WOLF CREEK
NUCLEAR OPERATING CORPORATION

Terry J. Garrett
Vice President, Engineering

April 18, 2007

ET 07-0008

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Reference: Letter ET 07-0004, dated March 14, 2007, from T. J. Garrett, WCNOC, to USNRC

Subject: Docket No. 50-482: Supplemental Information on Main Steam and Feedwater Isolation System Controls Modification

Gentlemen:

The Reference provided a license amendment request that proposed revisions to Technical Specification (TS) 3.3.2, "Engineered Safety Feature Actuation System (ESFAS) Instrumentation," TS 3.7.2, "Main Steam Isolation Valves (MSIVs)," and TS 3.7.3, "Main Feedwater Isolation Valves (MFIVs)." The Reference proposed changes to these specifications based on a planned modification to replace the MSIVs and associated actuators, MFIVs and associated actuators, and replacement of the Main Steam and Feedwater Isolation System (MSFIS) controls.

On March 21, 2007, Wolf Creek Nuclear Operating Corporation (WCNOC) received electronic mail from the Nuclear Regulatory Commission (NRC) Project Manager indicating that the Reference was lacking sufficient information to support the review of the application. On April 3, 2007, the NRC Project Manager provided by electronic mail, a generic list (table) of items that the Technical Branch believed was necessary for completion of the staff review of the application. During a telephone conference on April 3, 2007, WCNOC agreed to provide by April 4, 2007, if the information in the generic list was currently available and if not currently available when it would be available. On April 4, 2007, WCNOC provided by electronic mail a modified table that provided information regarding specific information identified by the NRC as being needed and the availability of the information. WCNOC provided the available information on April 9, 2007, and indicated that this information would be provided on the docket by May 4, 2007.

The Enclosures provide, on the docket, the information provided on April 9, 2007. Enclosures IV, VII, IX, and XII contain proprietary information.

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Enclosure IV provides the proprietary CS Innovations LLC Report 6000-00000, "ALS Level-1 System Specification," Rev. 1. As Enclosure IV contains information proprietary to CS Innovations LLC, it is supported by an affidavit signed by CS Innovations LLC, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information, which is proprietary to CS Innovations, be withheld from public disclosure in accordance with 10 CFR 2.390 of the Commission's regulations. This affidavit, along with a CS Innovations LLC authorization letter, 91000-00006, "Application for Withholding Proprietary Information from Public Disclosure," is contained in Enclosure V.

Enclosure VII provides the proprietary WCNOC Report "System Reliability Analysis for Advance Logic System," Rev. 1. As Enclosure VII contains information proprietary to WCNOC, it is supported by an affidavit signed by WCNOC, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information, which is proprietary to WCNOC, be withheld from public disclosure in accordance with 10 CFR 2.390 of the Commission's regulations. This affidavit is contained in Enclosure VIII.

Enclosure IX provides the proprietary CS Innovations LLC Report 6101-00002, "MSFIS System Specification, Wolf Creek Generating Station," Rev. 0.96. As Enclosure IX contains information proprietary to CS Innovations LLC, it is supported by an affidavit signed by CS Innovations LLC, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information, which is proprietary to CS Innovations, be withheld from public disclosure in accordance with 10 CFR 2.390 of the Commission's regulations. This affidavit, along with a CS Innovations LLC authorization letter, 91000-00004, "Application for Withholding Proprietary Information from Public Disclosure," is contained in Enclosure X

Enclosure XII provides the proprietary CS Innovations LLC Report 6000-00010, "ALS Design Tools," Rev. 0.8. As Enclosure XII contains information proprietary to CS Innovations LLC, it is supported by an affidavit signed by CS Innovations LLC, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR 2.390 of the Commission's regulations. Accordingly, it is respectfully requested that the information, which is proprietary to CS Innovations, be withheld from public disclosure in accordance with 10 CFR 2.390 of the Commission's regulations. This affidavit, along with a CS Innovations LLC authorization letter, 91000-00008, "Application for Withholding Proprietary Information from Public Disclosure," is contained in Enclosure XIII.

