

NEK

Krško Nuclear Power Plant
Vrbina 12
8270 Krško



TECHNICAL SPECIFICATION

Feedwater Pump Motor Replacements

KRŠKO NUCLEAR POWER PLANT

TS34-VNMG06

Revision 0

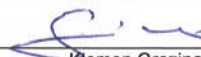
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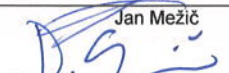
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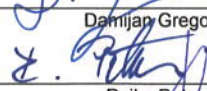
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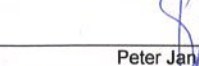
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1 SCOPE OF WORK

1.1 General

This specification establishes the general requirements for the design, performance, materials, quality assurance, testing, packing, and shipping of two horizontal, augmented quality induction motors. These motors are to be utilized as replacements for the Feedwater Pump motor at the Nuclear Power Plant KRŠKO. The original motors were supplied by Westinghouse.

This specification shall be used in conjunction with any other documents listed in the purchase order provided by the Purchaser. Any conflicts between this specification and the listed references shall be brought to the Purchaser's attention for clarification and approval before proceeding further with any actions by the Supplier.

1.1.1 Scope of Work & Supply

The Supplier shall be responsible for the design, material procurement, fabrication, testing, cleaning, packing, and shipping of all items specified, including those supplied by subcontractors or other divisions of the Supplier.

The Supplier is responsible for ensuring compliance with all detailed requirements outlined in this specification. Approval of any drawings, specifications, and/or tests by the Purchaser shall in no way relieve the Supplier from these responsibilities. There shall be no deviations from this specification or its references without prior written approval from the Purchaser.

Nothing in this specification relieves the Supplier of the responsibility to perform analyses, tests, inspections, or other activities beyond those explicitly required here, if such actions are deemed necessary to ensure the intended service or are required by common knowledge or best practices. The Bidder is responsible for obtaining any additional information required to fulfill the specifications. In the written proposal, the Bidder must either confirm compliance with all provisions of this specification or explicitly list any exceptions in the Compliance Matrix (see Appendix A4).

The Supplier shall deliver the complete and operable motor for existing Feedwater pump motor including, but not limited to, the following:

- [1] **Design and Fabrication:** The Supplier shall design, fabricate, assemble, test, and deliver two (2) Feedwater Pump Motors that are fit, form, and function equivalent replacements for any of the three existing Westinghouse motors (P.O. 13-KRA-176-NC, S.O. 88P0187) at any of the three operating locations (FW105PMP001-MTR, FW105PMP002-MTR, or FW105PMP003-MTR).
- [2] **Critical Characteristics:** All electrical and mechanical critical characteristics of the motors shall remain identical to the original, as specified in item 6 of this specification within standard NEMA and engineering tolerances.
- [3] **Interfaces and Outline:** All electrical and mechanical interfaces shall remain as shown on the original drawings. The motors shall be suitable for installation at any existing location without modification of adjacent equipment or the motors itself. Special attention shall be given to the dimensions of the main leads' terminal lugs. A set of terminal lugs shall be supplied as a separate item.

- [4] **Dimensional control:** The Supplier shall carry out measurements on the field to confirm the dimensions provided in the drawings according to item 25.2.1.1 of this specification.
- [5] **Half-Coupling:** The motors shall be supplied with the half-coupling installed that will be supplied by NEK according to item 6.2.6.1 of this specification.
- [6] **Painting:** The motors shall be painted according to item 13 of this specification.
- [7] **Quality Assurance:** Quality activities shall be established per the approved Production Quality Inspection & Test Plan during all stages of the project according to item 20 of this specification.
- [8] **Packing and Shipping:** The Supplier shall pack and ship the motors to NEK after the successful completion of the motors Factory Acceptance Testing (FAT) and shipping release. A packing list shall be provided before shipment. Shock/tilt recorders shall be utilized for the shipment.
- [9] **Project manager:** The Supplier shall assign a single point of contact (project manager) for this project to coordinate activities and communicate with the Purchaser. The name and contact information of the project manager shall be provided with the proposal.
- [10] **Progress report:** Progress reports, in a mutually agreed format and at a suitable frequency, shall be issued regularly.
- [11] **Spare part:** The Supplier shall provide one set of spare parts as required in paragraph 18. The minimum required parts are (if applicable):
 - a. Front bearing (1 pc)
 - b. Rear bearing (1 pc)
 - c. Oil ring (1 each)
 - d. Sight glass (1 each)
 - e. Labyrinth bearing seal (1 set each)
 - f. Bearing seal gasket (1 set each)
 - g. Space heaters (1 set)
 - h. Thermocouple for bearings(1 pc)
 - i. Vibration sensor; accelerometer and proximity transducer (1 each)
- [12] **Upgrades:** The Supplier shall preform upgrades to the original motor design:
 - a. Vibration monitoring according to item 6.5.2 of this specification.
 - b. Air filter on the air intake guards according to item 6.2.3 of this specification.

1.2 Activities Excluded from Supplier's Scope of Work

The following tasks are not part of the scope as per this Specification:

- [1] Receiving, unloading and storage of the motor at NEK.
- [2] Installation and connection (The proposal shall have an optional scope for this task).

1.3 Responsibility

The Supplier shall be responsible for:

- [1] Proper design, construction, performance, procurement of materials, fabrication, testing, cleaning, assembling, and shipment of the motor according to this Specification; this includes all items supplied by the Supplier's subcontractors or other divisions.
- [2] Preparation, approval, and submittal of the equivalency evaluation for the Purchaser's concurrence for the motor.

- [3] Rigid adherence to the design, arrangement, and dimensions of parts and assemblies as shown on the Purchaser-reviewed manufacturing drawings, unless deviations are specifically authorized in writing by the Purchaser.
- [4] The quality of all materials and workmanship; the suitability of all materials and apparatus for their application.
- [5] Compliance with all detailed requirements presented in this Specification.
- [6] Any damage to the motor while in the Supplier's custody or during shipment.

Any drawings, specifications, procedures and/or tests approved/acknowledged by the Purchaser shall in no way relieve the Supplier from the above responsibilities.

1.4 Deviation from Specification

Any deviation from the requirements in this Specification shall be approved in writing by the Purchaser prior to implementation.

1.5 Original documentation requirements

Due to limited available documentation for this motor, it is essential that the Supplier possesses the original motor documentation. Proof of possessing this documentation shall be submitted with the proposal.

If the Supplier offers a drop-in replacement and claims the motor can be constructed with the same performance characteristics as the original with the provided data and additional test on the motor in the plant, the proposal shall include the process for determining the critical characteristics.

If a duplicate is offer, the motor shall include all modification or upgrades that are required under this specification. The duplicates enclosure shall be evaluated and reinforced due to the mechanical properties of the existing enclosure.

2 DEFINITIONS

2.1 Definitions

OEM – In course of this specification this shall mean Westinghouse Electric Corporation which was the Original Equipment Manufacturer.

Purchaser – Person(s) appointed by Purchaser requesting the equipment to which this document is applicable.

Supplier – Company performing the work per this document.

Sub-contractor – A Company or person performing work in a specialized area for the Supplier.

Technical Contact – The person appointed by Purchaser to resolve any technical issues that arise during the time of services.

Project manager – The person appointed by Supplier to coordinate all activities and communicate with the Purchaser.

Equivalency Evaluation – A technical evaluation performed to confirm that an alternate replacement item (not identical to the original) will satisfactorily perform its designed function. The term is synonymous with "Equal-to-or-Better-Than" evaluation.

2.2 Abbreviations

AC	-	Alternating current
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWS	-	American Welding Society
BOM	-	Bill of Materials
COC	-	Certificate of Compliance
DBE	-	Design Basic Earthquake
DC	-	Direct Current
DE	-	Drive End
DWG	-	Drawing
EPRI	-	Electric Power Research Institute
FAT	-	Factory Acceptance Test
FME	-	Foreign Material Exclusion
FW	-	Feedwater
I&TP	-	Production Quality Inspections and Test Plan
IEEE	-	Institute of Electrical and Electronics Engineers
NCR	-	Nonconformance Report
NDE	-	Non-Destructive Examination
NEK	-	Nuclear Power Plant Krško
NEMA	-	National Electrical Manufacturers Association
NPT	-	National Pipe Thread
OEM	-	Original Equipment Manufacturer
P.O.	-	Purchase Order
PF	-	Power Factor
QA	-	Quality Assurance
RPM	-	Rotations Per Minute
RTD	-	Resistance temperature detector
S.O.	-	Shop Order
SRD	-	System Requirements Document
THD	-	Total Harmonics Distortion
TIR	-	Total Indicated Runout
TQR	-	Technical and Quality Requirement
VPI	-	Vacuum pressure impregnation

3 **CODES, STANDARDS AND REGULATORY REQUIREMENTS**

The Supplier shall control the quality of materials and services to meet the requirements of this Specification, applicable Codes and Standards, and TQRs when specified in procurement documentation.

All items delivered by the Supplier shall be designed, built, rated, tested, and shall perform in accordance with applicable ANSI, IEEE, NEMA, ASTM, ASME codes and/or standards; however, equivalent IEC codes and standards may be used instead.

The Supplier shall provide to the Purchaser a list of codes, standards, and specifications (identifying the effective issue by date) according to which the work will be performed.

3.1 Codes and Standards Applicable

The following standards or documents are referred to in this document:

3.1.1 NEMA (The National Electrical Manufacturers Association)

- [1] MG1-2016: "Motors and Generators"
- [2] MG2 10021-2023: "Safety Standard for Construction and Guide for Selection, Application, and Use of Electric Motors and Generators"
- [3] NEMA C50.41-2000 American National Standard for Polyphase Induction Motor for Power Generating Stations
- [4] MW 1000-2023: "Magnet Wire"

3.1.2 IEEE (Institute of Electrical and Electronics Engineers)

- [1] 43-2000: "Recommended Practice for Testing Insulation Resistance of Rotating Machinery"
- [2] 85-1973: "IEEE Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery"
- [3] 95-2002: "Insulation Testing of AC Electric Machinery with High Direct Voltage"
- [4] 112-2017: "Test Procedures for Polyphase Induction Motors and Generators"
- [5] 275-2008: "Thermal Evaluation of Insulation Systems for Alternating-Current Electric Machinery Employing Form-Wound Pre-Insulated Stator Coils for Machines Rated 6900 V and Below"
- [6] 286-2000: "IEEE Recommended Practice for Measurement of Power-Factor Tip-Up of Rotating Machinery Stator Coil Insulation"
- [7] 522-2023: "Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils for Alternating Current Rotating Electric Machines"
- [8] 620-2022: "Guide for the Presentation of Thermal Limit Curves for Squirrel-Cage Machines"
- [9] 1434-2000: "Trial Use Guide to the Measurement of Partial Discharges in Rotating Machinery"
- [10] IEEE Std 1776-2008, "Recommended Practice for Thermal Evaluation of Unsealed or Sealed Insulation Systems for AC Electric Machinery Employing Form-Wound Pre-Insulated Stator Coils for Machines Rated 15000 V and Below"

3.1.2.1 In case of any conflict between codes, or this Technical Specification and the codes, the more stringent requirements shall apply. Conflict shall be reported to NEK.

