector will review the documentation for completeness, legibility and reproduction quality. If satisfactory, the Purchaser's Inspector will issue either a QR or a WOI to the Contractor. If not satisfactory, the Contractor will be promptly advised that additional documentation is required.

Failure of the Contractor to comply with these requirements may be cause for rejection at the receiving inspection, with the material returned to the factory, and with all additional freight, off-loading, handling, and storage expenses for the Contractor's account.

These requirements also apply to shipments from Contractor's sub suppliers for any items to be shipped directly to the Purchaser.

20.5 Procedures and Drawings

The Contractor shall submit all procedures including with acceptance criteria and drawings to the Purchaser for review and approval. To the extent that approval of certain drawings or procedures by the Purchaser is required by this specification:

- No production work for which the indicated drawings or procedures are used shall be started until the Purchaser's approval has been obtained.
- All work shall be in accordance with the approved drawings or procedures.

Failure to comply with the requirement for approval may be the cause of rejection of the work by the Purchaser.

20.6 Documentation

20.6.1 Certificate of Compliance

A "Certificate of Compliance" shall be submitted by the Contractor certifying that the equipment is in conformance with the requirements of this specification.

The Contractor will not only be required to certify the compliance of his own actions, but those of sub-suppliers he may use.

The Contractor and the possible Contractor's Sub-contractors shall maintain adequate documentation to support the facts certified in the "Certificate of Compliance" for turnover to the Purchaser.

20.6.2 Records System

A record system shall be established and maintained by the Contractor to provide documentary evidence of the quality of items and activities affecting quality. 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 utilised, along with the revision level. All quality verification records, procedures, and qualifications shall be identifiable to the item or activity involved.

20.6.3 Contractor's Documentation

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

The Contractor shall be responsible for inspecting the item(s) and checking the applicable records, prior to shipment, to verify compliance with all specification requirements. Acceptance of the completed sets of records by the Purchaser does not relieve the Contractor of responsibility for compliance with specification requirements.

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 NPP Krsko 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

the Purchaser, all quality assurance records and documentation related to this specification shall be transferred to the Purchaser.

The minimum documentation required to be furnished is listed in the documentation table in the ATTACHMENT E PURCHASE ORDER INTERFACE SUBMITTALS.

Certified copies of test reports shall be furnished to the Purchaser's Project Engineer each properly identified and including a description of the test covered and of the materials or equipment tested. Reports shall be submitted on all tests specified.

20.6.4 Documentation Checklist – Index

Prior to the start of fabrication, the Contractor shall prepare and submit to the Purchaser, for review and approval, a preliminary Documentation Index detailing the quality assurance documents which will be required to comply with this specification and referenced codes and standards. This Index shall identify, both by document type (e.g., materials test report or PT report) and the specific component or part, each individual document that will be submitted to the Purchaser for information and approval. It shall also identify records which will document the results of operations, inspections, and tests. Upon completion of equipment fabrication, testing, and inspection, but prior to release for shipment, the Index shall be finalized to show the drawings and procedures actually used and the records which document the results of all inspections and tests performed.

The final Documentation Index shall be verified for accuracy and completeness and submitted to the Purchaser's Inspector.

The Contractor shall organize the Index in a logical and easy-to-follow format, so that for any shipment (whether it be a partial or complete shipment) it will be possible to readily ascertain the completeness of documentation applicable to the shipment. If more than one shipment to NEK site is involved, the index shall be organized by components as shipped, with all documents applicable to each component as shipped separately itemized.

The Documentation Index, when submitted to the Purchaser, will be reviewed for its adequacy. If satisfactory, it will be "Approved" and documentation of its approval will be returned to the Contractor. If not satisfactory, it will be returned with comments noted; the Contractor shall then promptly revise and resubmit the Index for approval.

This specification requires specific documents to be formally submitted to the Purchaser for information or review and approval. If these documents are changed subsequent to submittal, the Contractor shall resubmit the revised document(s) to the Purchaser for information or review and approval consistent with the original requirement. Any document required by this specification which is produced by a sub supplier of the Contractor shall first be reviewed and noted as being approved by the Contractor and then submitted to the Purchaser for review and approval. Contractors and sub suppliers who proceed to use unapproved documents do so at their own risk, and may be required to repeat activities that were performed if the document used is subsequently rejected by the Purchaser.

20.6.5 Deviation/Change Requests

Any deviations or design changes which are not fully in accordance with the technical or quality assurance requirements of the procurement documents and which the Contractor desires to accept, must be approved by the Purchaser. Any such deviation request must be made in writing by means of a Deviation/Change Request Form submitted to the Purchaser for approval prior to continuing work.