WCNOC is providing only proprietary versions of Enclosures IV, VII, IX, and XII as a non-proprietary version would be of no value to the public due to the extent of the proprietary information. Additionally, in the Reference, WCNOC provided non-proprietary CS Innovations LLC Report 9100-00003-NP, "Wolf Creek Generating Station Main Steam and Feedwater Isolation System (MSFIS) Controls Summary," that provides sufficient detail of the overall modification for public disclosure.

The supplemental information provided in the Enclosures does not impact the conclusions of the No Significant Hazards Consideration provided in the Reference. In accordance with 10 CFR 50.91, a copy of the submittal (without Enclosures) is being provided to the designated Kansas State official.

This letter contains no commitments. If you have any questions concerning this matter, please contact me at (620) 364-4084, or Mr. Kevin Moles at (620) 364-4126.

Sincerely,

Terry J. Garrett

TJG/rlt

Enclosure: I - Specification J-105(Q) for Replacement MSFIS System, Rev. 2
II - MSFIS Quality Assurance Plan, Rev. 0
III - MSFIS Configuration Management Plan, Rev. 0
IV - CS Innovations LLC Report 6000-00000, "ALS Level 1 System Specification," Rev. 1
V - CS Innovations LLC letter 91000-00006, "Application for Withholding Proprietary Information from Public Disclosure"
VI - Nutherm Qualification Report for CS Innovations Replacement MSFIS System, Rev. 0
VII - System Reliability Analysis for Advanced Logic System, Rev. 1
VIII - WCNOC Affidavit for Withholding Proprietary Information from Public Disclosure
IX - CS Innovations LLC Report 6101-00002, "MSFIS System Specification, Wolf Creek Generating Station" Rev. 0.96
X - CS Innovations LLC letter 91000-00004, "Application for Withholding Proprietary Information from Public Disclosure"
XI - Nutherm Dedication Plan for Replacement MSFIS System, Rev. 0
XII - CS Innovations LLC Report 6000-00010, "ALS Design Tools," Rev. 0.8
XIII - CS Innovations LLC letter 91000-00008, "Application for Withholding Proprietary Information from Public Disclosure"

cc: T. A. Conley (KDHE), wo/e
J. N. Donohew (NRC), w/e
V. G. Gaddy (NRC), w/e
B. S. Mallett (NRC), w/e
Senior Resident Inspector (NRC), w/e

STATE OF KANSAS)
) SS
COUNTY OF COFFEY)

Terry J. Garrett, of lawful age, being first duly sworn upon oath says that he is Vice President Engineering of Wolf Creek Nuclear Operating Corporation; that he has read the foregoing document and knows the contents thereof; that he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By _____
Terry J. Garrett
Vice President Engineering

SUBSCRIBED and sworn to before me this 18 day of April, 2007.

RHONDA L. TIEMEYER
NOTARY PUBLIC
OFFICIAL SEAL
STATE OF KANSAS
RHONDA L. TIEMEYER
MY COMMISSION EXPIRES
January 11, 2010

Rhonda L. Tiemeyer
Notary Public

Expiration Date January 11, 2010

Specification J-105(Q) for Replacement MSFIS System, Rev. 2

WOLF CREEK
NUCLEAR OPERATING CORPORATION

SPECIFICATION J-105A(Q)
FOR
REPLACEMENT MSFIS SYSTEM

WOLF CREEK GENERATING STATION (WCGS)

This specificaton consists of the following documents:

1. Specification J-105A(Q), Rev. 2, Replacement MSFIS System
2. Data Sheets: None
3. Attachments:
   - A. Reference Drawing Package as listed in Specification J-105A(Q) Section 4.1
   - D. Specification No. 10466-J-820 Rev. 1 Seismic Qualification Requirements for Class 1E Control and Instrumentation Devices
   - E. Drawing J4-104 Sheet 1 Rev. 4 Nameplate Standards
   - H. Specification No. 10466-J-821 Rev. 2 Seismic Qualification Requirements for Class 1E Control Panel Assemblies
4. Appendices:
   - A. Input Signals and Sources
   - B. Power Supply Fusing and Supply to the Buyer-Supplied Status Monitor
   - C. Modified Power Supply Fuses and Functions Assigned
   - R. Buyer's Inspection Procedures

   Form APF-05-004-03 - Documentation Submittal Requirements

REVISION DESCRIPTION: Rev. 2 issued to conform the requirements to the particular details of the vendors controls system and to provide specific requirements which were intenitally left vague in previous Revisons.

SPECIFICATION NUMBER J-105A(Q)			REV 2
			DC2 10/03/06
ORIGINATED	VERIFIED	SUPERVISOR APPROVED/DATE 08.08.2006	RELEASED

Form APF-05-004-02, Rev. 0

	REVISION STATUS SHEET	SPECIFICATION NO: J-105A(Q)

SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.
Cover	2	19	2	Doc Sub 7	1						
Rev Stat i	2	20	2								
Title	2	21	2								
1	2	22	2								
2	2	23	2								
3	2	24	2								
4	2	25	2								
5	2	26 App. A	2								
6	2	27 App. A	2								
7	2	28 App. A	2								
8	2	29 App. A	2								
9	2	30 App. B	2								
10	2	31 App. C	2								
11	2	32App. R	2								
12	2	33 App. R	2								
13	2	Doc Sub 1	1								
14	2	Doc Sub 2	1								
15	2	Doc Sub 3	1								
16	2	Doc Sub 4	1								
17	2	Doc Sub 5	1								
18	2	Doc Sub 6	1								

SPECIFICATION

FOR

REPLACEMENT MSFIS SYSTEM

WOLF CREEK GENERATING STATION (WCGS)

			Replacement MSFIS System	08/08/2006	
REV ORG	ORIG	VER	DESCRIPTION	SUPV APP/DATE	RLSD

WOLF CREEK
NUCLEAR OPERATING CORPORATION

SPECIFICATION NUMBER J-105A(Q)	REV 2

Specification J-105A

Replacement MSFIS System

Table of Contents

1.0 SCOPE

The Scope of Work is to replace various parts of the existing safety-related electronic Main Steam and Feedwater Isolation System (MSFIS) with a safety-related logic-controller-based system to perform the control functions of the Main Steam Isolation Valves (MSIVs) and Main Feedwater Isolation Valves (MFIVs). The Replacement MSFIS System will be installed in conjunction with replacement of the existing electro-pneumatic-hydraulic MSIVs and MFIVs by new MSIVs and MFIVs with system-medium actuators. The MSFIS System, existing and replacement, has two redundant subsystems located in separate cabinets:

MSFIS Channel I (1) located in MSFIS Cabinet SA075A
MSFIS Channel IV (4) located in MSFIS Cabinet SA075B

The replacement project will retain the existing cabinets, external power supply feeds, and channel separation scheme in the overall plant configuration. The replacement project will include changes to the functions by which the Replacement MSFIS System controls the replacement MSIVs and MFIVs. These changes account for the differences in the function of the existing and replacement MSIVs and MFIVs, that is, electro-pneumatic-hydraulic actuators replaced by system-medium actuators.

The existing and replacement MSFIS Systems are both considered digital in that they deal with ON-OFF inputs and outputs, and there are no analog / magnitude inputs and outputs involved. However, the systems do not have general digital computer components and characteristics such as a clock-driven central processing unit in continuous operation.