Supplier shall be responsible for compliance with all applicable codes, standards, and regulations. NEK will accept only material and equipment, that meets the criteria of this Technical Specification and the referenced codes and standards.

4 SUPPLEMENTAL DATA

4.1 General

Codes and standards listed on 3.1.

5 DOCUMENT SUBMITTAL

All document submitted to NEK shall be in form of electronic media. They must include Purchase Order Number, Equipment Tag Number and Supplier Shop Order Number. Electronic media shall be in format fully compatible with the standard software.

All drawings (including drawings, graphs, specifications, etc.) submitted shall be in the form of searchable electronic media. Four (4) hard copies with hard cover of the manuals as defined under paragraph 33 shall be delivered. All drawings shall be submitted in pdf format (original paper size). A 3-D model of the motor assembly and its parts shall be provided in a standard format that will be agreed upon.

All the manuals, reports, specifications and other document shall be submitted in English.

6 DESIGN REQUIREMENTS AND DESIGN INPUTS

6.1 General

6.1.1.1 These motors are intended as a replacement for the existing Feedwater Pump Motor. The FW motors are horizontal squirrel-cage induction motors with a Drip-Proof enclosure. They shall be designed and manufactured as electrical and mechanical duplicate or drop-in replacement within the margins described in this specification. Motor shall be suitable for use on a 50 Hz, high resistance grounded power system having a voltage of 6300 V, with the following basic characteristics (see Appendix A1):

6000 HP, 1486 rpm, 50 Hz, 6000 V, 3 phase, class F insulation, 80°C temperature raise at 1.0 service factor.

As a minimum, it shall meet the following from the original motor:

- all motor outline dimensions including anchor bolts size and pattern shall be the same,
- main leads and cable lug size shall be the same,
- all accessory wire size shall be the same,
- grounding pad and lifting lug relative orientation shall be the same,
- shaft, coupling, and key groove dimensions shall be the same,
- main and auxiliary connection box size and orientation shall match the existing one,
- the weight of the motor shall not exceed the weight of the existing one,
- overall envelope of the motor shall not exceed the existing one.

6.1.1.2 The motor efficiency shall not be less than that of the existing motors. However, the motor reliability shall be a priority over efficiency. The motor shall be designed to withstand a lifetime of 40 years with preventive maintenance.

6.1.1.3 Modifications and upgrades to the overall design or parts shall be presented to the Purchaser for consideration (if a duplicate motor is offered). Only modifications and upgrades approved by the Purchaser may be applied.

6.2 Mechanical details

The motors shall be mechanically fully interchangeable with the existing motor on the installed location without any need for alteration of the existing original equipment or installation location.

6.2.1 Enclosure

The motor enclosure shall be a Drip-Proof enclosure (IP23 or greater). For enclosure details, see DWG 8335D97 – General Assembly of Feedwater Pump Motor (see Appendix A2.1).

The motor assembly is consisted of the motor and the main terminal box. The motor shall be supplied without the main terminal box and shall be able to be connected to the existing one. Prior to the drawing submission the Supplier shall preform measurements of the assembly and define the leads accordingly.

The enclosure shall have adequate strength and rigidity to support the stator core and windings. It shall withstand, without distortion or damage, the stresses associated with motor starting, axial thrust, running power supply bus transfer, and sustained operation (2 years) at vibration levels defined in MG1 (or IEC equivalent). The supplier shall provide drawings showing layout, welding details, material types, and material thicknesses.

The enclosure design shall permit complete disassembly of all parts, accurate positioning and realignment of the parts when reassembled. The end-shield stator frame interfaces and bearing fit shall be machined to rabbet-type fits. The top enclosure, cover, and panels shall be separate and easily removable.

External frame dimensions (height, width, radius, etc.) shall not exceed the dimensions of installed equipment dimensions to avoid hatchway and installation interferences.

- 6.2.1.1 The motor frame structural assemblies shall be constructed of heavy welded steel. All the welds on the motor frame must be inspected and declared as acceptable, signed off and dated in writing by a Certified Welding Inspector. If end welds made during the assembly of the frame will be rendered inaccessible after the subsequent welding or another frame component, the Welding Inspector must inspect and sign off those welds as satisfactory before they are rendered inaccessible for adequate inspection. Bolted construction is not acceptable except for fastening the minimum number of structural elements required for motor disassembly. Designs in which the stator laminations form part of the enclosure or in which the stator laminations are otherwise directly exposed to external cooling are not acceptable.
- 6.2.1.2 The mounting footprint (fit type, bolting pattern, bolt size, etc.) shall match that of the installed equipment.
- 6.2.1.3 The Motor Loading characteristics shall not exceed those of the existing ones (see Appendix A2.2).
- 6.2.1.4 Motor shall be equipped with lifting and alignment lugs in accordance with MG1 and the general assembly drawings of the installed equipment. Lifting lugs shall be designed for lifting the parts of the motor with 200% capacity.

6.2.2 Main leads and auxiliary terminal boxes

- 6.2.2.1 Main leads and auxiliary terminal boxes shall be supplied at their original size and relative orientation. All terminal boxes shall be able to rotate in steps of 90° around its rotational axis. The existing connection entry points and cable sizes shall be respected in every manner.

6.2.3 Cooling

The motor shall be self-ventilated. Air inlet and outlet openings shall be protected with metal guard screens to prevent the entrance of foreign objects. The motor shall have air filters on the inlet guard screens that are safety interchangeable while the machine is operating.

6.2.4 Bearings

The motor bearings shall be sleeve bearings and oil-lubricated with forced lubrication as per paragraph 6.2.5. Sleeve bearings in the motor shall be horizontally split, with horizontally split bearing brackets that allow replacement without removing the lower half of the bearing bracket. The motor's bearings shall be supplied with oil rings and a reservoir to allow for safe shutdown and startup.

6.2.4.1 If suitable, the Supplier shall offer alternative bearing types if they exceed the performance and maintenance requirements.

6.2.4.2 The bearings shall be designed to operate continuously for a minimum of two years between inspections. Bearings shall be capable of bi-directional shaft rotation. At a minimum, reverse rotation shall be allowable with the shaft coupled to the driven equipment and running unloaded at rated speed.

The bearings' insulation shall be provided on one side to prevent the circulation of shaft currents.

6.2.4.3 Bearing temperatures shall be monitored using Type E thermocouples (TC), which shall be wired to the auxiliary terminal box.

6.2.5 Oil system

Each feedwater pump system (pump, gearbox, and motor) has an individual lube oil system, consist of an oil tank, two pumps, a heat exchanger, two filters in parallel, and various instruments.

The lube oil pressure is maintained between 12 and 18 psig (82.7 kPa to 124.1 kPa), and the temperature range between 53 and 68°C. The oil has a viscosity of 180 to 250 SSU at 37°C. Refer to DWG 453-D49875 – Motor Lube Oil Piping (see Appendix A2.3). The new motor shall be designed to ensure that the piping fits the existing conditions.

The bearing shall be designed to provide adequate lubrication to enable the motor to be shut down safely following the loss of the oil-circulating pumps.

6.2.6 Shaft and Coupling

The motor shall have a solid shaft designed with an ample margin to accommodate all stresses encountered in starting and running, including overspeed conditions, electrical fault conditions and considering any external loads imposed on the motor shaft.

6.2.6.1 The Supplier shall fit and install the half-coupling that is identical to the existing one. Coupling detail drawings are available from NEK. After installing the half-coupling, the Supplier shall perform face and outside diameter run-out checks. The coupling driving half will be shipped to the Supplier's shop from NEK at a mutually agreed time.

6.2.7 Direction of Rotation

The direction of rotation shall remain the same as that of the original motors have. Motor main terminal leads shall be labelled T1, T2, and T3, or shall have tags attached for identification.

6.2.8 Vibration and noise

Vibration shall not exceed the values specified by NEMA MG1 or IEC Standards for rigid mountings under no-load operation.

The motor shall be designed and manufactured to operate as quietly as possible in accordance with IEEE 85. The Supplier shall state the noise level at no-load conditions.

6.3 Electrical details

The motors shall have the same electrical characteristics as the original for clarity and readability and suitable for connection without any alteration to originally installed equipment or mounting location.

6.3.1 Voltage Ratings

The motors shall be rated for 3-phase, 6000V, 50 Hz, and be suitable to deliver its rated output on a balanced three-phase, 50 Hz, high-resistance grounded system with a voltage of 6300V.

6.3.2 Stator

The design of the stator winding shall be consistent with long-life requirements, considering the stress associated with across-the-line starting and automatic transfer capability as specified in Section 7.

6.3.2.1 The stator insulation system shall utilize to the latest technology and at least class F materials. The Supplier shall provide a thermal life curve for the insulation system. The insulation system's life shall be qualified in accordance with IEEE 275 or IEEE 429 or IEEE1776, as applicable to the type of the system used.

6.3.2.2 The insulation system shall be made using global vacuum pressure impregnation. If, after completion of the VPI process, the stator winding fails to pass either the AC high potential test, the stator must be completely stripped and rewound at the Supplier's expense. The rewound stator shall be subjected to the same tests as the original.

6.3.2.3 Supplier shall supply a minimum of three (3) sample stator coils from the same manufacturing lot as those used in the motor winding.

Following VPI, one of the extra stator coils shall be dissected and inspected by the Supplier for proper resin penetration and void content in the insulation system. The dissected sample shall be made available for inspection to the NEK representative. The remaining sample coils shall be destructive tested.

6.3.2.4 Motor leads shall be extra flexible copper brought out of the motor frame for connection inside the terminal box. Leads shall be rated for 130°C and 125% full load of the motor. Protective sleeving shall be installed around the leads at the frame penetration to prevent

chafing against the frame edges. The penetration shall be such that the leads with the terminal lugs pass through. Leads shall be of suitable length for cut out, as measured from main lead adapter end. Terminal lugs shall be compatible for connection to the existing terminal lugs on feed in cables. The terminal lugs shall not be crimped to the leads but shall be shipped separately.

