

NEK

Krško Nuclear Power Plant
Vrbina 12
8270 Krško



TECHNICAL SPECIFICATION

Spare Component Cooling Pump Motor

KRŠKO NUCLEAR POWER PLANT

TS34-VNMG10

Revision 1

NUCLEAR SAFETY RELATED

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RECORD OF REVISION

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0	First Issue	N/A
1	Added requirement for Documental Submittal.	6
	Added clarification/requirement for motor weight.	6
	Motor lead temperature rating requirement reduced to 90°C (previously 130°C).	10
	Notice for witness points from requirement reduced from 20 to 15 working days.	14, 28, 29
	Stator flux test allowing core hotspot up to 10°C instead of 2°C above coolest area.	14
	Seismic requirements added and clarified.	18, 19
	Commercial Grade Dedication Section rewritten and clarified.	23
	Added clarification for omitting measurements if a duplicate motor is offered.	26

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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 one horizontal, safety related, environmentally qualified induction motors. The motor will be utilized as a spare for the Component Cooling Pump at the Nuclear Power Plant KRŠKO. The original motors were supplied by Westinghouse.

This specification shall be used in conjunction with any other Purchaser documents listed in the purchase order. 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, safety and environmentally classification, 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 A5).

The Supplier shall deliver the complete and operable motor assemble for existing Component Cooling Pump including, but not limited to, the following:

- [1] **Design and Fabrication:** The Supplier shall design, fabricate, assemble, test, and deliver one (1) set of the Component Cooling Pump Motor, that is a fit, form, and function equivalent replacement for any of two existing Westinghouse motors (P.O. 13-KRA-139-CC, S.O. #76F66283) on any of the three operating locations (CC102PMP01A-MTR or CC102PMP02B-MTR or CC102PMP03C-MTR).
- [2] **Critical Characteristics:** All electrical and mechanical critical characteristics of the motor shall remain identical to the original, as specified in item 6 of this specification within NEMA standards and engineering tolerances.
- [3] **Interfaces and Outline:** All electrical and mechanical interfaces shall remain as shown on the original drawings. The motor shall be suitable for installation at any existing location without modification of adjacent equipment or the motor 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 motor shall be supplied with the half-coupling installed that will be supplied by the purchaser prior to the installation.
- [6] **Painting:** The motor 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 motor to NEK after the successful completion of the motor 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] **Clarifications:** The project manager shall take part in clarifications before signing the contract.
- [11] **Progress report:** Progress reports, in a mutually agreed format and at a suitable frequency, shall be issued regularly.
- [12] **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. Space heaters (1 set)
 - e. Sight glass (1 each)
 - f. Thermocouple (1each)

Upgrades to the original motor design:

- [1] Stator coil shall have temperature monitoring. Duplex Pt-100 resistance temperature detectors shall be used.

1.2 Activities Excluded from Supplier's Scope of Work

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

- [1] Receiving, unloading and storage of motor in NEK.
- [2] Installation and connection.

1.3 Responsibility

The Supplier shall be responsible for:

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

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.

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
CFR	-	Code of Federal Regulations
COC	-	Certificate of Compliance
CC	-	Component Cooling
DBE	-	Design Basic Earthquake
DC	-	Direct Current
DE	-	Drive End
DWG	-	Drawing
EPRI	-	Electric Power Research Institute
EQ	-	Environmental Qualification
EV	-	Activation Energy

FAT	-	Factory Acceptance Test
FME	-	Foreign Material Exclusion
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
OBE	-	Operating Basic Earthquake
ODE	-	Opposite Drive End
OEM	-	Original Equipment Manufacturer
P.O.	-	Purchase Order
PAOT	-	Post-Accident Operation Time
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.

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] 323-1974 (or newer 2003): "IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"
- [8] 334-2006: "IEEE Standard for Qualifying Continuous Duty Class 1E Motors for Nuclear Power Generating Stations"
- [9] 344-2004: "IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"
- [10] 522-2023: "IEEE Guide for Testing Turn-to-Turn Insulation on Form-Wound Stator Coils for Alternating Current Rotating Electric Machines"
- [11] 620-2022: "Guide for the Presentation of Thermal Limit Curves for Squirrel-Cage Machines"
- [12] 1776-2008, "IEEE 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"
- [13] 1434-2000: "IEEE Trial Use Guide to the Measurement of Partial Discharges in Rotating Machinery"

3.1.3 CFR (Code of Federal Regulation)

- [1] 10CFR Part 21, "Reporting of Defects and Noncompliance"
- [2] 10CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"
- [3] Regulatory Guide 1.100, "Seismic Qualification of Electric Equipment for Nuclear Power Plants", Rev. 3, September 2009.
- [4] Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants", October 1973
- [5] Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants", November 1974
- [6] Regulatory Guide 1.29, "Seismic Design Classification", Rev. 4, March 2007

3.1.3.1 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, which 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 submitted documents shall be searchable.

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 shall be provided in a standard format that will be agreed upon.

All the manuals, reports, specifications, records and other document shall be submitted in English. If records are in another language, summary report with all measured values, observations and conclusions must be provided in English language.

6 DESIGN REQUIREMENTS AND DESIGN INPUTS

6.1 General

6.1.1.1 This motor is intended as a spare for the existing Component Cooling pump. The CC motor is a horizontal squirrel-cage induction motor with a Drip-Proof enclosure. It shall be designed and manufactured as electrical and mechanical duplicate or drop in replacement within margins described in this specification. The motor shall be suitable for use on a 50 Hz, high resistance grounded power system with a voltage of 6300 V, with the following basic characteristics (see Appendix A1):

500 HP, 1486 rpm, 50 Hz, 6000 V, 3 phase, class F insulation or higher, 1,15 service factor.

As a minimum, it shall meet the following from the original motor's outline drawing:

- all motor outline dimensions including anchor bolts size and pattern,
- main leads and cable lug size,
- all accessory wire size,
- grounding pad and lifting lug relative orientation,
- shaft, coupling, and key groove dimensions,
- main and auxiliary connection box size and orientation,
- overall envelope of the motor shall not exceed the existing one.
- the dimensions of the motor without the auxiliary boxes shall not exceed the existing one. All boxes shall be detachable for installation purposes,
- The weight of the motor shall be within a 10% tolerance of that of 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 (in case 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 motors on installed locations without any need for alteration of the existing original equipment or installation location.

6.2.1 Enclosure

The motor enclosure shall be Drip-Proof enclosure. For enclosure details see reference DWG 9504D18 – Outline (Component Cooling Pump Motor) (see Appendix A2).

The enclosure shall be designed according to the AISC handbook standards as a minimum and provide adequate strength and rigidity to support the stator punching 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 at vibration levels specified in MG1. The supplier shall provide drawings showing layout, welding details, material types, and material thicknesses.

The enclosure design shall allow for the complete disassembly of all parts and ensure accurate positioning and realignment upon reassembly. 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 cast iron or heavy welded steel in accordance with AWS D1.1 and AISC handbook.

In the case of a heavy welded steel construction all the welds on the motor frame must be inspected and declared as acceptable per AWS D1.1 and 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 At least three access at each end shall be provided for measuring the air gap between the stator and the rotor.
- 6.2.1.4 Motor shall be equipped with lifting and alignment lugs in accordance with MG1 and the outline drawing of the installed equipment. Lifting lugs shall be designed for lifting the assembled 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.

6.2.2.2 Main leads terminal box shall be designed in a manner, that during operation, inspection with infra-red camera of the leads is possible.