The Replacement MSFIS System project shall be worked by two suppliers; 1) Control System Supplier (Controls Seller) 2) Qualification and Dedication Supplier (Qualification Seller). The Controls Seller is responsible for the selection, assembly, implementation testing, and implementation of the Replacement MSFIS System. The Qualification Seller is responsible for the Qualification and Dedication of the Replacement MSFIS System supplied by the Controls Seller. The Qualification Seller shall be a qualified 10CFR50 Appendix B vendor.

The Buyer or Buyer's consultant will perform an overall independent Validation & Verification of the Replacement MSFIS System development and implementation. Final approval of the Replacement MSFIS System by the Buyer shall be required to ensure the requirements of this document have been fully satisfied.

1.1 Work Included

1. The Controls Seller's scope of work focuses on selection and production of new items for replacement of existing items, the Controls Seller is also responsible for system selection to perform the required system functions. The Qualification Seller is responsible for factors such as seismic qualification, etc., applied to the final integrated system and cabinet configuration.

2. Replacement of the existing MSFIS system components in the form of circuit cards. The existing system includes input buffer cards, valve controller module cards, and relay driver cards. These components shall be replaced by a logic-controller-based system which performs the required functions of the replacement MSIVs and MFIVs. Replacement of the racks which contain and support these circuit cards is included if required by the configuration, quantity, ambient temperature / cooling, back-plane wiring, or any other configuration aspect of the replacement circuit cards.

3. Appropriate test capability for the replacement system. The existing system's Manual Test Panel may be re-used as is, modified as appropriate, or completely replaced as required by the replacement system configuration.

4. Provide an output dry contact or equivalent in each MSFIS Cabinet for a new summary trouble alarm.

5. Replacement of the existing system power supply modules with redundant hot-swappable power supply modules.

6. Replacement of output relays and bases and supply of new surge suppressors.

7. Mounting hardware and wiring devices as necessary to mount the replacement components and interconnect them to each other and existing circuits.

8. Required new portable test equipment.

9. Initial stock of repair parts for twenty years' use.

Buyer acknowledges that the nature of a replacement system intended for installation in existing cabinets in the Buyer's plant is that it will consist of many small items but no unifying structure. Thus, the items are packed and shipped individually or in groups and require individual installation into the Buyer's cabinets at the Buyer's plant.

Buyer acknowledges that some of the items specified may be delivered ready for use in the form of "One lot – mounting hardware and wiring devices."

1.2 Related Work Not Included

1. Installation of Replacement MSFIS System components in the MSFIS Cabinets.

2. The replacement MSIVs and MFIVs will be supplied and installed by others.

3. Connection of field cables to the replacement MSIVs and MFIVs will be done by others.

4. New field cable required for the new summary trouble alarm.

5. The overall project will also include electrical equipment and circuit changes outside the scope of this Specification.

2.0 OBJECTIVE

The plant's existing Main Steam Isolation Valves and Main Feedwater Isolation Valves have electro-pneumatic-hydraulic actuators. The existing valves have a discrete-component solid-state electronic control system to control the valve actuators and thus the valves. The valves will be replaced by new valves with system-medium actuators, rather than the electro-pneumatic-hydraulic actuators. The objective of this Specification is to procure an advanced-hardware-based control system which will have appropriate logic to control the replacement valves' system-medium actuators. The replacement control system will be custom-selected from available hardware items so that it will not utilize nor depend upon any program software.

3.0 ABBREVIATIONS

AC	-	All Close
C	-	Close / Closed
DC		Direct Current
ESFAS	-	Engineered Safety Features Actuation System
FWIS	-	Feedwater Isolation Signal
KC	-	Keep Closed
KO	-	Keep Open
MFIV		Main Feedwater Isolation Valve
MSFIS	-	Main Steam and Feedwater Isolation Actuation System
MSIS	-	Main Steam Isolation Signal
MSIV	-	Main Steam Isolation Valve
O	-	Open