- 6.3.2.5 The stator and rotor laminations shall be at least M19 grade to ensure low core losses and higher efficiency. The coating grade applied to the laminations shall be at least C5 grade. The used lamination material shall be confirmed by the purchaser in the design stage of the project.

6.3.3 Stator winding

Tapes used in coil construction shall be specifically designed for use with the VPI process and shall not be film-backed.

- 6.3.3.1 Six Pt-100 type duplex resistance temperature detectors embedded in the stator winding and positioned to measure the coil temperature at its hottest points along the slot. They shall be placed in slots between coils, two per phase. The RTDs shall be wired to the auxiliary terminal box.

6.3.4 Stator End Turns

The stator end turn bracing system shall be designed to withstand the stresses of repetitive starts and power supply switching transients described in this specification. The bracing system shall also withstand stresses at maximum allowable steady vibration without damage or loosening of the bracing elements. Additionally, the bracing system shall allow sufficient airflow to maintain end turn insulation temperature at or below the temperature of the winding insulation in the slot areas.

- 6.3.4.1 Photographs shall be taken of the finished wound stator winding prior to undergoing the VPI process to demonstrate that the tying and blocking schemes conform to the criteria specified in this document.

6.3.5 Service Factor

The motor shall have a service factor of 1.0.

6.3.6 Temperature Rise

The stator temperature rise, when operated at rated voltage, frequency, and 1.0 service factor load, in an ambient temperature of 40°C, shall not exceed 80°C when measured by resistance.

6.3.7 Rotor

The rotor shall have shaft extension as the existing one.

- 6.3.7.1 The rotor shall be balanced to the latest NEMA or IEC vibration standards. Balance weight locations shall be chosen to allow secure fixation without inducing high stresses. All balance weights shall be positively locked using a method that can be verified by visual inspection.

Balance weights shall not be attached to ventilating fan blades. The use of solder or similar deposits for balancing is not acceptable.

6.3.7.2 The shaft extension, diameter and keyway shall match those of the installed equipment. In no case shall cutting, drilling, or grinding be required to connect the motor with the driven equipment. The motor side half-coupling shall be installed on the shaft.

6.3.7.3 The magnetic center and end float shall be permanently scribed on the shaft without introducing localized residual stresses and referenced to a stationary point on the frame. The magnetic center shall be verified to be within 0.060" of the mechanical center when the motor is running.

6.3.7.4 All markings that require scribing shall be done in a manner and with tooling designed to leave minimal residual stresses on the shaft surface.

6.3.8 Locked Rotor Current

The locked rotor current shall not exceed that of the original motors.

6.4 Miscellaneous Requirements and Safety

The motor design shall ensure that inadvertent contact with the motor will not result in any injuries to personnel from electrical shock, rotating parts, heat, or other hazards. There shall be adequate lifting points provided for both motor and major component removal and re-installation.

The vendor shall identify any lifting restrictions, in advance. The lifting means shall remain secure during normal operating conditions and shall not affect the operation of the motor.

6.5 Accessories

6.5.1 Space Heaters

Space heaters shall be installed in such a way to allow easy replacement in case of a failure. Heaters will be connected to 400 VAC, 50 Hz.

The heaters must be sized to maintain the temperature of the motor a minimum of 5°C above the ambient temperature to prevent condensation of moisture in its interior.

6.5.2 Vibration Monitoring

The motor shall be equipped with sensors that allow vibration monitoring of the enclosure (accelerometer SPM) and the shaft (shaft displacement with Proximity transducers on at least one end). The details of mounting and the type of used sensor shall be discussed with NEK in the design stage of the project. The supplier shall recommend the mounting of the sensor on the proposed outline drawing with the proposal.

7 PERFORMANCE REQUIREMENTS

Motor performance characteristics shall remain the same as those of the original motors.

7.1 Starting requirements

The motor shall start, accelerate and run the driven equipment successfully with any variation in voltage or frequency permitted in this specification and applicable standards. The motor shall be designed for full voltage starting and shall be capable of accelerating the pump to rated speed with 80% of the motor nameplate voltage applied to the motor terminals.

The magnitude and duration of the starting current (starting characteristics) during acceleration and running of the load, at all possible supply voltages defined by the most restrictive of MG1 20.14 and this specification, shall be equal or below the existing motor. The margin between the two curves shall be equal to or greater than the existing motor.

As a minimum, the starting duty shall be as follows:

- Motor cold: 2 consecutive starts.
- Subsequent starts with motor running between starts is 20 minutes apart.
- Subsequent starts with motor standing idle between starts 45 minutes apart.

7.2 Loading and Torque Requirements

New motor performance curves shall remain identical, within a reasonable margin, to those of the original motor. A comparison between new and original curves shall be conducted as part of the equivalency evaluation (see also item 25.2.1.1 of this specification).

7.3 Operating reliability

The motor shall be designed for continuous operation and must also be suitable for long periods of inactivity.

7.3.1.1 The motor shall be constructed and braced as necessary to withstand end-winding stresses, transient torques, and all other stresses resulting from Fast and Slow Supply Voltage Transfer/Reclosures in accordance with ANSI C50.41 Section 14 (Motor residual V/Hz vs. System supply V/Hz difference up to 90 degrees and 1.33 p.u. voltage). The Supplier shall calculate the most severe mechanical and electrical response to a full load transfer throughout the supply voltage range with a transfer time of up to ten (10) cycles to verify that the design remains within the allowable limits specified in ANSI Section 14 (IEC 60034-1 and IEC 60034-18).

7.3.1.2 The motor shall operate successfully under the following conditions of voltage and frequency variation, though not necessarily in accordance with the standards established for operation at normal rating:

- [1] Where the variation of voltage does not exceed 10% above or below the rated value.
- [2] Where the variation of frequency does not exceed 5% above or below the rated value.
- [3] Where the combined variation of voltage and frequency does not exceed 10% (with the variation of frequency does not exceeding 5%) above or below the rated value.

- 7.3.1.3 The motor shall be capable of operating at rated load with a 1% voltage unbalance for 24 hours.
- 7.3.1.4 Motor power factor shall be no less than 0.85 at 100% and 80% load.
- 7.3.1.5 The use of external capacitors to improve the power factor shall not be allowed.
- 7.3.1.6 The harmonic output of the motor shall be less than 1% THD in voltage.
- 7.3.1.7 The motor shall be capable of withstanding overspeed for two minutes without mechanical or electrical damage in accordance with MG1-20.13.
- 7.3.1.8 The first critical speed of rotation of the motor rotor shall not be in the range of 80 to 125 percent or below 60 percent of the normal operating speed.

8 MATERIAL REQUIREMENTS

- 8.1.1.1 The Supplier shall be responsible for selecting all materials and defining their procurement specifications. The traceability of all purchased materials and material certificates is required.
- 8.1.1.2 Quality verification documents shall be submitted upon project completion, as requested in item 25.3 of this specification.
- 8.1.1.3 All hardware, including bolts, fasteners, caps, plugs, and washers shall be corrosion-resistant material or be plated or treated with corrosion-resisting material. All bolts shall be free of thread debris and lubricated prior to installation. Fasteners used on rotating elements or subject to loosening from vibration shall be positively locked to ensure they do not loosen during service.
- 8.1.1.4 The use of asbestos or products containing asbestos is strictly prohibited in all equipment and materials provided.

9 FABRICATION AND ASSEMBLY

Manufacturing of the motor shall not commence until the Purchaser has approved the Production Quality Inspection and Test Plan.

Materials, processes, and standard parts which are not specified herein, but which are necessary for the manufacturing of the motor, shall be new, of the highest quality and shall be in accordance with the best practice typical to the manufacture of large polyphase induction motors.

Workmanship shall adhere to the best practices to ensure satisfactory operation and service life as specified in this document.

10 INSPECTIONS AND TEST

10.1 General Requirements

The Supplier shall provide a Project schedule and a Production Quality Inspection & Test Plan. The Purchaser's representative(s) presence will be indicated in the latter as witness points.

The Supplier shall provide twenty (20) working days' advance notice for activities designed as "witness" points. Detailed test agenda, including acceptance criteria for each test, shall be attached. During construction and testing, the motor and all its components may be subject to inspection by the Purchaser's technical representative, who shall have access to the Supplier's premises at all reasonable times to the extent necessary to assess compliance with this specification and any related documents applicable to the purchase. Such inspection shall not relieve the Supplier of its obligations or responsibilities under the contract.

The Supplier shall, upon request, provide all design and manufacturing documentation to be reviewed by Purchaser's representative(s) during their visits. However, this documentation shall remain at the Supplier's facilities.

The Supplier shall submit records and reports for all tests and inspections required by this Specification and the Supplier's Quality Production Inspection & Test Plan. These records and reports shall be prepared promptly after each test or inspection and compiled into a package for review. A copy of all records shall be transmitted to the Purchaser prior to the shipment of the motor to the site.

Any discrepancy in performance or operating parameters from those of the original (currently operating) motors shall be investigated and explained in a suitable written report.

Manufacturing deviation reports shall be provided to the Purchaser's technical representative(s) for evaluation and disposition approval.

10.2 Subassembly testing

The Supplier or its manufacturing subcontractors shall follow their own production and testing procedures. However, the tests and checks listed below are the minimum requirements by the Purchaser.

10.2.1 Stator core tests and checklists

Once the stator core is assembled and before the stator winding is installed, the core shall be subjected to a rated flux test. This test shall be performed with an induced core flux density of approximately 105% of rated flux density. Coil voltage and ampere-turn requirements shall be according to IEEE Std. 432. The stator bore surface shall be monitored for hotspots using infrared test equipment for at least 60 minutes. The test data shall be recorded and submitted to Purchaser for review.

The acceptance criteria for such tests shall be as follows:

- [1] No core hotspots higher than 2°C above the coolest area of the core.
- [2] Maximum core loss of 2.0 watts/lb.

10.2.2 Stator coil testing

Stator coil surge testing, in accordance with IEEE 522, shall be performed on individual stator coils after final installation in the stator core, but before they are connected to other coils or to the winding leads, as specified in NEMA 20.35.7.b. Coils with unsatisfactory or questionable test results shall be excluded from the motor.