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.

6.2.4 Bearings

The motor bearings shall be sleeve bearing that are oil lubricated. The 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 The bearings shall be designed to operate continuously for a minimum of two years between inspections and oil changes. 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.

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

6.2.5 Bearing oil reservoir

Shaft and bearing housing shall be constructed with suitable deflectors and seals to prevent oil migration either out of the motor or into the winding. Bearing reservoirs shall have oil sight glasses with oil-level marked for standstill and running conditions. Oil fill and drain plugs shall be provided to drain the sump at the lowest point in the reservoir, including the settling chambers. The oil reservoir shall contain a settling chamber to capture foreign material.

6.2.6 Dimensions and Threads

- [1] Dimensions and data on all drawings incorporating an interface with the Purchaser (e.g., outline, etc.) shall be shown in imperial units.
- [2] Dimensions on drawings of component parts submitted for approval, should be in inches, though soft conversions from metric units are required.
- [3] All fastening materials shall be provided in inch-based dimensions, as per the Unified Thread Standard (UTS).

6.2.7 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.

6.2.7.1 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.

6.2.8 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.

6.2.9 Vibration and noise

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

Factory vibration levels shall be obtained with the motor rigidly mounted to the floor, i.e., resilient mountings are not allowed.

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 motor shall have the same electrical characteristics as the original and be suitable for connection without any alteration to originally installed equipment or mounting location.

6.3.1 Voltage Ratings

The motor 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 class F or better. 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 IEEE 1776, 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 The supplier shall supply a minimum of three (3) sample stator coils from the same manufacturing lot as those used in the motor winding. The coils shall undergo identical VPI treatment as the coils used in the 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 90°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 designed so that the leads with the terminal lugs pass through. Leads shall be of suitable length for cutting, as measured from the main lead adapter end. Terminal lugs shall be compatible with the existing terminal lugs on the feeding 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 located to measure the coil temperature at its hottest points along the slot. They shall be placed in slots between coils, two per phase. The RTD's 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 1.15.

While the motor is not designed to operate normally in the service factor range, such operation must be available without reducing the capability of the motor to perform its design function.

6.3.6 Temperature Rise

The stator temperature rise, when operated at rated voltage, frequency, and 1.15 service factor load, in an ambient temperature of 50°C, shall not exceed 80°C when measured by resistance.

6.3.7 Rotor

The rotor shall have shaft extension as shown in DWG 9504D18 – Outline (Component Cooling Pump Motor).

- 6.3.7.1 The rotor shall be balanced to the latest NEMA 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 at minimum of 5°C above the ambient temperature to prevent condensation of moisture in its interior.

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 NEMA MG1-20.14 and this specification. 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.

Motor starting duty shall in no case be more restrictive than of original motors. As a minimum, the starting duty shall be as follows:

- Motor cold: 2 consecutive starts
- Motor at operating temperature: 1 consecutive start
- Subsequent starts with motor running between starts is 15 minutes apart
- Subsequent starts with motor standing between starts 45 minutes apart

The magnitude and duration of the starting current (starting characteristics) during acceleration and running of the load, at all possible supply voltages defined by MG1 20.14 and this specification, shall be equal or below the characteristic curve of the existing motor.

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 25.2.2 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.

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 3% voltage unbalance for 24 hours.

- 7.3.1.4 Motor power factor shall be no less than 0.85 at 80% and 100% load.
- 7.3.1.5 The use of external capacitors to improve the power factor shall not be allowed.
- 7.3.1.6 The motor shall be capable of withstanding overspeed for two minutes without mechanical or electrical damage in accordance with MG1-20.13.
- 7.3.1.7 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 to 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

The Supplier shall maintain a quality control and inspection program that has been reviewed and accepted by Purchaser. This program shall include the requirements from a Production Quality Inspection & Test Plan, which covers all component inspections, tests, manufacturing procedures, and hold points for the motor contract.

Manufacturing of the motor shall not commence until the Purchaser has approved the Inspection and Test Plan (I&TP).

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 fifteen (15) 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 10°C above the coolest area of the core.
- [2] Maximum core loss of 3.0 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 (no rework on unsatisfactory coils is allowed).

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), power factor tip-up 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. The Supplier shall determine the method used for the determination of the Efficiency in the proposal.

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:

- [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] Bearings and heaters insulation resistance test.
- [6] Air gap measurement.
- [7] Auxiliary equipment testing:
 - All heaters operability check.
 - RTD and TC operability check.
- [8] No load testing:
 - No load current, voltage and power input at rated voltage.
 - No load speed.
 - No load vibrations.
 - No load noise.
- [9] Shaft voltage.
- [10] Locked rotor current and torque.
- [11] 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.
 - Acceleration curve at rated pump load.
- [12] Motor load testing at 0.8 UN:
 - Speed torque characteristics.
 - Acceleration curve at rated pump load.
- [13] 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.
- [14] Rated load stator temperature rises:
 - Stator winding.
 - Bearings.
- [15] AC high potential test with at least 70% of final AC hi-pot test voltage (e.g. $0,7 \times (2 \times UN + 1000)V = 9kV$).

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

11.1 Safety Classification

Safety classification of motor, motor parts and services in the scope of this Specification is classified as Nuclear Safety Related – Class 1E. The motor shall be provided under a 10 CFR 50, Appendix B, Quality program that has been approved by NEK.

11.2 Environmental Qualification

Supplier shall certify that the supplied motor is Environmentally Qualified in compliance with IEEE Standard 323-1974 (or newer version IEEE 323-2003) and in compliance with IEEE Standard 334-2006 considering following EQ conditions:

Normal operating environment (ambient):

- Temperature: 50°C
- Pressure: 101.3 kPa
- RH: 60 %
- 40-year gamma dose: 8.64E+00 Gy (8.64 Gy)

Design Basis Accident conditions: Not Applicable (normal operating conditions applies) – MILD conditions.

Required Post Accident Operating Time (PAOT): Not Applicable.

Other motor service (operating) conditions are specified in previous sections 6 and 7.

IEEE 323-1974, IEEE 323-2003 and IEEE 334-2006 margins shall be applied to specified EQ conditions.

Required motor performance requirements shall be confirmed by Environmental Qualification.

Seismic qualification requirements are defined and discussed in continuation, in Section 11.3.

Supplier shall provide the qualification documentation in accordance with IEEE 334-2006, Section 7.

The Supplier must describe in the offer how the motor will be qualified - is the motor pre-qualified or will he have to perform new qualification tests, etc. With this purpose, the Qualification Concept shall be provided in the offer.

In case that equipment has not yet been qualified to EQ conditions defined here (not pre-qualified motor), the Supplier shall prepare detailed Qualification Procedure (in accordance with IEEE 334-2006) and send it to NEK for review and approval. Qualification may be proceeded after NEK approval of Qualification Procedure.

Qualification Report shall be prepared in accordance with IEEE 334-2006, Section 7.2 (Mild environment documentation).

If there is any difference (material, design/construction or performance parameters) between the pre-qualified motor and subject supplied motor, the differences should not degrade original equipment qualification level in any viewpoint to accomplishing its safety function during qualified life. Accordingly, supporting similarity analysis with references shall be provided and delivered to confirm acceptability of difference.

Supplier shall state whether the item requires any periodic maintenance or replacement of parts in order to maintain qualification during motor installed life.