21.0 SPECIAL HANDLING

The Contractor shall specify special handling and rigging requirements, which are required, and provide NEK with appropriate procedure, which shall explain and emphasize them in detail.

The Contractor shall also specify additional requirements necessary to maintain equipment warranties.

The Contractor shall provide specific instruction in maintenance, instruction and operating manual for maintaining the components during storage if necessary.

22.0 SHELF LIFE

The Contractor shall not ship any item, which has less than one year remaining shelf life at time of shipment. The contractor shall provide shelf life data as following:

- Expiration date,
- Cure date and material composition,
- Material composition.

If above requirements are not met the material will be shipped back to the Contractor at his expenses.

Shelf life for recommended spare parts list shall be provided.

23.0 10CFR21 REPORTING

N/A

24.0 COMMERCIAL GRADE DEDICATION

N/A

25.0 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.

26.0 NEK PROPRIETARY DATA

NEK has a proprietary interest in all of the drawings, designs, specifications, documents, information or know-how which may be furnished pursuant contract execution and in any know-how, improvement, discovery or invention which may be made, developed, or conceived in the performance of work hereunder or which may arise or result there from (hereinafter collectively referred to as the "Information"). All such information shall be considered to be proprietary to the NEK. The right to use of all such Information shall be transmitted to the contractor only for its personnel use and shall be entirely restricted to the performance of the contract and subject to the confidentiality provision.

NEK proprietary data are defined in the Contract. Refer to General Terms and Conditions proprietary-related paragraph.

27.0 NON-CONFORMANCE REPORTS

Any deviations or design changes which are not fully in accordance with the technical or quality assurance requirements of the procurement documents and which the Contractor desires to accept shall be approved by NEK. Any such deviation request shall be made in writing prior to disposition by means of Deviation /Change Request Form submitted to NEK for approval prior to continuing work.

Nonconformance with specification requirements and applicable codes and standards invoked by this specification will not be accepted until approved by NEK. When such a condition exists, Contractor shall initiate Nonconformance Report (NCR) using the Vendor's standard nonconformance document, which identifies the nonconformance and the Vendor's proposed disposition.

The Contractor shall:

1. Segregate the nonconformance item to prevent any further processing which may result in a change of the nonconformance as identified.
2. Make the NCR available to the responsible NEK inspector for review to ensure the nonconformance is completely identified and accurately stated.
3. Transmit NCR with recommended disposition to NEK in an expeditious manner. The Contractor shall provide technical justification for the recommended dispositions.

The requirements of the specification are binding; no deviations are acceptable without the prior consent of NEK.

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

Once the item is identified with a NCR, the NCR shall remain assigned to that item permanently and NEK shall be advised of the originating NCR.

28.0 REPAIR RECORD

A record system shall be established and maintained by the Contractor as defined in Section 20.6.2.

With the documentation package shipment, the Contractor shall provide NEK with all generated record of repairs and they shall include as a minimum the following information:

- Summary of repair/refurbishment work that has been performed on the equipment and brief analysis of the reason for failure of the equipment.
- Details of any "special process" used during repairs that were not used in manufacture process.
- A list of replacement parts installed in the repaired equipment.

All repair records shall be delivered to the Purchaser.

29.0 SOURCE INSPECTION / SURVEILLANCE NOTIFICATION

The Contractor shall provide access to Contractor's plant facilities and records pertaining to the purchase order for the purpose of planning and performing source inspection/surveillance activities.

NEK requires 10 days advance notice for the purpose of establishing witness/hold points. The Contractor shall contact the NEK's designated representative when a witness or hold point has been reached and the Supplier will not proceed past that point until inspection has been established or waived by NEK. Inspections or examinations performed by NEK representatives or designated representatives do not relieve the Contractor of its responsibility to meet the requirements of this specification and purchase order.

Listed below are specific examinations and test, which NEK representatives or designated representatives shall witness:

- Start of manufacturing in the heat exchanger Supplier's shop (kick off meeting)
- Tube cleanliness after bundle manufacturing
- Tube Joints and tubes Helium Test (Hold Point)
- Tube/Shell Side Hydrostatic Test (Hold Point)
- Examination of Radiographs
- Surface/volumetric NDE inspections to Pressure Containing Parts and Welds
- Examination of Repairs to Pressure Containing Parts and Welds
- Examination of Nameplate Data
- Examination of Weld Records
- Verification of Critical Dimensions on "Dimension Record" Form

- Inspection of Final Cleanliness prior to packaging.
- Final inspection (Hold Point)
- Inspection of adequate Packaging & Sealing (Hold Point)

This list may be expanded at some later date or the Purchaser may waive witnessing of any of these examinations and tests.