As requested in 6.3.2.3 the sample coils shall be provided and shall undergo a destructive test (AC Hi-pot) along other recommended tests. The coils shall be cut and inspected for any voids and inconsistencies.

If any one of these acceptance criteria are not met, Supplier shall contact Purchaser's Technical Representative with proposed corrective actions.

10.2.3 Winding testing

Tests after winding process is finished but prior to VPI treatment:

- [1] Phase resistance measurement.
- [2] Phase sequence verification.
- [3] Surge comparison test.
- [4] RTD operability check.

Final tests after stator completion:

- [1] Phase resistances measurement.
- [2] Stator winding Insulation Resistance and Polarization Index (All together and separate phases).
- [3] Reduced voltage stator winding current balance test.
- [4] Surge comparison test.
- [5] Dissipation Factor (tan delta) and capacitance measurement.
- [6] Partial discharge measurement.
- [7] RTD operability check.
- [8] AC high potential test with at least 70% of final AC hi-pot test voltage (e.g. $0,7 \times (2 \times U_N + 1000) \text{V} = 9 \text{kV}$).
- [9] Water immersion test (optional scope of work).

10.2.4 Rotor testing

Required rotor tests:

- [1] All brazed joints between rotor bars and shorting rings shall be ultrasonic tested.
- [2] Ring to rotor bar joints shall be 100% brazed and 100% NDE inspected. The joints must be located so that they are 100% accessible for future NDE inspections.
- [3] Rotor shall be placed in a lathe for Total Indicated Runout (TIR) measurement of the following: rotor body, shaft journals, seal areas, coupling fit and the coupling face runout.

10.3 Factory Acceptance Testing (FAT)

After completion the motor shall be tested according to the methods described in the latest revision of NEMA MG-1 and IEEE Std. 112.

The motor's parameters shall be determined in accordance with IEEE 112.

10.3.1.1 All stator and rotor test records from Section 10.2.1 shall be included in the FAT report or tests shall be repeated during this stage.

FAT shall include, but not be limited to the routine test:

- [1] Stator winding Insulation Resistance and Polarization Index.
- [2] Phase resistance measurement and percent imbalance.
- [3] Dissipation Factor (tan delta) and capacitance measurement.
- [4] Partial discharge measurement.
- [5] Auxiliary equipment testing:
 - Heater operability check.
 - RTD and TC operability check.
- [6] No load testing:
 - No load current, voltage and power input at rated voltage.
 - No load speed.
 - No load vibration.
 - No load noise.
- [7] Stator winding temperature.
- [8] Bearing temperature.
- [9] Shaft voltage.
- [10] Lock rotor current and torque.
- [11] Rotor thermal stability test.
- [12] Bearing insulation resistance test.
- [13] AC high potential test (e.g. $0,7 \times (2 \times U_N + 1000) \text{ V} = 9 \text{ kV}$) followed by a insulation resistance test of stator winding.

At least one of the two motors shall complete the following tests (the proposal shall include an optional scope for testing the second motor):

- [1] Motor load testing:
 - Speed torque characteristics.
 - Efficiency from 25 per cent to 125 per cent load.
 - Power factor from 25 per cent to 125 per cent load.
 - Rated load slip.
- [2] Motor load testing at $0.8 U_N$:
 - Speed torque characteristics.
- [3] Rated load stator temperature rises.
 - Stator winding.
 - Bearings.
- [4] Vibration testing - from horizontal, vertical and axial directions of the DE and ODE motor bearings – the data shall be continuously recorded during accelerations, running and coast down.

With all the measurements and test preformed, the individual losses of the motor shall be determined (ventilation, core, windings ...).

10.4 Acceptance

Acceptance of the completed motor will be based on the requested inspections, tests, records, and reports, which are necessary for the Purchaser (NEK) to determine that the equipment meets all specification requirements. All records and reports must be traceable to the Purchaser (NEK) purchase order, the Supplier's shop order, and the motor serial number.

After delivery, the Purchaser will conduct a receive inspection. Upon successful completion of this inspection, an acceptance handover protocol will be signed, confirming that the motor is suitable for installation.

If any deficiencies are discovered after the motor installation and initial operation within the warranty period, the Purchaser has the right to continue using the motor, provided it is in a serviceable condition, until a convenient time to make the necessary warranty claim corrections.

11 QUALIFICATION, PARTS CLASSIFICATION AND DOCUMENT TRACEABILITY

Not Applicable.

12 CLEANING

The FME program shall be adhered throughout the work. All surfaces must be clean and free from dirt, weld spatter, slag, rust, and other foreign matter. Before closing any part of the motor that will become inaccessible, a thorough visual inspection must be conducted and formally recorded (photographs shall be taken).

13 CORROSION PROTECTION / COATING

All metallic surfaces exposed to the air shall be treated to prevent corrosion. The Supplier shall provide final painting details (coating and execution) to the Purchaser before the commencing the painting process.

14 MARKING AND IDENTIFICATION

All markings and identification plates shall be of non-corrosive material and securely attached to the motor.

14.1.1.1 The nameplate information shall be according to NEMA MG1-20.25 or IEC 60034-1.

14.1.1.2 Additional markings and identifications required on separate plates attached to the motor at suitable locations:

- [1] Starting duty.
- [2] Total motor weight and individual weights of rotor and stator.
- [3] Center of gravity.

- [4] Heater rating and connection details.
- [5] Static and running oil levels separately for each oil pot.
- [6] Direction of shaft rotation when facing the end of motor opposite the driving end with the T1-T2-T3 leads arrangement.
- [7] Year of manufacture.

15 PACKAGING, HANDLING AND STORAGE

Packaging shall be performed in accordance with the requirements of ANSI N45.2.2 (or IEC equivalent). Shipping containers for the equipment shall indicate the identification numbers of the units contained.

The motor shall be boxed, crated or otherwise suitably protected to prevent damage due to inclement weather and shipping conditions during transport. Threaded opening shall be covered with steel caps or plugs. Flanged openings shall be provided with metal blind flanges equipped with synthetic rubber gasket.

The motor shall be shipped without oil. The rotor shall be secured to prevent axial and radial movement. Bearing surfaces shall be suitably protected against corrosion or contamination during shipping and storage.

Packaging or crating shall ensure the satisfactory transportation, handling, and arrival of the equipment at its destination in a condition that allows NEK to judge it as readily handled and placed immediately in its permanent position, ready for operation with a minimum of field labor.

ShockWatch and TipNTell indicators (or equivalent equipment) shall be installed on the equipment housing and each shipping crate in all three axes prior to shipment. Clear receiving inspection acceptance criteria shall be provided by the Supplier before shipment.

The Supplier shall inform NEK of any special storage requirements sufficiently in advance of shipping the motors to allow for necessary preparations.

16 NONCONFORMING MATERIALS

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

Nonconformance with specification requirements and applicable codes and standards invoked by this specification will not be accepted until approved by NEK.

Nonconformances that cannot be corrected to meet specification requirements through rework or replacement shall be reported to NEK and await approval. When such conditions exist, the Supplier shall initiate a Nonconformance Report (NCR) using the Supplier's standard nonconformance document. This report should identify the nonconformance and include the Supplier's proposed disposition. The Supplier 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 the NEK in an expeditious manner. The supplier shall provide technical justification for the recommended dispositions.
- [4] The requirements of the specification are binding, no departures are acceptable without the prior consent of the NEK.

The NCR shall provide the method by which the Supplier shall obtain a documented response and approval from NEK when nonconformance is identified. The use of NCR will pertain to the work at the Suppliers and/or Sub-Contractor's shops. Once the item is identified with an NCR that NCR shall remain assigned to that item permanently and NEK shall be advised of the originating NCR.

17 RECORDS

17.1 Record System

A record system shall be established and maintained by the Supplier to provide documentary evidence of the quality of items and activities affecting quality. Quality assurance records shall include results of reviews, inspections, tests, audits, monitoring of work performance, and material analysis. Records shall, at a minimum, identify the Supplier's name, order number, inspector and data recorder, type of inspection performed, procedures used, results, acceptability, and actions taken with deficiencies noted. Records of inspection shall also include the identity of drawings and procedures utilized, along with their revision levels.

All quality verification records and procedures shall be identifiable to the item or activity involved. These records shall be submitted to NEK as they are generated and shall also be included in the final documentation package delivery.

17.2 Fabrication Records

Additionally, in accordance with the manufacturing data requirements, the Supplier shall prepare and provide all fabrication records related to NEK equipment.

18 OTHER REQUIREMENTS

The Supplier shall compile a list of all spare parts needed for general refurbishment of the motor according to the new Instruction Book. This spare parts list shall be listed in the new Instruction Book. Additionally, one set of all essential spare parts (such as bearings, heaters, and side glass for oil checks) shall be supplied with the motor. Each item on the list shall be described with its part number (P/N), a detailed description, and the required quantity.

Any additional requirements and/or exceptions imposed beyond the specifications during the bidding, negotiating, and contracting process shall be identified as changes to this specification. These changes must be brought to NEK attention for resolution, concurrence, and/or approval.

19 RIGHT OF ACCESS

NEK or NEK representatives shall be allowed access to the working areas and engineering offices of the Supplier and their subcontractors during normal business hours. Access shall also be granted at any time when work or testing on NEK-ordered equipment is performed outside normal business hours, for the purpose of auditing.

- [1] The Supplier's accepted Quality Assurance Program
- [2] The Subcontractor's accepted Quality Assurance Program
- [3] Factory acceptance testing

Such audits will include the examination of documentary evidence of activities affecting quality and will be conducted a planned and periodic basis, during the course of the work.

20 QA PROGRAM REQUIREMENTS

The SELLER shall maintain Quality Assurance (QA) program which comply with ISO 9001 or comparable standard and confirms with relevant NEK QA requirements from Quality Specifications QS-610 Generic Quality Assurance Program Specification, revision 2. The relevant requirements are indicated in Attachment A of the Quality Specifications QS-610.

The Supplier's bid shall be accompanied by the QA Manual of the latest revision, if not previously submitted to NEK. The relevance and effectiveness of the Supplier's QA Program shall be reviewed and approved by NEK prior to the contract award. The same shall apply to any subsequent changes proposed by the Supplier during the implementation of the purchase order.

All work shall be carried out in compliance with the Supplier's QA Program and with the previously approved Production Quality Inspection & Test Plan. In accordance with this specification, the Supplier shall also assume responsibility to require any Subcontractors to comply with the quality requirements, technical and commercial requirements, and schedules, in accordance with this specification.