Installation details (orientation, sealing, electrical and process connection etc.) required to maintain qualified configuration shall be specified and supplied with qualification records.

11.3 Seismic Qualification

The motor shall be seismically qualified in accordance with NEK's seismic qualification program ED-18, Rev. 3, NEK specification SP-S702, Rev. 11, and IEEE Standard 344, 2004. Seismic loads shall represent an envelope of a.) and b.) below:

- a. Applicable floor response spectra, figures A37, A38, A39 and A40 as specified (reference Floor Response Spectra - Floor Response Spectra – see Appendix A3), Auxiliary Building, el. 100.300. Equipment damping of 2% and 3% shall be considered for OBE and SSE, respectively.
- b. OBE accelerations of $\pm 1.5g$ acting horizontally and $\pm 1.0g$ acceleration in vertical direction, occurring simultaneously, and SSE accelerations of $\pm 3.0g$ acting horizontally and $\pm 2.0g$ acceleration in vertical direction, occurring simultaneously (original motor input).

The scope of seismic qualification is: qualification for functionality, integrity and anchorage of the motor on the existing pedestal. Related to mass of the motor, note that no modification is allowed to the original/existing anchorage system. The weight of the motor shall be within 10% of the mass of the existing motor (as per requirements in section 6.1.1.1 of this specification) in order to not affect existing motor anchoring.

It is recommended that a combined analysis and testing method is used for seismic qualification of the motor as per recommendations of standards (IEEE 344). Test are recommended to be used for determining resonant frequencies of the motor, governing sub-components of the motor (drive shaft, housing, any appurtenances vital to operation of the motor, etc.). Resonant frequencies represent input to latter analytical qualification. If the analysis option alone is chosen, the analysis must contain the method of frequency calculation as well as results of the calculation. In addition, qualification by analytical approach alone is acceptable in the case if: the methodology for resonance frequency calculation is calibrated based on past resonance test of similar components, OR if it can be shown that the bias in analytical natural frequency estimates does not considerably affect the seismic forces/qualification (e.g., if natural frequencies are above 35 Hz). In any case, it should be shown that, in the past, analytical approach alone has already been successfully implemented for other nuclear sites.

The design of the equipment shall be such that there is no loss of function during and after the prescribed seismic disturbance as defined herein. No loss of function implies that rotating equipment will not seize, pressure vessels will not rupture, support will not collapse, systems required to respond actively will response actively. For OBE (Operating Basic Earthquake) the function shall be performed without permanent deformation. For DBE (Design Basis Earthquake) permanent deformation is tolerable (localized permanent deformation) if it does not impair the equipment's function.

The motor assembly and all individual part of the motor shall be defined to operate satisfactorily during earthquake forces resulting from acceleration in the horizontal and vertical direction. The entire assembly must be designed to receive and transmit these forces through the supports to the foundation. The supports, when design weight of the equipment is included, shall be designed to have a natural frequency in excess of 35 csp.

The stresses from the normal operation conditions, when combined with the OBE stresses resulting from a $\pm 1.5g$ acceleration acting horizontally and a $\pm 1.0g$ acceleration acting vertically and occurring simultaneously, shall be maintained with the allowable material working stresses limits accepted as food practice as set forth in Section III of the ASME Boiler and Pressure Vessel Code.

In addition to the above, stresses from the normal operating conditions when combined with the DBE stresses resulting from $\pm 3.0g$ acceleration acting horizontally and a $\pm 2.0g$ acceleration acting vertically and occurring simultaneously, shall be limited to prevent loss of function of the equipment. For the purpose of calculation, the no-loss-of-function stresses shall be limited to the yield strength of the material or as otherwise specified by Section III of the ASME Boiler and Pressure Vessel Code.

12 CLEANING

The FME program shall be adhered to 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.

13 CORROSION PROTECTION / COATING

Supplier shall provide the painting procedure for Purchaser review and concurrence.

14 MARKING AND IDENTIFICATION

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

14.1.1.1 The nameplate information shall be according to NEMA MG1-20.25.

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 45.2.2. 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 with 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 sent 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 attached to 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 the attention of the NEK 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 Supplier shall have a Quality Program that complies with 10CFR50 Appendix B and which shall assure that all materials, manufacturing practices, examinations and testing conform to the requirements of this specification and the Code. The Supplier shall submit its Quality Assurance Program for the NEK review and acceptance with the proposal and prior to commencement of any work on the design and manufacture of the component. The Supplier shall provide a Project Quality Manual with the proposal for NEK review and acceptance.

The accepted Production Quality Inspection and Test Plan shall become a part of the contract.

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 standards.

23 10CFR21 REPORTING

The deliverables per this specification or related order are subjected to the provisions of the Title 10 of the U.S. Code of Federal Regulations Part 21: Reporting of Defect and Noncompliance. All of the reporting pursuant to 10CFR21 shall be made to NEK Procurement Support (ING.PDO) Superintendent at the same time when reporting to the authority (US NRC) is done. For safety related equipment supplied outside of USA, the Vendor shall be subject to reporting pursuant to 10CFR21 to the NEK ING.PDO Superintendent, only.

24 COMMERCIAL GRADE ITEM DEDICATION

The Commercial grade dedication (CGD) shall be in accordance with the nuclear industry standard and documented as acceptable to the NRC requirements. The Vendor shall give notice in writing to the NEK if dedicated commercial grade items are to be used.

Commercial grade dedication practice shall be described in the QA program manual. CGD plans shall be submitted to the NEK for review, completion and approval prior to the issue of the purchase order and prior to the start of the CGD.

Dedication test records shall be supplied with items or shall be supplied as part of the final documentation package.

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 25.2.2.
- [8] Offered spare parts lists, together with part numbers and quantities.
- [9] Supplier Quality Assurance Program.
- [10] The proposed painting coating of the motor.
- [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 and optional scope).
- [13] Motor Compliance Matrix (see Appendix A4).
- [14] Any deviations or exceptions to this Specification listed shall be listed on the Equipment Specification Compliance Matrix (see Appendix A5). 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.
- [15] Qualification Concept (per Section 11.2 and 11.3).

The proposal shall include detailed description 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 following order placement

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

- [1] Project 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
- [14] Qualification Procedure as defined under paragraphs 11.2 and 11.3.

During design, manufacturing, dedication, qualification, 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.
- [4] Qualification Reports per Sections 11.2 and 11.3.

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, groundwall, 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 submission of the drawings, the Supplier shall carry out measurements of the existing motor, including the baseplate, coupling, external connections, and motor enclosure. The Supplier shall not depend on the provided existing outline drawings in case of deviations. If a duplicate motor is offered and the supplier possesses the original drawings and guarantees that they fully correspond to the as-built state, physical measurements may be omitted.

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).

All calculated values shall be measured (determined by tests) on the motor after completion and compared to the calculated values. The comparison shall be presented to NEK for review.

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

Project Production Quality Inspection and Test shall include:

- [1] Collectively indicate sequences and dates for material requisition and testing, fabrication, testing, qualification and shipment, with R (record), W (Witness) and H (Hold) points, which will be commented, fulfilled and approved by NEK. The submitted time line 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] Method for equipment qualification per section 11.2 and 11.3.
- [4] 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 fifteen (15) 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 45.2.2, 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 in accordance with this specification and the contract.

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.

In addition, NEK may establish hold points and temporary notification points if necessary to ensure resolution of quality problems or temporary quality problems. Predetermined hold or notification points require receipt of notification at least fifteen (15) working days in advance of the scheduled time of performance.