30.0 SHIPPING REQUIREMENTS

The Contractor shall provide packaging and shipping methods for protection from the effects of temperature extremes, humidity and in transit shocks. Tube bundles shall be delivered in wooden box.

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 Contractor 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

CONTENTS: Contents Description (Provide reference to Purchase Order) The Contractor shall include packing list identifying each item or assembly shipped.

31.0 DELIVERY SCHEDULE

The Contractor shall deliver Scope of Work till September 30st, 2026.

32.0 WITNESS/HOLDPOINTS FOR SUBMITTAL OF SUPPLIER DOCUMENTATION

The Contractor shall not start with fabrication prior NEK approval of drawings, calculations, fabrication & testing procedure and Manufacturing and Inspection plan.

Purchaser will assign witness/hold point inspection in the Manufacturing and Inspection plan.

33.0 VENDOR TECHNICAL MANUAL AND REGISTERED UPDATES

All manuals shall be provided to NEK for review, comment and acceptance prior to final issue and delivery.

34.0 TRAINING

N/A

35.0 ATTACHMENTS

Attachment 1: Existing WNES CHILLER UNIT OUTLINE – drawing 650J416

Attachment 2: Existing Heat Exchanger Specification sheet – TC235 Evaporator

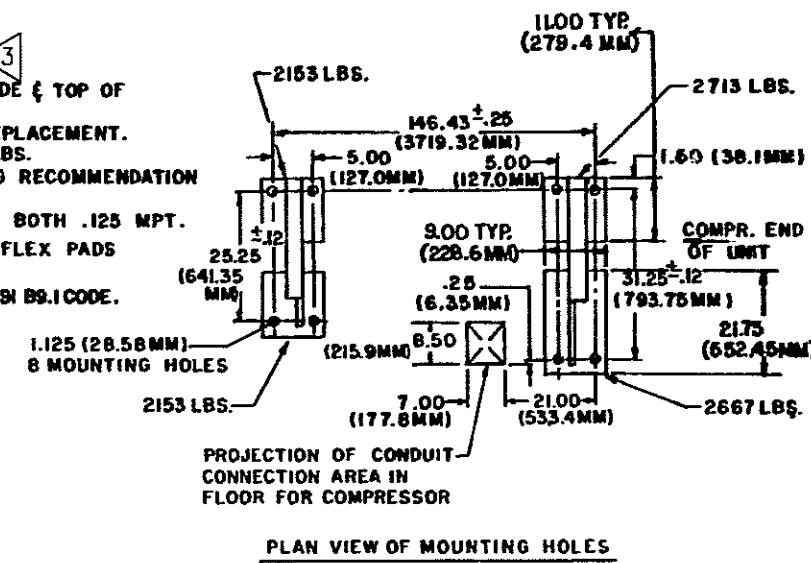
Attachment 3: Existing Heat Exchanger Specification sheet – KB198 Condenser

Attachment 4: E-304-251, ESSENTIAL SERVICE WATER-COMPONENT
COOLING BUILDING PLANS EL. 94.210 AND 100.00.

Attachment 5: Krško NPP / Floor Response Spectra (figure A37 ad A38).

NOTES:

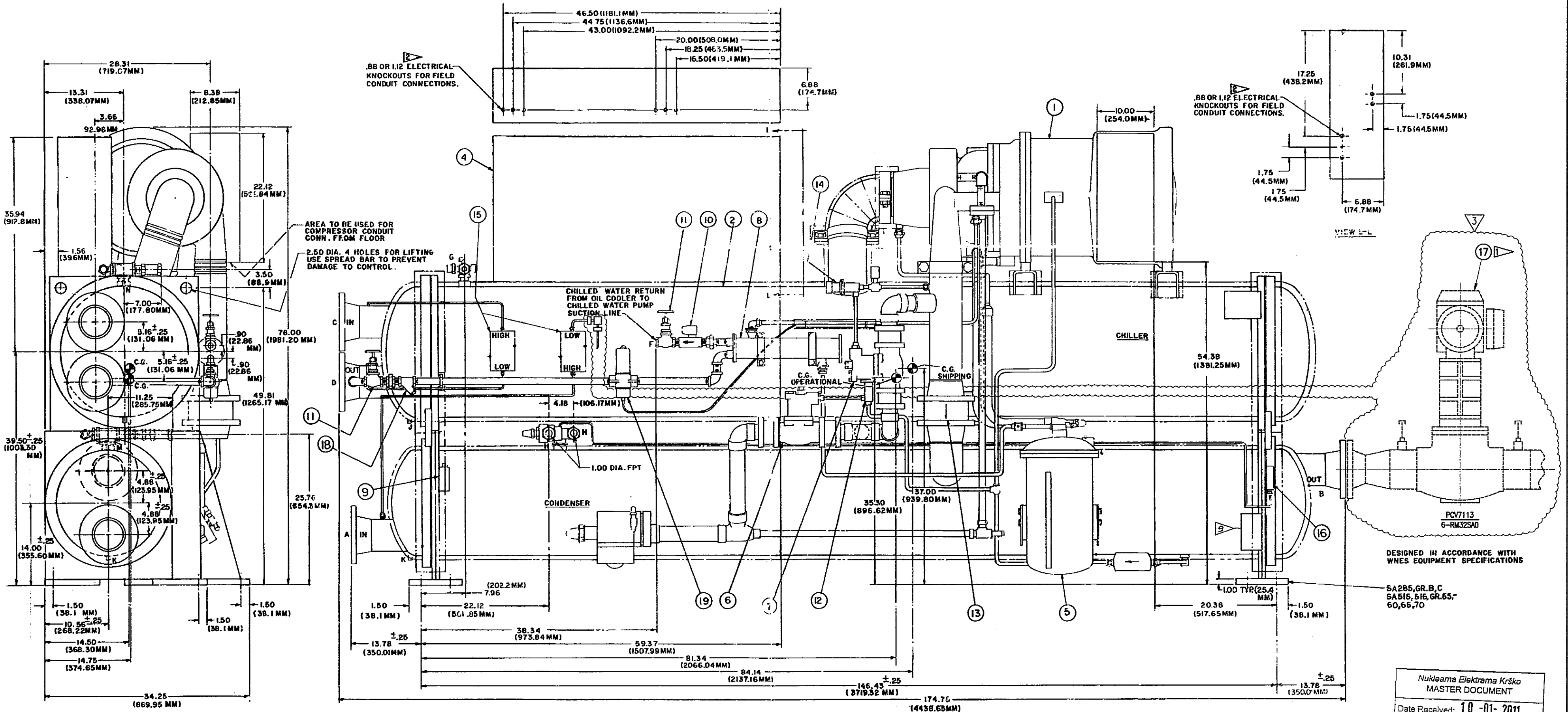
2. KNOCKOUTS FOR ELECTRICAL SERVICE ARE PROVIDED ON SIDE & TOP OF CONTROL BOX AS SHOWN.
3. INS INS REQUIRED AT EITHER END OF UNIT FOR TUBE REPLACEMENT.
4. UNIT WEIGHT AT SHIPPING 898 LBS.. 9866 OPERATING LBS.
5. CONDENSER PUMP DOWN CAPACITY IS BASED ON ARI RATING RECOMMENDATIONS OF 80% FULL AT 90° F.
6. "M" CONDENSER HEAD VENT & "N" CHILLER HEAD VENT ARE BOTH .125 MPT.
7. WHEN USING .38X9.0X11.0 (9.65X228.6X279.4 MM) SHEAR FLEX PADS THE OPERATING HEIGHT INCREASES BY .33 (8.38MM).
8. EVAPORATOR & CONDENSER RELIEF VALVES MUST BE FIRED PER ANSI B31 CODE.
9. STEEL BRACING PAD, 3.00X4.00 (76.2MM X 101.6MM) WITH .50-13UNC-2B, 100 (25.4MM) DEEP IS PROVIDED. 1.125 (29.58MM)