4.0 CODES AND STANDARDS

IEEE Standards

IEEE Standard 279-1971, Criteria for Nuclear Power Plant Protection Systems
IEEE Standard 323-1974, IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations
IEEE Standard 336-2005, IEEE Standard Installation, Inspection, and Testing Requirements for Power, Instrumentation, and Control Equipment at Nuclear Facilities
IEEE Standard 338-1987, IEEE Standard Criteria for Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems
IEEE Standard 344-1975, IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations
IEEE Standard 352-1987, Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Safety Systems
IEEE Standard 379-2000, Application of the Single Failure Criterion to Nuclear Power Generating Station Class 1E Systems
IEEE Standard 383-2003, IEEE Standard or Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
IEEE Standard 384-1974, Criteria for Independence of Class 1E Equipment and Circuits
IEEE Standard 420-2001, IEEE Standard for the Design and Qualification of Class 1E Control Boards, Panels, and Racks Used in Nuclear Power Generating Stations
IEEE Standard 472-1974, Guide for Surge Withstand Capability Tests
IEEE Standard 603-1998, Standard Criteria for Safety Systems for Nuclear Power Generating Stations

Standards other than IEEE

EPRI Topical Report TR-102323-R2, Guideline for Electromagnetic Interference Testing in Power Plants
IEC-801-2, Electromagnetic Compatibility for Industrial-Process Measurements and Control Equipment Part 2: Electrostatic Discharge Requirements
IPCEA S-19-81, Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
IPCEA S-61-402, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

4.1 References

NRC Regulatory Guides

Regulatory Guide 1.22, Periodic Testing of Protection System Actuation Functions
Regulatory Guide 1.29, Seismic Design Classification
Regulatory Guide 1.47, Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems
Regulatory Guide 1.53, Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems
Regulatory Guide 1.62, Manual Initiation of Protective Actions
Regulatory Guide 1.75 Rev. 2 dated 9/78, Physical Independence of Electric Systems
Regulatory Guide 1.92, Rev. 1, Combining Modal Responses and Spatial Components in Seismic Response Analysis
Regulatory Guide 1.100, Rev. 1, Seismic Qualification of Electric Equipment for Nuclear Power Plants
Regulatory Guide 1.118, Periodic Testing of Electric Power and Protection Systems
Regulatory Guide 1.131 dated 8/77 Qualification Tests of Electric Cables, Field Splices, and Connections for Light-Water-Cooled Nuclear Power Plants
Regulatory Guide 1.153, Criteria for Power, Instrumentation, and Control Portions of Safety Systems
Regulatory Guide 1.180, Rev. 1, Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems

Drawing List

Wolf Creek Drawing Number	Vendor Drawing Number	Title
J-104-00282	KAG8909	MSFIS Logic
J-104-00281	KAF8909 Sh 1	Signal Flow Block Diagram
J-104-00322	KAF8909 Sh 2	Signal Flow Block Diagram
J-104-00323	KAF8909 Sh 3	Signal Flow Block Diagram
J-104-00324	KAF8909 Sh 4	Signal Flow Block Diagram
J-104-00325	KAF8909 Sh 5	Signal Flow Block Diagram
J-104-00326	KAF8909 Sh 6	Signal Flow Block Diagram
J-104-00327	KAF8909 Sh 7	Signal Flow Block Diagram
J-104-00328	KAF8909 Sh 8	Signal Flow Block Diagram
J-104-00295	KJ7316	MSFIS Power Dist 15 V DC
J-104-00296	KK7316	MSFIS Power Dist 48 V DC
J-104-00289	9N53 Sh 1	MSFIS Cabinet Assembly
J-104-00303	9N53 Sh 2	MSFIS Cabinet Assembly
J-104-00512	PL9N53	MSFIS Cabinet Parts List
J-104-00291	R9N53	MSFIS Cabinet Installation
J-104-00300	KAA7366	MSFIS Cabinet 9N53-1 Marking
J-104-00299	KAL7366	MSFIS Cabinet 9N53-2 Marking
J-104-00330	KH7299 Sh 1	Double Card Rack Assembly
J-104-00331	KH7299 Sh 2	Double Card Rack Assembly
J-104-00314	PLKH7299	Double Card Rack Parts List
J-104-00332	KJ7299	Single Card Rack Assembly
J-104-00315	PLKJ7299	Single Card Rack Parts List
J-104-00302	7N228	Manual Test Panel Assembly
J-104-00298	S7N228	Manual Test Panel Schematic
J-104-00292	8N29	Power Supply Assembly / Parts List
J-104-00317	6N338	Valve Control Module Assembly
J-104-00320	S6N338	Valve Control Module Schematic
	PPS-A700/A300	Functional Description
	103.225.762, Sheets 1-8	System medium operated actuator for quick closing valve, Layout diagram