The following hold points for which prior notification is required are mandatory:

- [1] Equipment performance test.
- [2] Equipment qualification tests.
- [3] Factory Acceptance tests.
- [4] Shipping release.

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.
- [2] DWG 9504D18 – Outline (Component Cooling Pump Motor)
- [3] Floor Response Spectra of Auxiliary Building, el. 100.300
- [4] Compliance Motor Matrix to NEK Technical Specification No. TS34-VNMG10, Rev.1
- [5] Compliance Matrix to NEK Technical Specification No. TS34-VNMG10, Rev.1



NEK

Krško Nuclear Power Plant
Vrbina 12
8270 Krško



TECHNICAL SPECIFICATION

Spare Component Cooling Pump Motor Specification and Data

KRŠKO NUCLEAR POWER PLANT

APPENDIX A1

Revision 1

NUCLEAR SAFETY RELATED

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A1. MOTOR SPECIFICATION AND DATA

A1.1. Technical Data

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

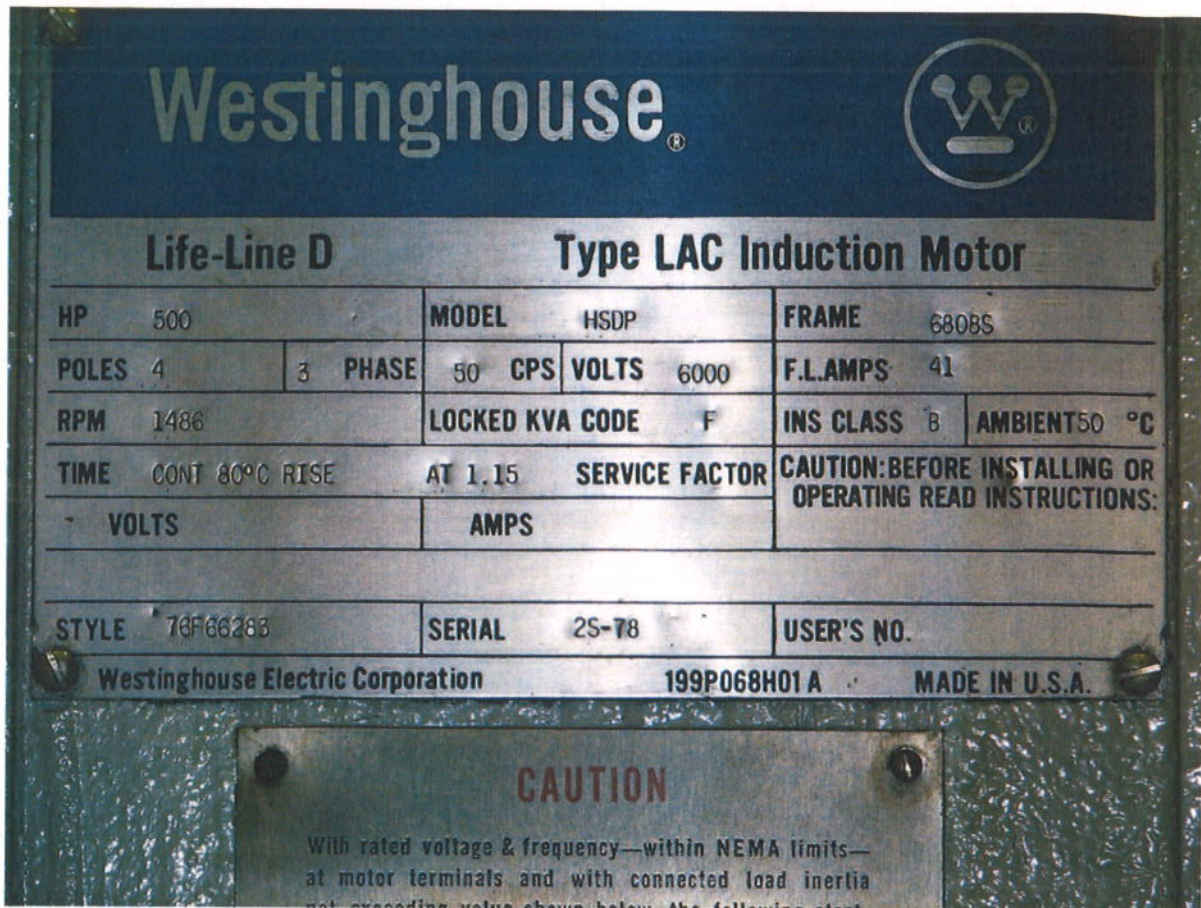
- [1] CC102PMP01A-MTR (S/N 1S-78)
- [2] CC102PMP02B-MTR (S/N 2S-78)
- [3] CC102PMP03C-MTR (S/N 3S-78)

All motors are manufactured by Westinghouse and delivered under:

- [1] P.O.13-KRA-139-CC
- [2] S.O.76F66283

The following general technical data applies to all existing motors

Model	Life Line D Motor
Frame No.	6808-S
Type	Squirrel Cage
Mounting	Horizontal
Enclosure	Drip Proof
Phases	3
Frequency [Hz]	50
Nominal Power [HP]	500
Voltage [V]	6000
Service Factor	1.15
Full Load Rotation [RPM]	1486
Full Load Current [A]	41
Stator Insulation Class	B (New need upgrade to F)
Stator Temperature Rise [°C]	80
Space Heater	0.224 kW / 400 V
Bearing Style	4.5" Split Sleeve
Load Inertia [lb·ft ²]	99
Total Weight of Motor [lbs]	6000

A1.2. Nameplates

A1.3. Technical Data Reference Documents

A1.3.1. Motor Data Sheet

LACI-2 - Westinghouse Motor Identification

G.O. FENA-60064-L7 I.B. S.O. 78F34137Customer ELECTRIC UTILITIES OF CROATIA AND SLOVENMotor S.O. 76F66283Application COMPONENT COOLING PUMP MOTORA.C. Motor SQUIRREL CAGE

Data:

Frame 6808-S Type LLD NEMA Design B

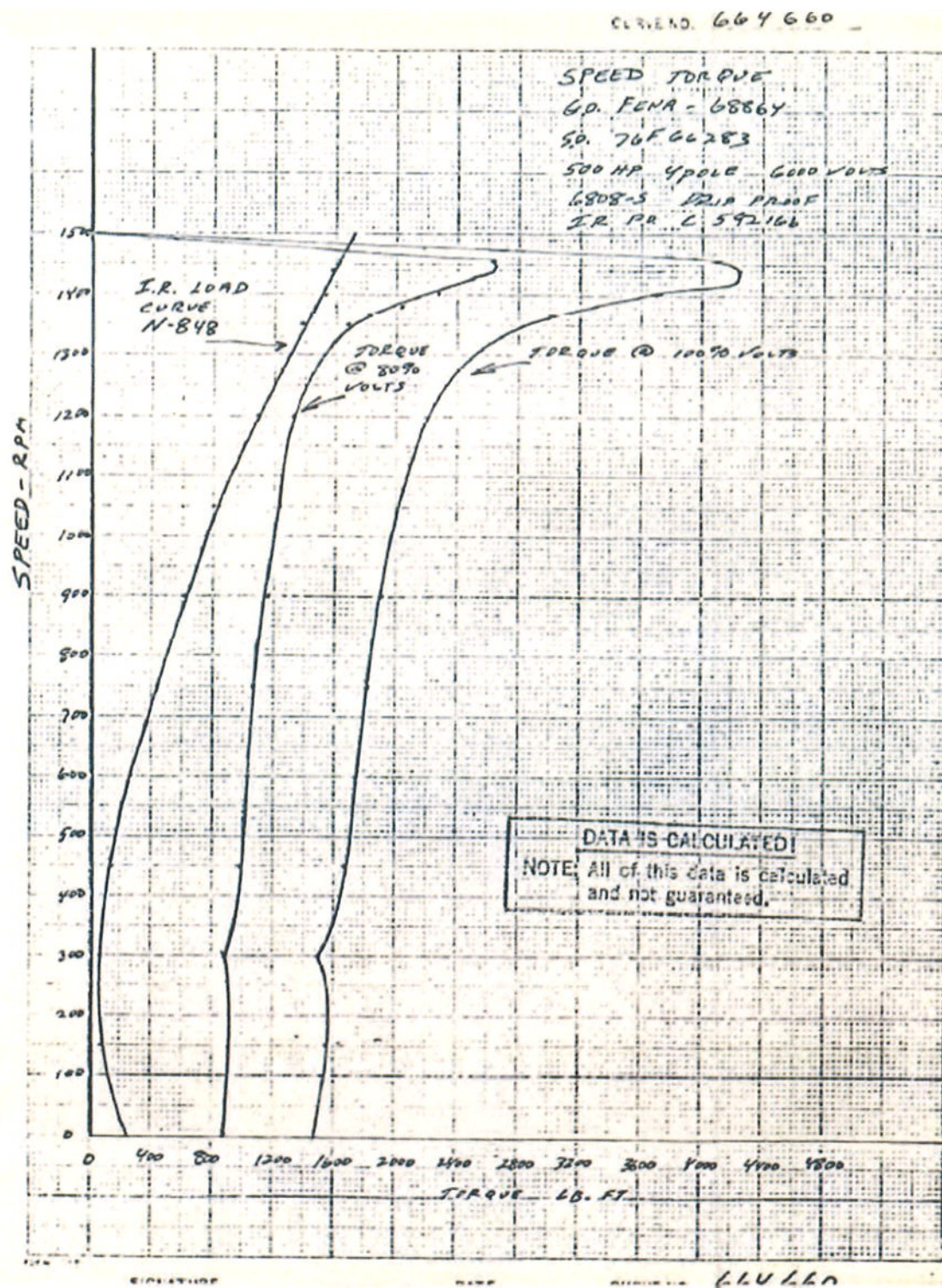
Rating:

500 HP 6000 Volts 41 Amperes1486 RPM 3 Phase 50 HertzLocked Code Letter F

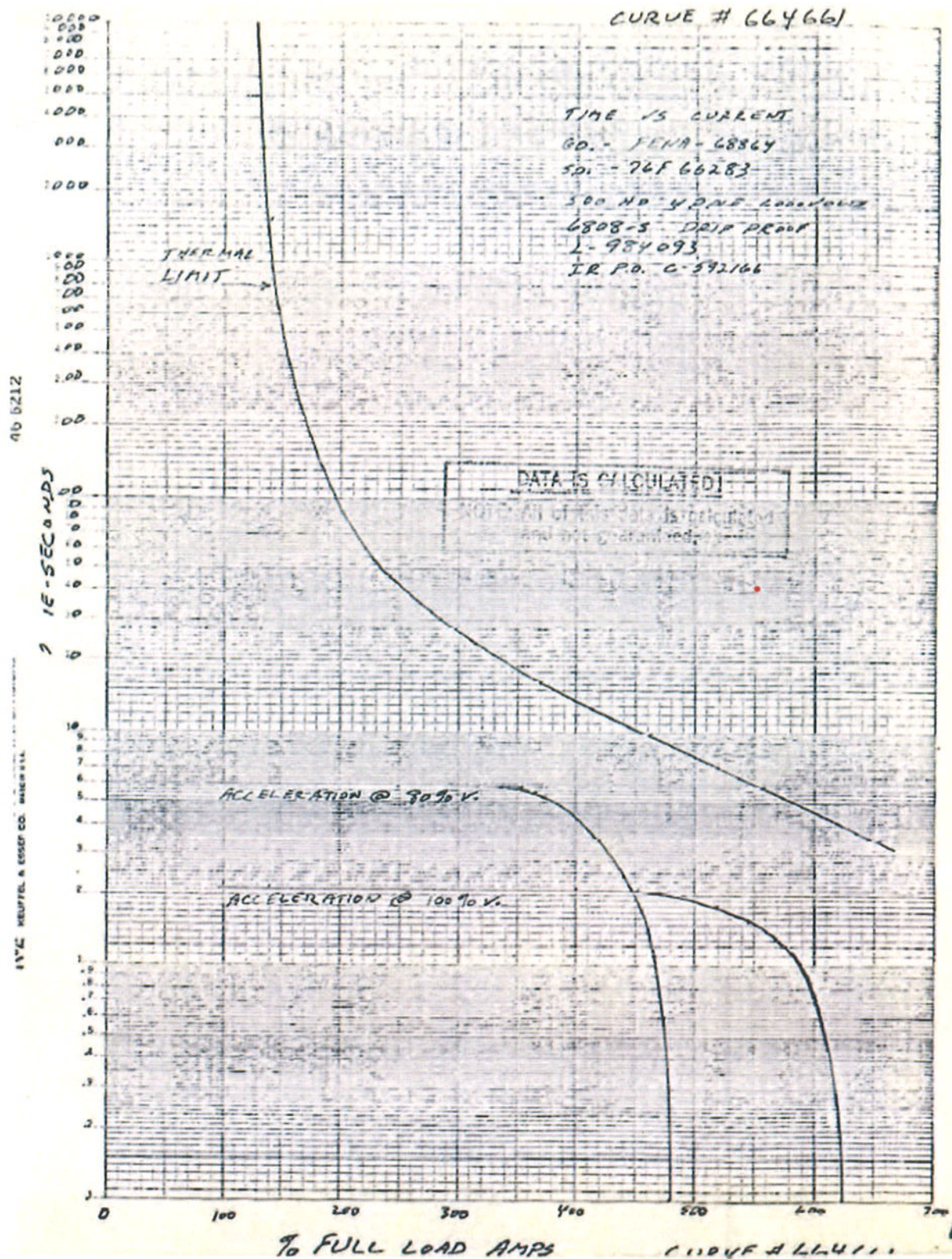
Characteristics:

Enclosure DRIP-PROOFDuty CONTINUOUSRotation CCWAmbient Temperature 50°CTemperature Rise 80°CService Factor 1.15Class of Insulation BDrive COUPLEDBearings SPLIT SLEEVELubrication OILMounting HORIZONTALMaintenance Instructions 3100-D1Outline Drawing 9504D18

A1.3.2. Speed-Torque Curve (Curve no. 664660)



A1.3.3. Time-Current Curve (Curves no. 664661)



A1.4. Quality Control Data (FAT)

A1.4.1. Motor #1 (S/N 1S-78)



Westinghouse Electric Corporation

BUFFALO, N.Y.