PLAN VIEW OF MOUNTING HOLES

ITEM	QTY.	NAME	PART NO.	MANUFACTURED BY
1	1	COMPRESSOR	36A1S3G52	WESTINGHOUSE
1	1	CHILLER (LESS HEADS)	7630604002	WESTINGHOUSE
3	1	CONDENSER (LESS HEADS;)	7630594014	WESTINGHOUSE
4	1	CONTROL BOX	359A165G03	WESTINGHOUSE
5	1	OIL PUMP	35A811G02	WESTINGHOUSE
6	1	LIQUID VALVE	350A406H26	ALCO
7	1	HOT GAS VALVE	350A406H24	ALCO
8	1	OIL COOLER	350A751H03	HEAT TRANSFER ENGINEERING, INC.
9	1	H.G.THERMOSTAT	350A052H17	HONEYWELL
9	1	SOLENOID	8210B27	ASCO (120VAC- 20WATTS)
11	2	WATER VALVE	1 IN. D.NO.438	CRANE
12	1	PILOT VALVE	350A406H18	ALCO
13	1	CHECK VALVE	350A403H34	MISSION
14	1	H.O. PILOT VALVE	350A772H02	ALCO
15	2	FLOW INDICATOR	J-2KKS55-254	UNITED ELECTRICAL
16	1	PRESSURE TRANSMITTER	1151DP7E22B1D1	ROSEMOUNT
17	1	WTR. REG. VALVE	55A3267 REV.C	FISHER (PCV7113)
		CAGE VALVE		
		DRIVE MOTOR	NH91	ITT GENERAL CONTROLS
		VALVE LINKAGE		
		TRANSFORMER	TRAHCUD1A-XFR2	
18	1	STRAIGHTER	608B	SPORLAN
19	1	WTR.REG.VALVE	V47AD-1	PENN (THERMAL BULB- NO EXT. POWER)

CONNECTION	SIZE (INCHES)	TYPE	RATING	MATERIAL SPECIFICATION	OPERATING CONDITIONS
"A" CONDENSER WATER INLET	8.00	FLANGE (RAISED FACE)	150 PSI	ASTM-A181-GR.1	SERVICE 95° F. 414 GPM
"B" CONDENSER WATER OUTLET					105.7° F. 414 GPM
"C" CHILLER WATER INLET					CHILLED WATER 48.6° F. 352 GPM
"D" CHILLER WATER OUTLET					CHILLED WATER 39° F. 352 GPM
"F" OIL COOLER OUTLET	1.00	FPT	125 PSI	BLACK STEEL	CHILLED WATER 57.5° F. 10 GPM
"G" CHILLER RELIEF VALVE	1.00	FPT	150 PSI	ASME UV	3940 LBS. PER HOUR (AIR) AT 150 PSI
"H" CONDENSER RELIEF VALVE	1.00	FPT	180 PSI	ASME UV	4700 LBS. PER HOUR (AIR) AT 180 PSI
"J" CHILLER DRAIN	.12	MPT	150 PSI	BLACK STEEL	
"K" CONDENSER	.12	MPT	150 PSI	BLACK STEEL	



Nukleama Elektrama Krško
MASTER DOCUMENT
Date Received: 10 -01- 2011
Log Number: 11607

NUKLEARNA ELEKTRARNA KRSKO NUCLEAR POWER PLANT KRSKO			
WNES CHILLER UNIT OUTLINE			
		DESIGN ENGINEERING	
NUCLEAR POWER PLANT KRSKO		KRSKO, SLOVENIA	
MADE	CHECKED	LE APPROVAL	
1. <i>J. J. J.</i>	2. <i>J. J. J.</i>	3. <i>J. J. J.</i>	
REFERENCE DRAWINGS: -			
SCALE	650J416		CS
1	DRAWING NUMBER	SYSTEM	SHNG. REV
2	650J416	3	3

SP-G3051, Rev.0 Technical Specification REPLACEMENT OF BTRS CHILLER UNIT - TRAHCU01
 Attachment 2: Existing Heat Exchanger Specification sheet - TC235 Evaporator

EXCHANGER SPECIFICATION SHEET:

ISSUED 9/26/77

1	NAME OF UNIT	TC235 - Evaporator	(W) S.P.I.N.	KRK
2	SIZE	TYPE TC235 - WC	CONNECTED IN	
3	SURFACE PER UNIT 1410 Ft. ²	SHELLS PER UNIT 1	EFF. SURFACE PER SHELL	1410 Ft. ²

PERFORMANCE OF ONE UNIT

6		SHELL SIDE	TUBE SIDE
7	FLUID CIRCULATED	Freon 12	Water
8	TOTAL FLUID ENTERING		
9	VAPOR		
10	LIQUID	616 Lb. /Min.	352 GPM
11	STEAM		
12	NON-CONDENSABLES		
13	FLUID VAPORIZED XXXXXXX	R-12	
14	STEAM CONDENSED		
15	GRAVITY-LIQUID	1.4	
16	VISCOSITY-LIQUID	.27	
17	MOLECULAR WEIGHT-VAPORS		
18	SPECIFIC HEAT-LIQUIDS		
19	LATENT HEAT-VAPORS		
20	TEMPERATURE IN	35.9	48.6
21	TEMPERATURE OUT	37.9	39.0
22	OPERATING PRESSURE	33.3	
23	NUMBER OF PASSES		4
24	VELOCITY		10 F/S
25	PRESSURE DROP (MAX. ALLOWABLE)	6	10 Psi
26	FOULING FACTOR	0	.0005
27			
28	HEAT EXCHANGED-B.T.U./HR.	1,698,000	M.T.D. (Corrected) 375
29	TRANSFER RATE-SERVICE		CLEAN