5.0 DESIGN REQUIREMENTS

5.1 Design Conditions

No specific requirement.

5.2 Performance Requirements

5.2.1 General Design Requirements

a. The MSFIS provides 125 Volt DC outputs to energize or de-energize control solenoids to operate and test the plant MSIVs and MFIVs.

b. The MSFIS is divided into two actuation channels. Each of the two independent actuation channels monitors system inputs and, by means of logic matrices, energizes / de-energizes the required solenoids in the required sequence for the appropriate valve operations.

c. The MSFIS System is comprised of solid-state components.

d. The Replacement MSFIS System shall not involve software such as an application program for a digital computer in the hardware in place during plant operation. However, software is permitted in portable test equipment which is completely disconnected from the Replacement MSFIS System at the conclusion of testing.

e. The Controls Seller shall configure the MSFIS control logic matrices to develop output states and output sequences in accordance with Appendix C and Sections 5.2.5 and 5.2.6 of this specification.

5.2.2 Modular Design

Interchangeability shall be provided and demonstrated for all similar modules or components.

Items designed to be removable from the equipment, such as assemblies, subassemblies, electrical parts, modules, and hardware, shall be replaceable physically and electrically with corresponding items without drilling, bending, filing, fabricating, or using undue force. Hot swap capability shall be included for the logic-controller-based system circuit cards. Hot swap capability includes the requirement that the controlled equipment shall not cause a plant transient. Further the redundant train shall not lose the capability to continue plant operation and shall continue to perform it's safety-related function, closure of the MSIVs and MFIVs when required by input conditions.

The replacement of parts, when accomplished in a manner prescribed by the Controls Seller, shall not cause the equipment to depart from the original specified performance.

5.2.3 Response Time

The overall response time of the Replacement MSFIS System specified herein shall be less than or equal to 100 milliseconds for an input signal step change. The Replacement MSFIS System is contained within the cabinets SA075A and SA075B, from field terminal block input to field terminal block output.

5.2.4 System Functional Requirements

a. System Input Signals

The MSFIS shall accept input signals (in the form of contact conditions) from control switches located on the Main Control Board and from output relays in the Engineered Safety Features Actuation System. Appendix A tabulates the inputs for each subsystem of the MSFIS.

1) The existing MSFIS System configuration obeys the plant's separation criteria by use of two separate MSFIS Cabinets, one for each Channel. The Controls Seller shall use the existing MSFIS Cabinets and Channels to continue adherence to these criteria. Incoming signal Channel assignments are specified in Appendix A.

2) The System inputs from the control switches will all be momentary (>70mS), and shall be sealed-in as necessary inside the Replacement MSFIS System logic circuits.

3) The contacts from ESFAS will be normally closed, and will open to cause an operation. The remaining input contacts will be normally open, and will close to cause an operation.