Date 2/23/78

Purchased Ingersoll Rand Stock Order No. 76F66283
 G.O. No. FENA-68864 H.P. 500 Volts 6000 Phase 3 Class Insulation
 Apparatus 6808S HSDP SB Poles 4 R.P.M. 1486 Cycles 50

	1	2	3	COMMENTS
Ampere Per Terminal at no load 6000 Volts	7.2			Stator Res. @ 25.5°C
Watts Input at no load	6005			3.24
Stator Res. (T-T) at 75° C - ohms	3.86			3.24
Starting Winding Res. at 75° C - ohms				3.24
Rotor Res. (bet rings) at 75° C - ohms				Vibration with 1/2 key
LOSSES IN WATTS AT FULL LOAD				
Stray Load Loss				Front Rear
Stator I ² R Loss				Horiz. .000072 .000044
Rotor I ² R Loss				Vert. .000097 .000076
Core Loss				Axial .00004 .000036
Friction and Windage Loss				Phasing
% Efficiency - Full Load	94.0			L1L2L3 CCW from end
- 1/2 Load	94.7			T1T2T3 opp. shaft, ext. ↗
- 1/4 Load	94.8			
115%	93.4			Stator Bore - 19.979
% Power Factor Full Load	90.9			Rotor Diam. - 19.860
- 1/2 Load	91.1			
- 1/4 Load	88.2			Air Gaps
115%	89.8			.062 .062 .064 .064
PM at Full Load	1491			
Ampere Per Term. at full load	42			
KW input at full load	396.8			
Ampere per Term-Rotor locked 6000V	221.5			
KW input - Rotor locked	745			
Max. Sec. Volts between rings				
Sec. Amps per ring at full load				Heaters
Full Load Torque (F.L.T.) in lb. ft.	1761			Volts 400
Max. Torque in % of F.L.T.	234			Amps .576
Starting Torque in % of F.L.T.	110			
End Play Tested	OK			
Balance Tested	OK			
Stator Ins Tested 13000 V 60 Sec.	OK			
Rotor Ins Tested V Sec.				
TEMPERATURE TESTS				
Length of Test in hours	6.0			
Volts	6000			
% Normal Full Load Amp.	117			
Temp. Rise Stator Copper by Res.	74			
in degrees C Stator Iron	36.5			
Bearings Frt.	34)	Total		
Rear	30.5)	Temp.		
Room temperature in °C	24			
Curve Nos.				

The above is a true and correct record of data obtained from tests made at the works of Westinghouse Electric Corporation.

REPORT OF TESTS ON INDUCTION MOTORS
Form 2055-KSigned John J. Wiley 3/1/78 Engine

A1.4.2. Motor #2 (S/N 2S-78)

FORM Z4080

WESTINGHOUSE ELECTRIC CORPORATION
MOTOR DIVISION, BUFFALO, N.Y.



REPORT OF COMMERCIAL TESTS - INDUCTION MOTOR

DATE 2/06/78		STYLE NO.		S.O.NO. 76F66283		C.O.NO. FENA-68864-L7		PURCHASER'S ORDER NO.			
PURCHASER Ingersoll Rand Co.											
NAME PLATE DATA											
H.P.	SPEED	PHASE	FREQ.	VOLTS	AMPS.	TYPE	FRAME	TEMP. RISE	TIME RATING	DESIGN (LETTER)	LOCKED R CODE (LV)
500	1486	3	50	6000	41	LLD	6808S	80°C	CONT.	B	F
TEST CHARACTERISTICS											
SERIAL NO.	NO LOAD					LOCKED ROTOR				OPEN CIRCUIT VOLTAGE (WOUND ROTOR)	DIELECTRIC TEST
	VOLTS	FREQ.	SPEED	AMPS.	WATTS	VOLTS	FREQ.	AMPS.			
2	6000	60	1499	7.15	6000				*		13000 V
				7.15							
				7.05							
Stator Resistance at 25°C = 3.20 ohms T-T											
Vibration Readings											
Phase Rotation Sequence											
	Front		Rear								
Hor.	0.00031		0.00025					CCW		L1 L2 L3	
Vert.	0.00005		0.00003					Front		T1 T2 T3	
Axial	0.00002		0.00002								

TESTS ON THIS MOTOR
DUPLICATE

APPROVED BY

John J. Kiley
ENGINEER

DATE

3/2/78

A1.4.3. Motor #3 (S/N 3S-78)

FORM 44000

WESTINGHOUSE ELECTRIC CORPORATION
MOTOR DIVISION, BUFFALO, N.Y.



REPORT OF COMMERCIAL TESTS - INDUCTION MOTOR

DATE 2/07/78	STYLE NO.	S.O.NO. 76F66283	G.O.NO. FENA-68864-L7	PURCHASER'S ORDER NO.
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PURCHASER
Ingersoll Rand Co.

NAME PLATE DATA

H.P.	SPEED	PHASE	FREQ.	VOLTS	AMPS.	TYPE	FRAME	TEMP. RISE	TIME RATING	DESIGN (LETTER)	LOCKED CODE LC
500	1486	3	50	6000	41	LLD	6808S	80°C	CONT.	B	F

TEST CHARACTERISTICS

SERIAL NO.	NO LOAD					LOCKED ROTOR					OPEN CIRCUIT VOLTAGE (GROUND ROTOR)	DIELECTRIC TEST
	VOLTS	FREQ.	SPEED	AMPS.	WATTS	VOLTS	FREQ.	AMPS.				
3	6000	60	1499	7.10	6000							13000 V
				7.22								
				7.40								
Stator Resistance at 24°C = 3.196 ohms T-T												
Vibration Readings												
	Front		Rear			Phase Rotation Sequence						
Hor.	0.00017		0.00014			CCW					L1 L2 L3	
Vert.	0.00015		0.00012			Front					T1 T2 T3	
Axial	0.000066		0.000084									