CONSTRUCTION

30	DESIGN PRESSURE	150 Psi	150 Psi
31	TEST PRESSURE	195 Psi	225 Psi
32	DESIGN TEMPERATURE 200°F.		
33	TUBES Copper	NO. 244 o.d. 0.75 BWG. .028	LENGTH 144 PITCH 0.938
34	SHELL Steel	i.d. 21.5" o.d. 22"	THICKNESS 0.25"
35	SHELL COVER .025		FLOATING HEAD COVER
36	CHANNEL		CHANNEL COVER
37	TUBE SHEET 1.5"		FLOATING
38	BAFFLES-CROSS	TYPE	THICKNESS
39	BAFFLE-LONG	TYPE	THICKNESS
40	TUBE SUPPORTS 3 each		THICKNESS 0.75
41	GASKETS-SHELL	TUBE	
42	CONNECTIONS-SHELL-IN 5" OUT 5"	TYPE ASME Flange	SCH. 40
43	CHANNEL-IN OUT	TYPE	SCH.
44	CORROSION ALLOWANCE-SHELL SIDE .063	TUBE SIDE .063	
45	CODE REQUIREMENTS ASME		TEMA CLASS Nonc
46	WEIGHTS-EACH SHELL 1124	BUNDLE 1020	FULL OF WATER 2809
47			
48			

FOR ADDITIONAL REQUIREMENTS SEE

Tube side design pressure - 150 Psi

Tube side design temperature - 200°F.

Tube side test pressure - 0 Psi with shell 195 Psi

EXCHANGER SPECIFICATION SHEET: _____

ISSUED _____

1	NAME OF UNIT	KB198 Condenser	(W) S.P.N.	KRK
2	SIZE	300 Ton	TYPE	Shell & Tube
3	SURFACE PER UNIT	1190 Sq. Ft.	SHELLS PER UNIT	1
			EFF. SURFACE PER SHELL	1190 Sq. Ft.

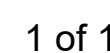
PERFORMANCE OF ONE UNIT

		SHELL SIDE	TUBE SIDE
6		Freon Gas	
7	FLUID CIRCULATED		
8	TOTAL FLUID ENTERING		
9	VAPOR	730.3	
10	LIQUID		3454.8 Lbs.
11	STEAM		
12	NON-CONDENSABLES		
13	FLUID VAPORIZED OR CONDENSED	R-12	
14	STEAM CONDENSED		
15	GRAVITY-LIQUID	1.4	1
16	VISCOSITY-LIQUID	.18	1.75
17	MOLECULAR WEIGHT-VAPORS		
18	SPECIFIC HEAT-LIQUIDS	.249	1
19	LATENT HEAT-VAPORS	52.24	
20	TEMPERATURE IN	115.7	95.0
21	TEMPERATURE OUT	105.7	105.7
22	OPERATING PRESSURE	148 Psi	150
23	NUMBER OF PASSES		3
24	VELOCITY		8.2 FPS
25	PRESSURE DROP (MAX. ALLOWABLE)	5 Psi	10 Psi
26	FOULING FACTOR	0.0	.001
27			
28	HEAT EXCHANGED-B.T.U./HR.	2,289,144	M.T.D. (Corrected) 10
29	TRANSFER RATE-SERVICE		CLEAN