NEK reserves the right to verify the Supplier's control activities by using the following methods:

- [1] Documentation review (Report).
- [2] QC procedures review (audits).
- [3] QC activities witnessing (Witness), testing (Test), and obligatory presence (Hold)

A Certificate of Compliance (COC) shall be supplied to NEK by the Supplier to certify that the provided equipment and services meet the requirements of this Specification and the related purchase order.

Any deviation from the Specification or repair to the equipment, which has been accepted in writing by NEK, shall not relieve the Supplier of its responsibility for ensuring satisfactory equipment performance in accordance with this Specification.

21 SPECIAL HANDLING

The Supplier shall specify special handling requirements, if applicable, and provide NEK with appropriate procedures detailing these requirements. The Supplier shall also specify additional requirements necessary to maintain equipment warranties.

Adequate means for lifting and handling shall be provided for motor, its subassemblies and parts.

22 SHELF LIFE

All items supplied under this Specification shall be new (not used or refurbished).

The Supplier shall provide the in-storage maintenance instructions to ensure proper care of the motor while not in service. The Supplier shall provide storage requirements in accordance with ANSI or IEC standards.

23 10CFR21 REPORTING

Not Applicable.

24 COMMERCIAL GRADE ITEM DEDICATION

Not Applicable.

25 SUPPLIER DOCUMENTATION REQUIREMENTS

The Supplier shall furnish the documents to the NEK.

25.1 Information and Documents Required with the Proposal

Documents required with proposal:

- [1] Preliminary Project Schedule.
- [2] Description of offered motor.
- [3] Reference list that include all warranty claims and if they were resolved by supplier.
- [4] Supplier shall determine what parts and works will be performed by sub-contractor, if any, their name and references.
- [5] Motor data sheet.
- [6] Preliminary outline drawing, as defined under paragraph 25.2.1.
- [7] Preliminary Calculated performance curves, as defined under paragraph 25.2.1.1.
- [8] Offered spare parts lists, together with part numbers and quantities.
- [9] The proposed coating of the motor.
- [10] Supplier Quality Assurance Program.
- [11] Preliminary Production Quality Inspection and Test Plan, as defined under paragraph 25.2.3.
- [12] Price of each section (fabrication of motor, Spare parts divided by item, optional scopes).
- [13] Motor Compliance Matrix (see Appendix A3).

- [14] Any deviations or exceptions to this Specification listed shall be listed on the Equipment Specification Compliance Matrix (see Appendix A4). Supplier shall send all exceptions to this specification together with the Proposal for NEK review, comment and acceptance. After that, further deviations regarding equipment or documentation shall not be accepted by NEK.

The proposal shall include descriptions of:

- [1] The stator coil insulation system.
- [2] The method of wedging and bracing of the stator coils.
- [3] The location of the winding temperature sensors.
- [4] The rotor bar retaining method in the slots.
- [5] The bearings, method of lubrication, recommended lubricant and the reasons for choosing the proposed bearing.

25.2 Documents requirements after signing the contract

Documents required for review and/or approval shall be submitted two (2) months after the order is placed:

- [1] Production and delivery schedule.
- [2] Production Quality Inspection and Test Plan, as defined under paragraph 25.2.3.
- [3] Motor data sheet see, as defined under paragraph 25.2.1.
- [4] Outline drawing see, as defined under paragraph 25.2.1.
- [5] Performance curves, as defined under paragraph 25.2.2.
- [6] General assembly drawing w/ itemized BOM.
- [7] Front bearings cross section drawing w/ itemized BOM.
- [8] Rear bearing cross section drawing w/ itemized BOM.
- [9] Shaft profile drawing.
- [10] Motor Loading Diagram.
- [11] Stator Factory Testing Procedure(s).
- [12] Test Procedure for Factory Acceptance Testing.
- [13] Spare parts lists, together with model numbers and quantities

During design, manufacturing, and assembly the following documentation shall be submitted to NEK:

- [1] Fulfilled Production Quality Inspection and Test Plan.
- [2] All procedures and documents NEK shall review and approve. Those procedures shall be available for review to NEK at least 30 working days prior beginning of the activity that the procedure is related to.
- [3] Draft version of the Installation and Operation manual.

Detailed field installation instructions 6 weeks before the FAT including the following as a minimum:

- [1] Installation, Operation and Maintenance Instructions as defined under paragraph 33.
- [2] Copies of all test reports performed by the Supplier and required under paragraph 10. and Quality Assurance documents.
- [3] Copies of any applicable nonconformance reports and disposition.
- [4] Long Term In-Storage Maintenance Procedure (as part of Motor Instruction Book).

25.2.1 Drawings

The Supplier shall submit complete data for the equipment offered. This shall include, but not necessary be limited to the following:

- [1] Motor general descriptive data and shop order number.
- [2] General dimensions and clearances including interfaces' details.
- [3] Weights of assembled motor as well as stator and rotor individually.
- [4] Motor ventilation scheme.
- [5] Center of gravity of assembled motor.
- [6] Schematic diagram, terminal markings and electrical data of space heaters.
- [7] Motor base & shaft extension details.
- [8] Endplay.
- [9] Number of stator and rotor bars.
- [10] Direction of rotation.
- [11] All bearings' types and sizes, all bearings clearances as well as approximate oil quantities in both oil pots.
- [12] Motor main leads cables size and material.
- [13] Drawing of the shaft, spider and lamination construction. Details of the rotor bar retaining method within the rotor body and at connection rings shall be included.
- [14] Winding diagram showing all parallel circuits and connections points.
- [15] Stator bar fabrication dimensions, including coil cross-section dimensions (strand turn, package, ground wall, etc.) and bulk dimensions (slot length, bend radii, etc.).

The drawings and data in the proposal shall be preliminary. After the order is placed the drawings shall be completed submitted for comments and approval.

25.2.1.1 Prior to the drawing submittal the supplier shall carry out measurements of the existing motor (baseplate, coupling, external connections and motor enclosure). The Supplier shall not depend on the provided existing outline drawings in case of deviations.

25.2.2 Calculated performance curves and motor data

A comparison between new (calculated and measured, when available) and original motor performance curves and data shall be performed by the Supplier. Any differences shall be brought to the Purchaser's attention.

Calculated performance curves and data:

- [1] Stator winding Resistance.
- [2] Subtransient Reactance (X_d'').
- [3] Time Constants – Open-circuit AC (T_{do}'').
- [4] Short-circuit AC (T_d'').
- [5] Short-circuit DC (T_a).
- [6] X/R ratio.
- [7] Starting Power Factor (PF).
- [8] Locked Rotor Current.
- [9] Main Stator Core Loss.
- [10] Load $W K^2$.
- [11] Load vs. Efficiency.
- [12] Power Factor vs. Load.
- [13] Current vs. Speed (80% & 100% UN).
- [14] Torque vs. Speed (80% & 100% UN).
- [15] Efficiency vs. Horsepower.

- [16] Speed vs. Horsepower.
- [17] Input KW vs. Horsepower.
- [18] Starting Current and Power Factor vs. Voltage.
- [19] Current vs. Time (80% & 100% UN).

All plotted data shall also be delivered in table form (spreadsheet).
In addition, the following data shall be provided after the FAT described in 10.3.

- [1] Inertia of rotor (uncoupled).

25.2.3 Production Quality Inspection and Test Plan

Production Quality Inspection and Test shall include:

- [1] Collectively indicate sequences and dates for material requisition and testing, fabrication, testing, and shipment, with R (record), W (Witness) and H (Hold) points, which will be commented, fulfilled and approved by NEK. The submitted timeline shall be in weeks from date of receipt of purchase order.
- [2] A copy of the production test program and acceptance criteria along with a listing of the standard to which they conform, which shall be commented and approved by NEK.
- [3] Types of tests, material, manufacturing procedure or sequence, or construction listed in this Specification, which are not the Supplier's standards.

25.3 Documents requirements after the completion of the project

The documents shall be submitted before the shipping of the motor to the Purchaser. The documents must be approved by the Purchaser prior to the shipping:

- [1] All documents and or records required in this specification shall be sent to Purchaser before the motor shipment from the Suppliers facility.
- [2] All additional documents and/or records not specified herein but required in the Purchase order and agreed upon in the Contract shall be submitted before the motor shipment from the Suppliers facility.
- [3] All test reports of the subassembly testing as described in 10.2 and test report of the Factory Acceptance Testing as described in 10.3.

The quality verification documents shall include but shall not be limited to the following:

- [1] Quality Release & Transmittal Letter.
- [2] Certificate of Compliance.
- [3] Certificates of Origin.
- [4] Reports per Production Quality Inspection and Test Plan.
- [5] Chemical and Mechanical Test Reports.
- [6] Material Test Reports.
- [7] Certificate of Equivalency Evaluation Report for Motor.
- [8] Documentation and Final Release Checklist.

26 NEK PROPRIETARY DATA

NEK has a proprietary interest in all drawings, designs, specifications, documents, information, or know-how furnished pursuant to contract execution and in any know-how improvement, discovery, or invention made, developed, or conceived in the performance of work hereunder or which may arise or result therefrom (hereinafter collectively referred to

as the "Information"). All such Information shall be considered proprietary to NEK. The right to use all such Information shall be granted to the Supplier only for its personal use and shall be entirely restricted to the performance of the contract and subject to the confidentiality provisions.

27 NON-CONFORMANCE REPORTS

The Supplier shall submit all nonconformance reports for approval, specifically regarding repair or use-as-is dispositions of material during the manufacturing process, only in cases that affect interchangeability, design, or operating parameters generated during the manufacture or processing of this order. These reports shall include technical justification for the nonconformance dispositions. Any dispositions that do not return an item to the conditions specified in an approved drawing or specification must be approved by NEK prior to the shipment of the affected item.

28 REPAIR RECORDS

Together with the documentation package shipment, the Supplier shall provide NEK with all generated records of repairs, which shall include at a minimum the following information:

- [1] A Summary of repair/refurbishment work that has been performed on the equipment.
- [2] A Brief analysis of the reason for the equipment's failure.
- [3] A Details of any "special processes" used during repairs that were not used in manufacture.
- [4] A list of replacement parts installed in the repaired equipment.

29 SOURCE INSPECTION / SURVEILLANCE NOTIFICATION

The Supplier shall contact NEK or NEK's designated representative at least 20 working days in advance when a witness or hold point will be reached. The Supplier shall not proceed past that point until inspection has been conducted or waived by NEK.