TESTS ON THIS MOTOR
DUPLICATE

APPROVED BY

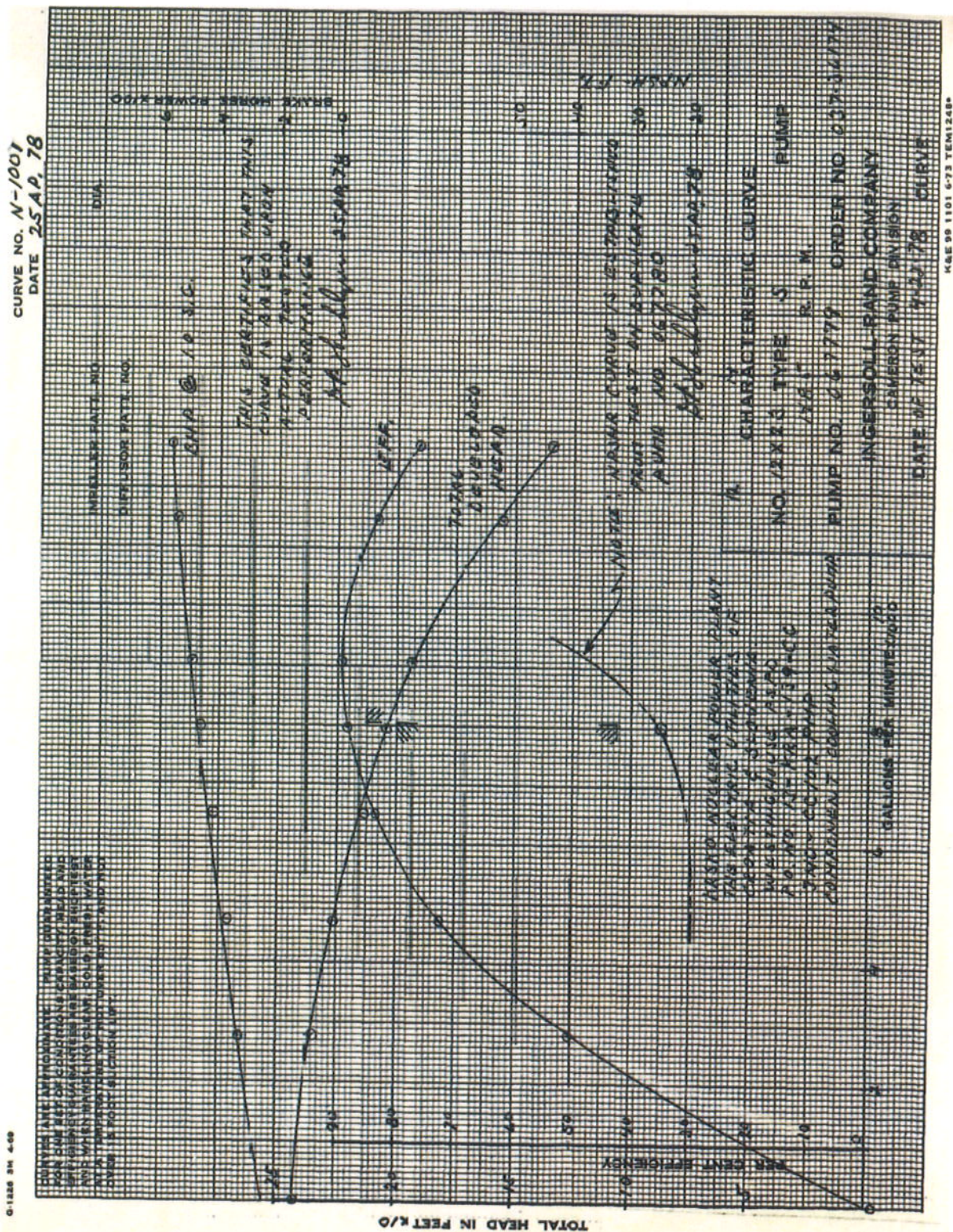
John J. Wiley
ENGINEER

DATE

3/2/70

A1.5. Pump characteristics

A1.5.1. Operational Curve of Pump





NEK

Krško Nuclear Power Plant
Vrbina 12
8270 Krško



TECHNICAL SPECIFICATION

Spare Component Cooling Pump Motor

DWG 9504D18 – Outline (Component Cooling Pump Motor)