CONSTRUCTION

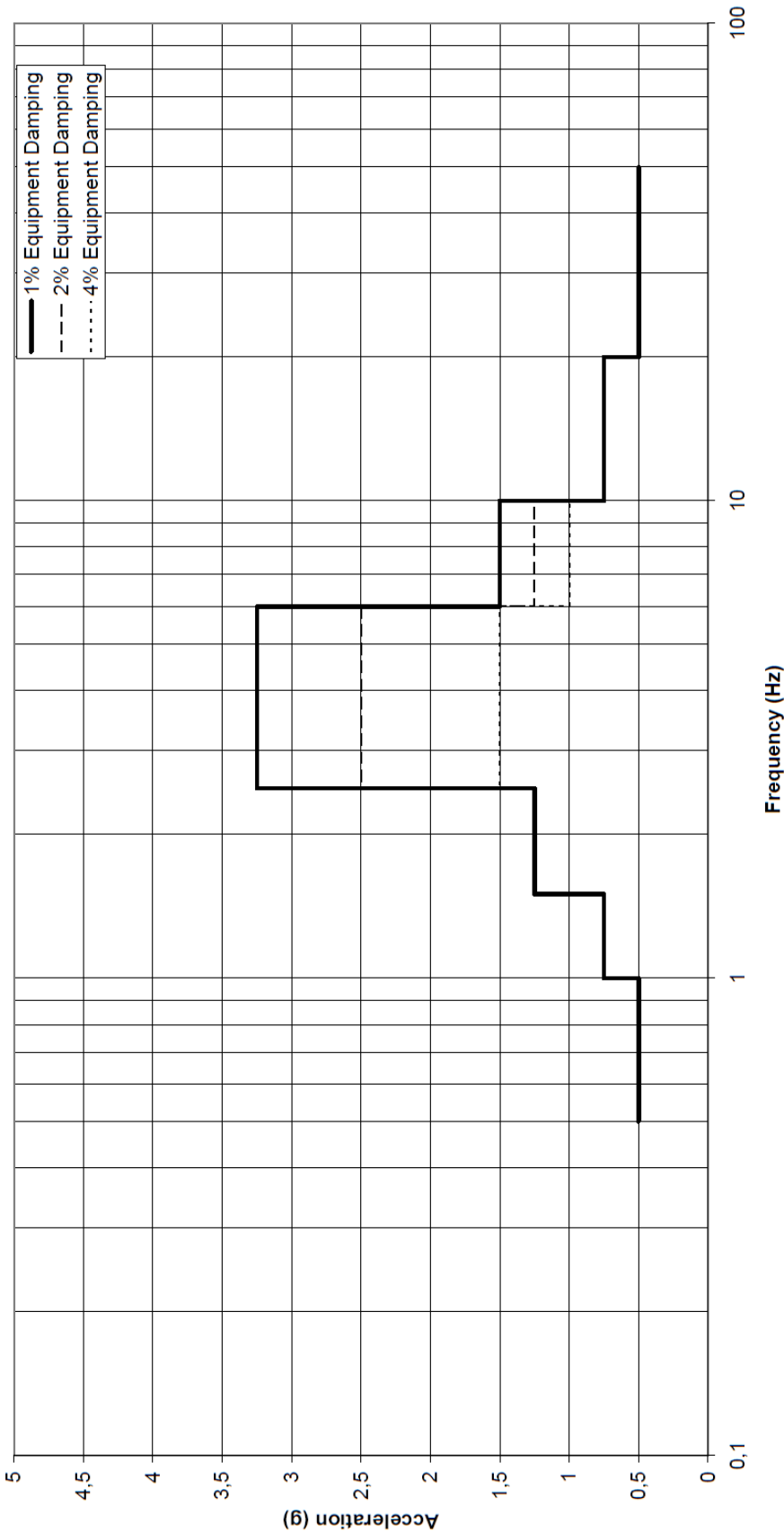
30	DESIGN PRESSURE	180 Psi	150 Psi
31	TEST PRESSURE	235 Psi	200 Psi
32	DESIGN TEMPERATURE	300° Max.	
33	TUBES CUNI	NO. 200 O.D. .75 BWG. .035	LENGTH 144 PITCH .938
34	SHELL Steel	I.D. 17.5" O.D. 18"	THICKNESS .25
35	SHELL COVER		FLOATING HEAD COVER
36	CHANNEL		CHANNEL COVER
37	TUBE SHEET 1.0" CUNi Clad		XXXXXX Fixed
38	BAFFLES-CROSS	TYPE	THICKNESS
39	BAFFLE-LONG	TYPE	THICKNESS
40	TUBE SUPPORTS 3		THICKNESS .75"
41	GASKETS-SHELL	TUBE	
42	CONNECTIONS-SHELL-IN 5" OUT 5"	TYPE ASME Flanged 150 Psi	SCH. 40
43	CHANNEL-IN OUT	TYPE	SCH.
44	CORROSION ALLOWANCE-SHELL SIDE 0.0	TUBE SIDE .063	
45	CODE REQUIREMENTS ASME Section VIII		11MA CLASS
46	WEIGHTS-EACH SHELL 850	BUNDLE 987	FULL OF WATER 2304
47			
48			