Inspections or examinations performed by NEK representatives or designated representatives do not relieve the Supplier of its responsibility to meet the requirements of this specification and purchase order.

30 SHIPPING REQUIREMENTS

The Supplier shall provide packaging and shipping methods to protect against the effects of temperature extremes, humidity, transit shocks, and jarring during transport and storage.

Shock and tilt recorders shall be used during shipment.

The motor shall be shipped in accordance with ANSI N45.2.2, Level B. The EPRI document 1009698 "*Shipping and Storage of Electric Motors*" shall be used as a guideline to ensure proper handling.

Materials and all certifications or accompanying documentation supplied under this order shall be shipped directly from the Supplier to NEK. The Distributor shall not take possession of any material or documentation.

The NEK authorized source inspectors have the right to hold the shipment if purchase order requirements are not met.

31 DELIVERY SCHEDULE

The equipment shall be delivered to NEK in accordance with this specification and TQR's.

32 WITNESS/HOLDPOINTS FOR SUBMITTAL OF SUPPLIER DOCUMENTATION

NEK shall have the right to establish hold points and notification points, for which the Supplier shall give prior notification. NEK will identify inspection, witness, or hold points in which it intends to participate, based on the submitted Production Manufacturing and Quality Plan. This plan shall be submitted to NEK according to the mutually agreed schedule, as defined in paragraph 25.

33 VENDOR TECHNICAL MANUAL AND REGISTERED UPDATES

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

The Supplier shall furnish technical manuals with all necessary information for operation and maintenance, including updated specific data and drawings for all equipment. The manual shall include all drawings and a Bill of Materials that lists all electrical and mechanical items installed in the motor, their catalog numbers, type or style designation, manufacturer name, electrical rating, and replacement schedule. The Bill of Materials shall be in the form of a spreadsheet.

34 TRAINING

The proposal shall include an optional scope for training NEK personnel.

35 APPENDICES

- [1] Specification and Data, Rev. 0
- [2] Motor drawings, Rev. 0.
- [3] Compliance Motor Matrix to NEK Technical Specification No. TS34-VNMG06, Rev.0
- [4] Compliance Matrix to NEK Technical Specification No. TS34-VNMG06, Rev.0



NEK

Krško Nuclear Power Plant
Vrbina 12
8270 Krško



Feedwater Pump Motor Replacements

Specification and Data

KRŠKO NUCLEAR POWER PLANT

APPENDIX A1

Revision 0

AUGUMENTED QUALITY

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A1. MOTOR SPECIFICATION AND DATA

A1.1. Technical Data

There are the three Westinghouse FW motors utilized at Nuclear Power Plant Krško:

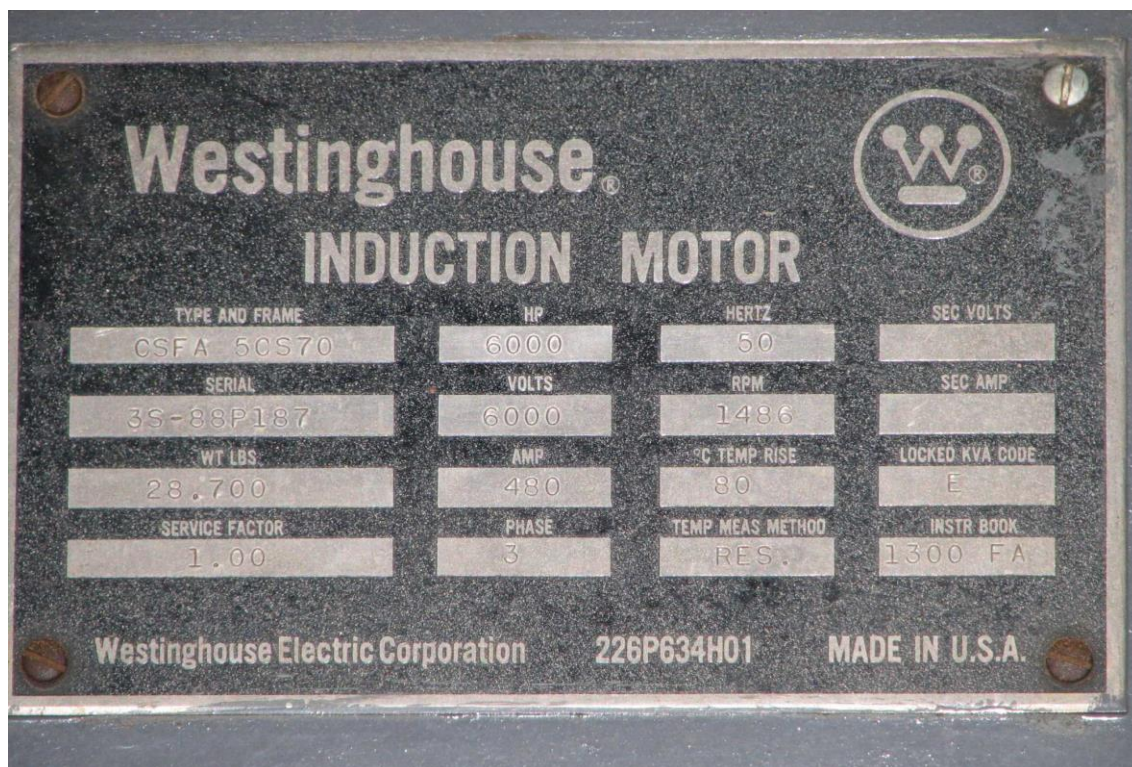
- [1] FW105PMP001-MTR
- [2] FW105PMP002-MTR
- [3] FW105PMP003-MTR

All motors are manufactured by Westinghouse and delivered under:

- [1] P.O. 13-KRA-176-NC
- [2] S.O. 88P187

The following general technical data applies to all existing motors

Model	CS F/A
Frame No.	5CS70
Type	Squirrel Cage
Mounting	Horizontal
Enclosure	Drip Proof
Phases	3
Frequency [Hz]	50
Nominal Power [HP]	6000
Voltage [V]	6000
Service Factor	1
Full Load Rotation [RPM]	1486
Full Load Current [A]	480
Stator Insulation Class	B (New need upgrade to F)
Stator Temperature Rise [°C]	80
Space Heater	2.778 kW / 400 V
Bering Size (Front)	6''x 6'' Split Sleeve (insulated)
Bering Size (Rear)	7''x 6'' Split Sleeve
Total Weight of Motor [lb]	28733

A1.2. Nameplates and pictures

A1.2.1. Motor without the enclosure

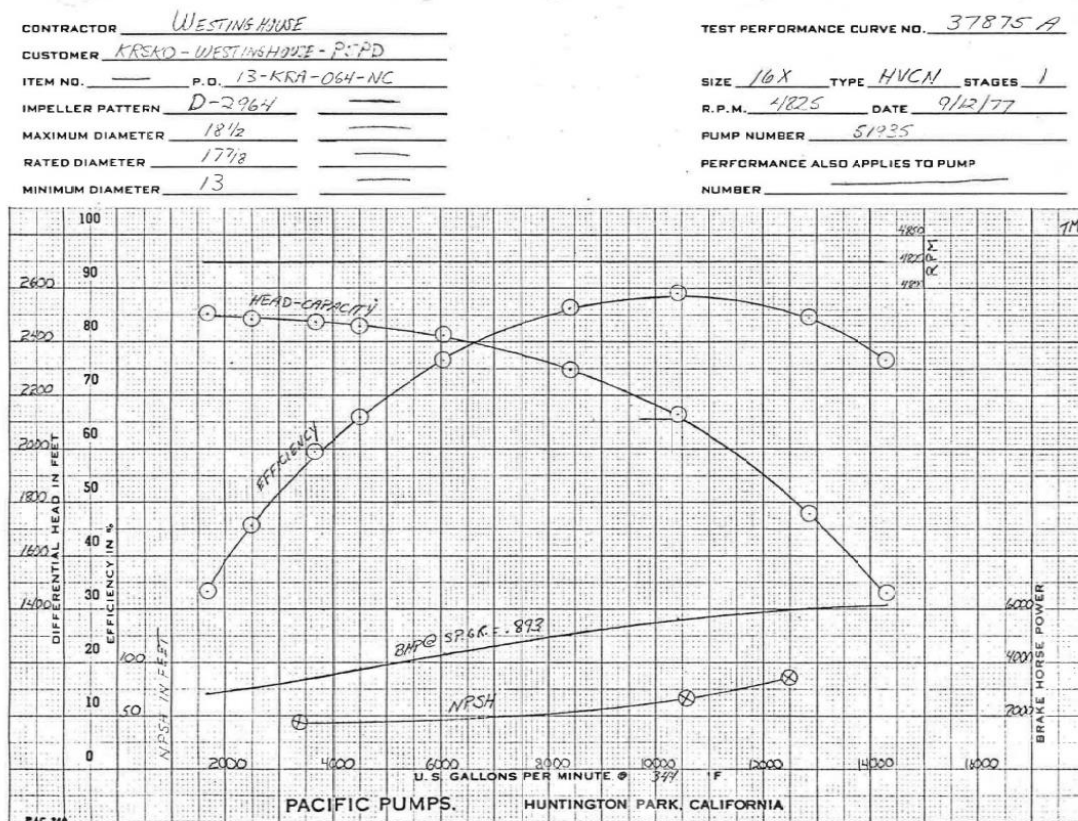


A1.2.2. Motor with the main power lead terminal box



A1.2.3. Motor with the lube oil system



A1.3. Pump characteristics

The design conditions of the pump are according to table:

Parameter name	Value	
Capacity	4,600,000 lbs/hr	2,086.5 t/h
Suction temperature	344°F	173.3°C
Normal	375 psig	26.36 kp/cm ²
Minimum	280 psig	17.57 kp/cm ²
Maximum	450 psih	31.63 kp/cm ²
Discharge pressure	1190 psig	83.66 kp/cm ²
Speed (motor)	1500 rpm	1500 o/min
Suction side design	500 psig	35.5 kp/cm ²

The actual operating capacity of the pump is 4,087,230 pounds per hour (1,854 metric tons per hour) at 340.7°F (171.5 °C). The pump operates at 4825 rpm.

The pump is designed to have a head capacity characteristic which rises steadily from the rated capacity to shutoff.