KRŠKO NUCLEAR POWER PLANT

APPENDIX A2

Revision 1

NUCLEAR SAFETY RELATED

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NEK

Krško Nuclear Power Plant
Vrbina 12
8270 Krško



TECHNICAL SPECIFICATION

Spare Component Cooling Pump motor

Floor Response Spectra of Auxiliary Building, el. 100.300

KRŠKO NUCLEAR POWER PLANT

APPENDIX A3

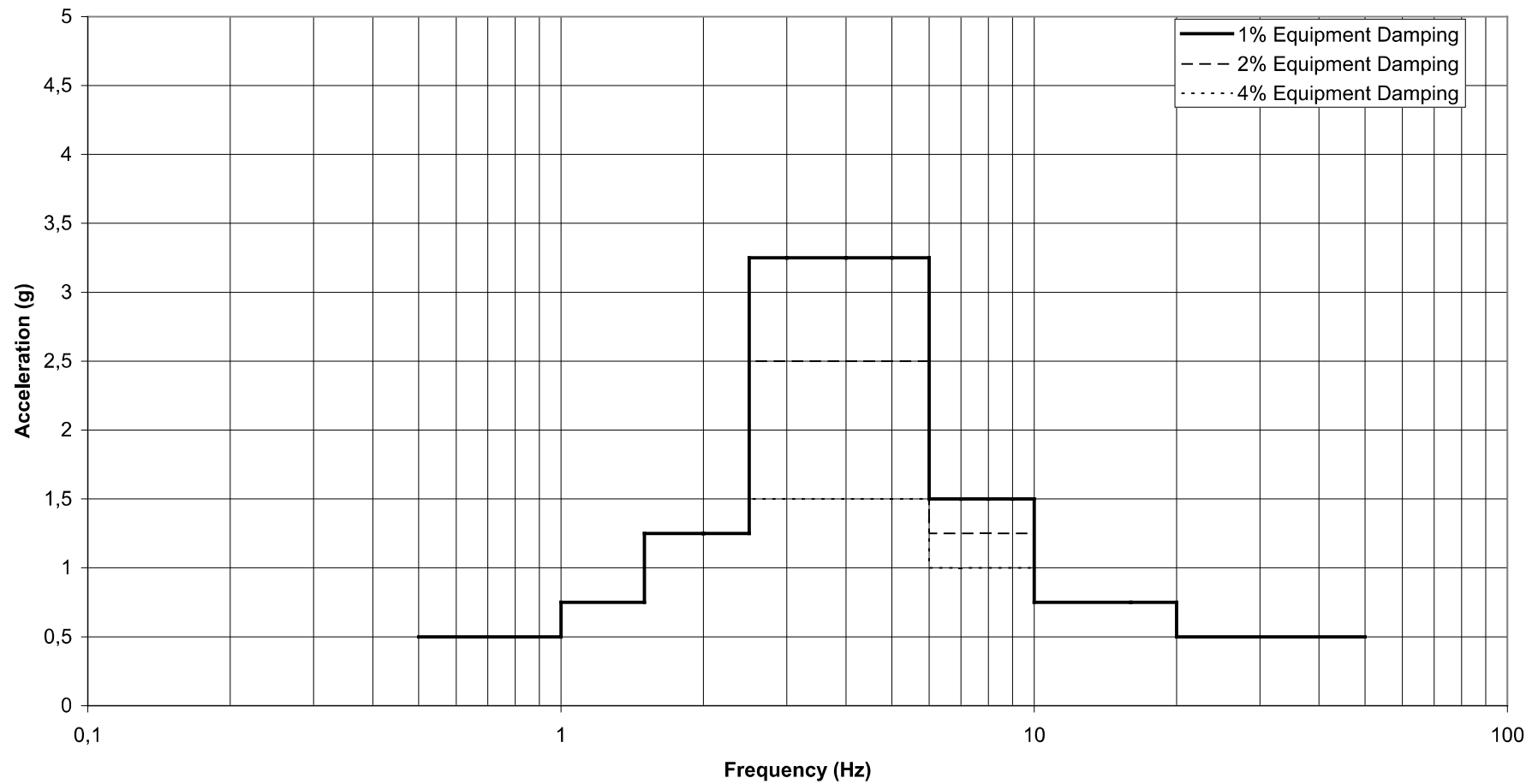
Revision 1

NUCLEAR SAFETY RELATED

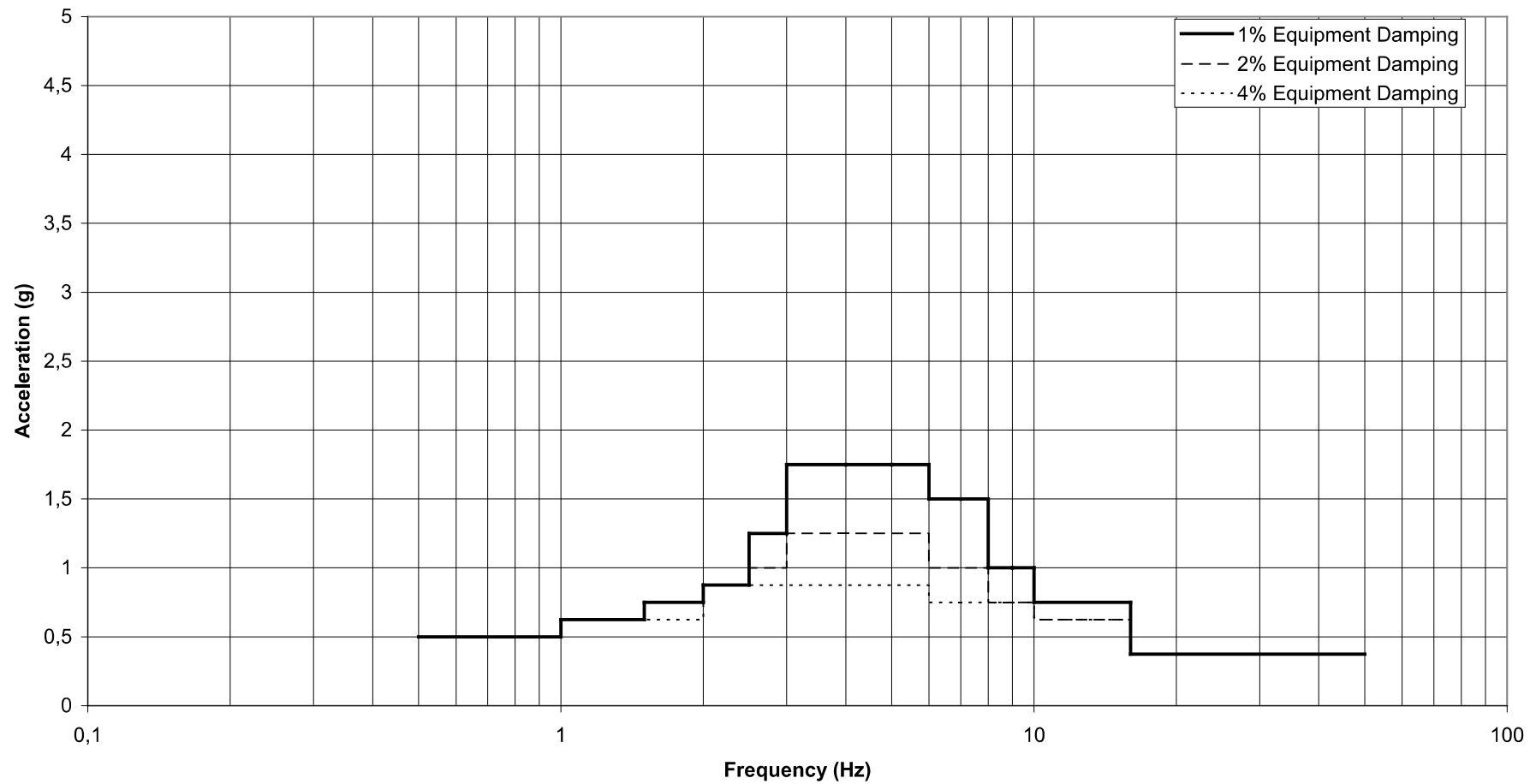
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A3.1	Floor Response Spectra, Auxiliary Building EL. 100.3 M, Horizontal OBE	1
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A3.3	Floor Response Spectra Auxiliary Building EL. 100.3 M Horizontal SSE	3
A3.4	Floor Response Spectra Auxiliary Building EL. 100.3 M Vertical SSE	4

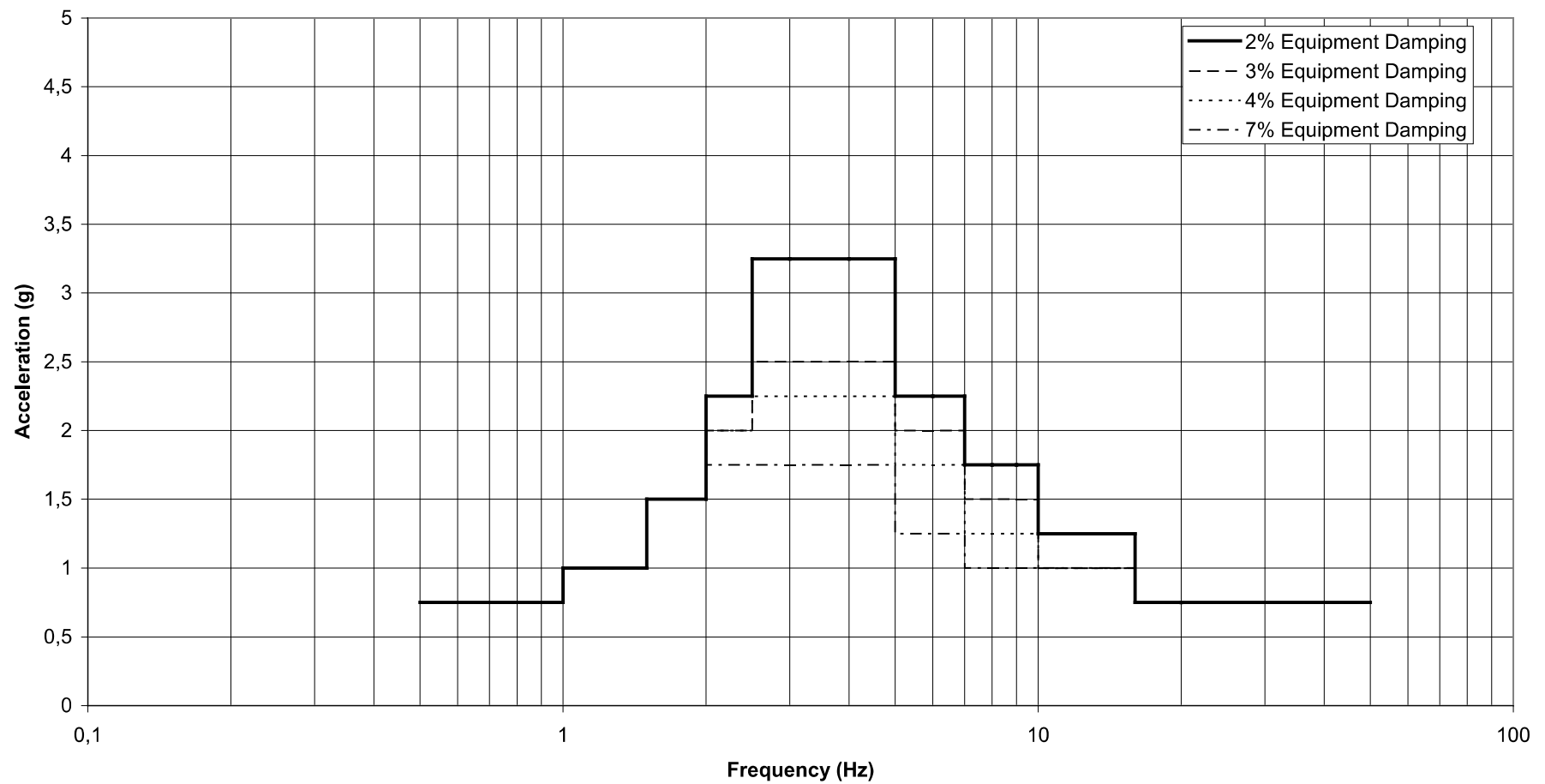
**Krsko NPP
Floor Response Spectra
Auxiliary Building EL. 100.3 M
Horizontal OBE**



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



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



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