FOR ADDITIONAL REQUIREMENTS SEE Water side working pressure 150 Psi



10	04.01.17	K.K.	REV'D PER CAP 2016-1667		B.S.	A
9	07.01.11	F.F.	REV'D PER MOD 752-CS-L		V.B.	
8	23.02.10	SIPRO	CADO CONV & REV'D PER MOD 182-CZ-L		V.B.	
NO.	DATE	BY	REVISION		CKD BY	LE

Krsko NPP
Floor Response Spectra
Auxiliary Building EL. 100.3 M
Horizontal OBE



Appendix A

Revision 11
November 2024

Krsko NPP
Floor Response Spectra
Auxiliary Building EL. 100.3 M
Vertical OBE

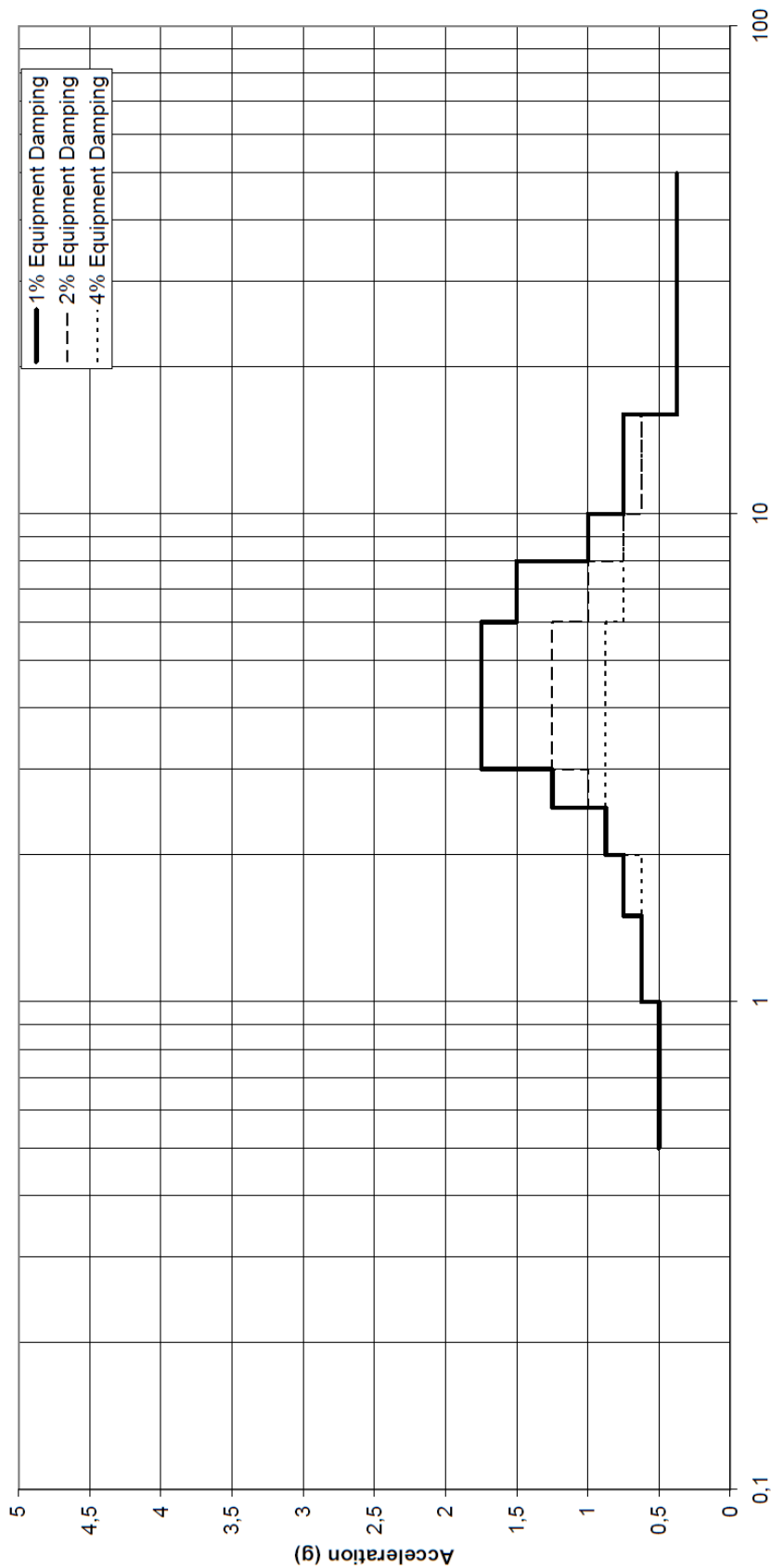


Figure A38