TECHNICAL SPECIFICATION

Feedwater Pump Motor Replacements

Motor drawings

KRŠKO NUCLEAR POWER PLANT

APPENDIX A2

Revision 0

AUGUMENTED QUALITY

TABLE OF CONTENT

A2.1 DWG 8335D97 – General Assembly (Feedwater Pump Motor)1

A2.2 Loading Diagram.....2

A2.3 DWG 452-D49875 – Motor Lube-Oil Piping3

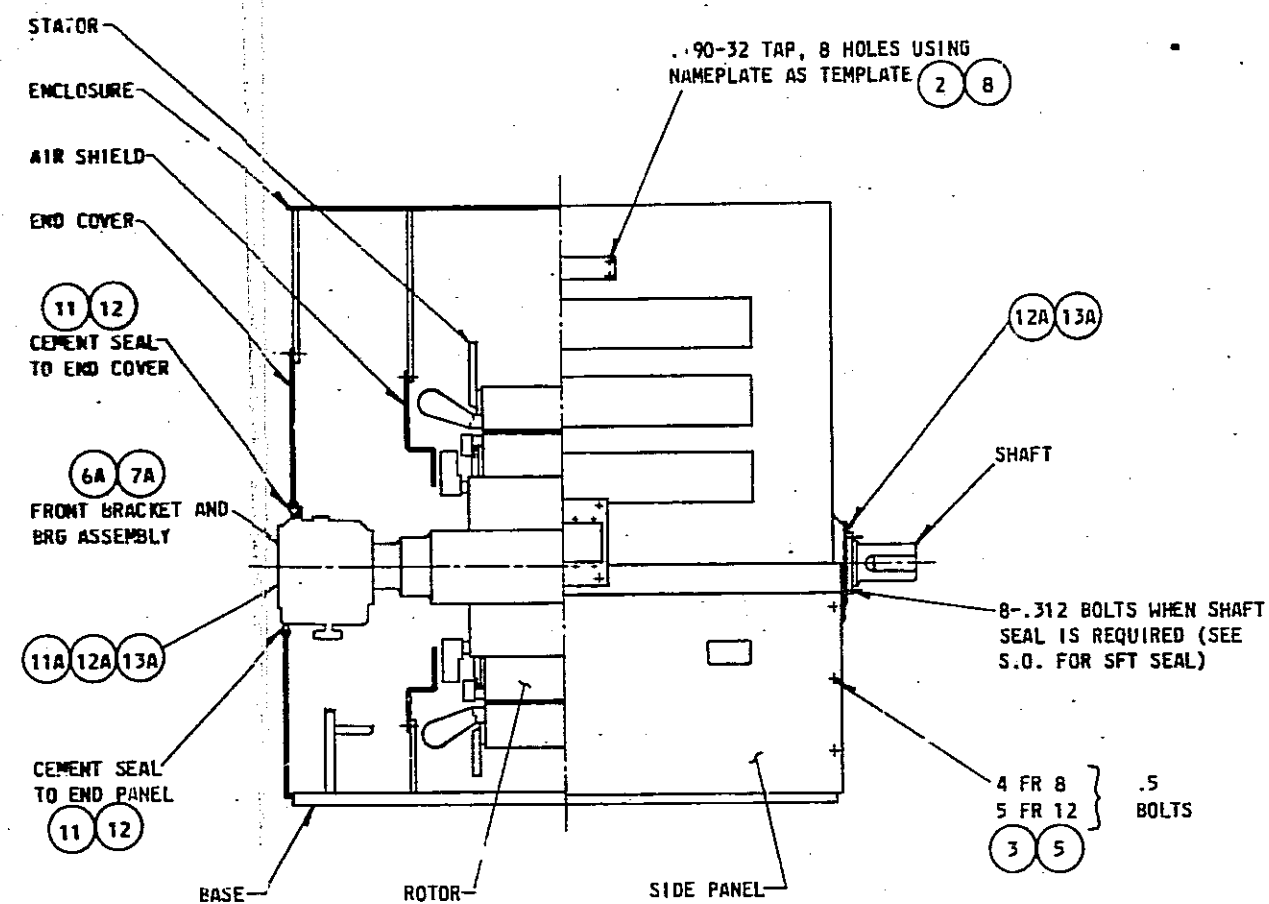
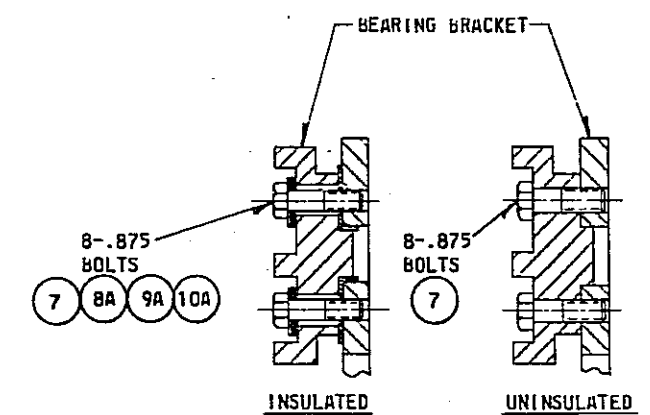
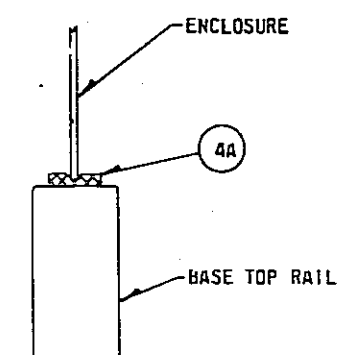


FIGURE 1
(D.P.-S.P. AND W.P. I MOTORS)



SECTION "A-A"



VIEW "X"

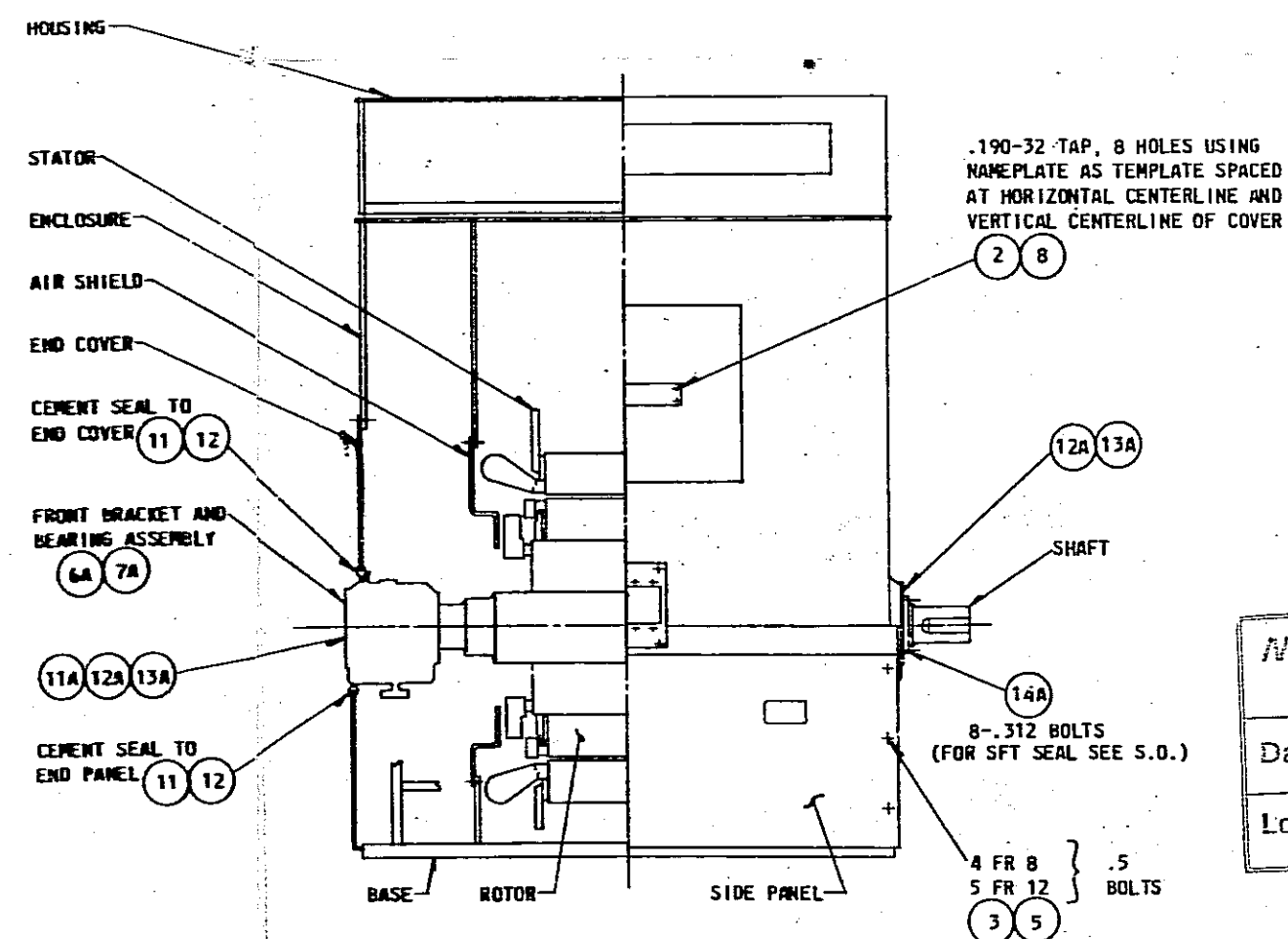
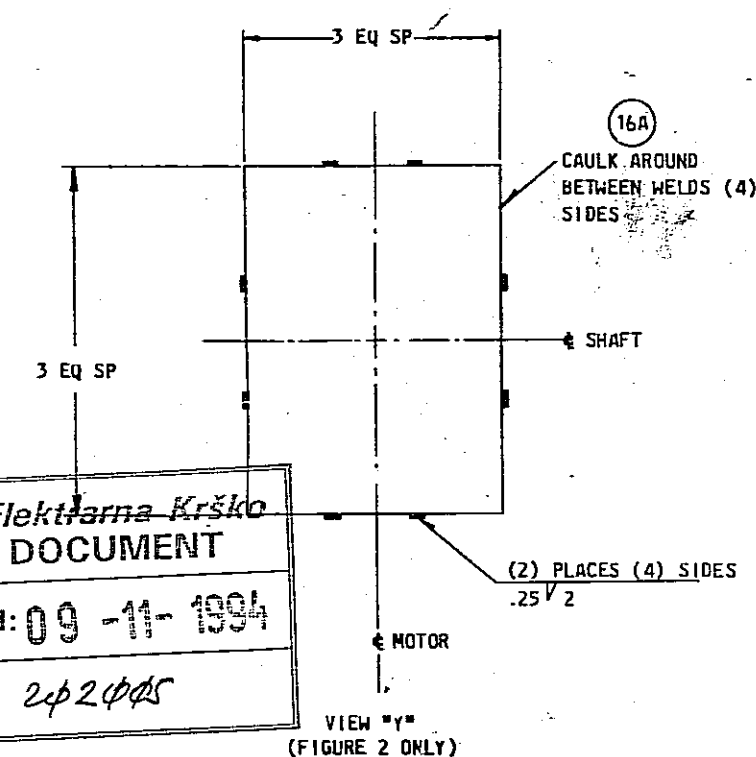


FIGURE 2
(L.P. II MOTOR)



S.O. 88P 187

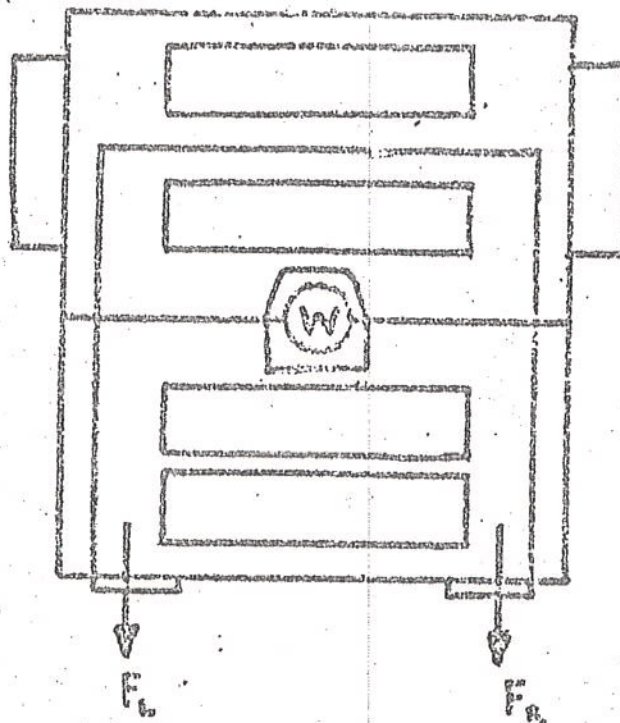
AUTHORIZED CHANGES ONLY

Nuklearna Električna Krško MASTER DOCUMENT	
Date Received:	09 - 11 - 1994
Log Number:	2p2p25

88P187

01CFC

LOADING
DINAMICA



W

34687-21-033-0

ASSUME CW ROTATION.

AT STANDSTILL,

Torque = 0 :

$F_L = 14,367 \text{ LB}$

$F_R = 14,367 \text{ LB}$

AT NORMAL TORQUE : $F_L = 17,899 \text{ LB}$

$F_R = 10,834 \text{ LB}$

NUKLEARNA ELEKTRANA KRŠKO			
- v ustanavljanju -			
6442 DOKUMENTACIJA			
DO	PREJETO	FILE	KOPHA
28369	10-08-1979	FW106	MTR

GILBERT
ASSOC., INC. W.O. NO

SEP 30 '76 4687

AT SHORT CIRCUIT TORQUE : $F_L = 37,189 \text{ LB}$

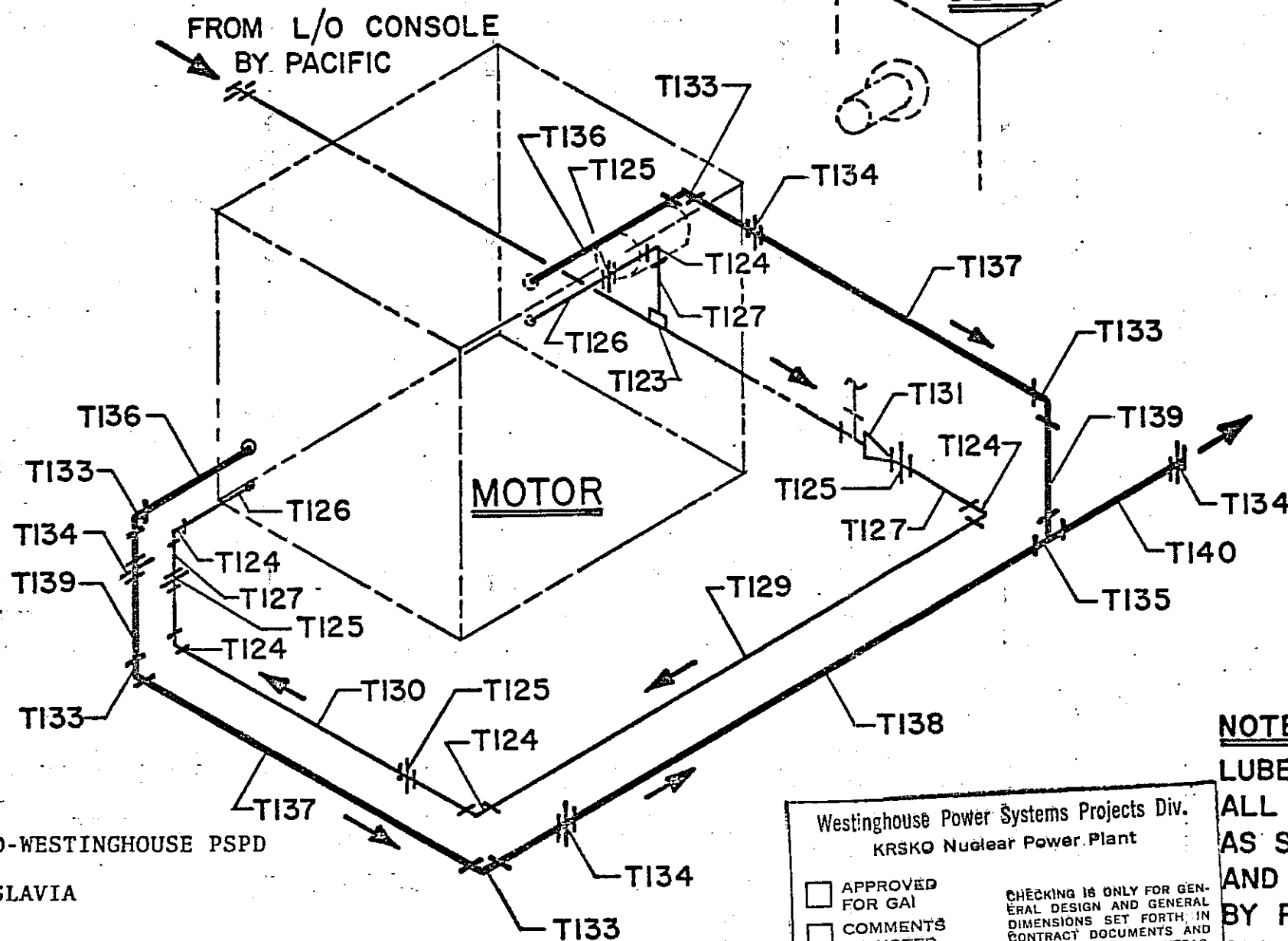
$F_R = -8456 \text{ LB}$

6000HP. $\approx 1500 \text{ RPM}$

IMO: FW106 MTR

Richard M. M... 8-23-76

144



MATERIAL LIST

TI23 - 1/2" S.W. WELDOLET
 TI24 - 1/2" S.W. ELBOW
 TI25 - 1/2" S.W. UNION
 TI26 - 1/2" NPT T.O.E. PIPE
 TI27 - 1/2" PIPE
 TI28 - 1/2" PIPE
 TI29 - 1/2" PIPE
 TI30 - 1/2" PIPE
 TI31 - 2" X 1/2" S.W. SWAGE NIPPLE
 TI33 - 1-1/2" S.W. ELBOW - 90°
 TI34 - 1-1/2" S.W. UNION
 TI35 - 1-1/2" S.W. TEE
 TI36 - 1-1/2" PIPE
 TI37 - 1-1/2" PIPE
 TI38 - 1-1/2" PIPE
 TI39 - 1-1/2" PIPE
 TI40 - 1-1/2" PIPE

NOTE:

LUBE OIL PIPING TO AND FROM MOTOR:
 ALL PIPE AND FITTINGS FURNISHED BY PACIFIC
 AS SHOWN. ALL PIPE LENGTHS ARE RANDOM CUT
 AND SHALL BE FITTED AND WELDED TOGETHER
 BY PURCHASER.
 ALL FITTINGS ARE 3000# CARBON STEEL.
 ALL PIPE - SCHEDULE 80 CARBON STEEL.

CUSTOMER: KRSKO-WESTINGHOUSE PSPD

LOCATION: YUGOSLAVIA

CONTRACTOR:

P.O. NO: 13-KRA-064-NC

ITEM NO:

SERVICE: STEAM GENERATOR FEED

OUR ORDER: 5D49-875

PUMP S/N: 51935/936/937

SIZE/TYPE: 16X HVCN STGS.

KRSKO NUCLEAR POWER PLANT	
System/Spin/INO	FW105 PM2001-003
Status of Dwg	CEC
Transmittal	P-1601-2209
W Authority & Date	11/11/77

Westinghouse Power Systems Projects Div. KRSKO Nuclear Power Plant	
<input type="checkbox"/> APPROVED FOR GAI <input type="checkbox"/> COMMENTS AS NOTED <input type="checkbox"/> RETURNED FOR CORRECTION <input checked="" type="checkbox"/> INFORMATION & REFERENCE ONLY	CHECKING IS ONLY FOR GENERAL DESIGN AND GENERAL DIMENSIONS SET FORTH IN CONTRACT DOCUMENTS AND DOES NOT RELIEVE CONTRACTOR FROM HIS OBLIGATION AS TO DETAIL, WORKMANSHIP AND GUARANTEES.
GILBERT ASSOCIATES, INC.	
BY: J. H. Healy	DATE: NOV 17 1977
W.R. REF: GA/DPK 7412-428	
INO: FW105 PM2001-003 FILE 80:34	
CTRL. NO: 1866 LSC G311/3-5	

PACIFIC PUMPS DIVISION DRESSER INDUSTRIES, INC.			
TITLE: MOTOR L/O PIPING			
DWN EMDC	CKD EV	CERTIFIED	DATE
PRODUCT ENGINEERING DWG NO. 453 - D49875			REV. 0

REV	DATE	MD	CK	REV	DATE	MD	CK	REV	DATE	MD	CK	REV	DATE	MD	CK
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4687-21-097-1