4) The Controls Seller shall determine the voltage and current ratings of the buffer input circuits based on the power supplies as required under Section 5.6.3 and also subject to the maximums of NEMA ICS-5 P300 ratings and the minimums required to keep the contacts clean and function in a nuclear plant instrument cabinet room with unshielded cables connecting the remotely located input contacts to the system.

b. System Logic Matrices

The logic matrices shall adhere to the requirements of channel independence and separation required by Appendix A.

c. System Output Signals

1) Actuation Outputs

The MSFIS shall energize / de-energize the MSIV and MFIV actuator solenoids in accordance with the logic requirements of Sections 5.2.5 and 5.2.6. The output signals shall adhere to the requirements of channel independence and separation required by Appendix A. The outputs shall provide sufficient voltage to energize the actuator solenoids. The specifications for the actuator solenoids are as follows.

Nominal Line Supply Voltage	125VDC
Supply Voltage Tolerance	+12% / -28%
Coil Resistance	97.6 Ohm @ 20°C
Inductance	40 – 60 Henry
Nominal Current	1.28A @ 20°C
Nominal Power Consumption	160 Watt @ 20°C

2) Status Outputs

In addition to the actuation outputs, one status output shall be provided for each actuation train for each valve. This status output is shown in Appendix B. The MSFIS System status output will supply 125 Volt DC power to an input relay at the Status Panel if both of the following are true: a) 125 Volt DC power is available downstream of the individual power supply fuses for solenoid MV5(6), and b) there is no test in progress in the MSFIS System logic. The output to the Status Panel shall be able to handle a 125VDC, <25mA load.

3) Annunciator

The MSFIS shall provide outputs to the plant Annunciator system as described in section 5.6.7. The annunciator outputs shall be able to handle a 125VDC, <25mA load.

4) ESFAS Test Circuits

The MSFIS shall provide one output for each actuation train for each valve to the ESFAS test circuitry, as described in section 5.2.6. These outputs shall be able to handle an 118VAC, <500mA load.

5.2.5 System Operation

In response to command signals from various sources, the MSFIS shall energize and de-energize sets of output terminals in accordance with the requirements set forth below. These outputs will be connected by the Buyer to control solenoids in the actuators of the Main Steam Isolation Valves and the Main Feedwater Isolation Valves. For illustrative purposes, the functional description document for these actuators is included in this specification. Reference will be made to the operation of these actuators and of their component parts; such references are solely for the purposes of discussion.

The Replacement MSFIS System shall measure actual System outputs, compare the outputs to the required output states, and alarm any discrepancies. See section 5.6.7.

The responsibility of the Controls Seller shall be limited to energizing and de-energizing the system outputs as specified.

Note that the actuators are divided into two "sides," and that each side is controlled by three solenoids labeled MV1, MV3, and MV5 for one side, and MV2, MV4, and MV6 for the other side. The three MSFIS outputs associated with each side of each valve are likewise identified as outputs MV1, MV3, and MV5 for one side, and MV2, MV4, and MV6 for the other side.

There must be no connection nor communication of information within the MSFIS between the controls for the two sides of any valve. The states of the outputs for the two sides of a valve must be completely independent of one another. This separation is accomplished by assigning the two "sides" of each valve to opposite Channels MSFIS Cabinets.

a. Output States and Commands

1) Output States

There are three output states for each valve actuator; 1) **CLOSE**, 2) **KEEP CLOSED**, and 3) **OPEN**. The normal state (during normal plant operations) for each MSIV and FWIV is **OPEN**. The required output to each solenoid for all three of the valve actuator states is shown below.

		Outputs to MSIV / MFIV MV1, 3, 5 Side			Outputs to MSIV / MFIV MV2, 4, 6 Side		
Output State	Symbol	MV1	MV3	MV5	MV2	MV4	MV6
CLOSE	C	-	-	-	-	-	-
KEEP CLOSED	KC	-	-	+	-	-	+
OPEN	O	+	+	-	+	+	-

Key: + = energized
- = de-energized

2) Commands

There are four commands; 1) ***All Close***, 2) ***ESFAS***, 3) ***Close***, and 4) ***Open***.

The ***All Close*** command is generated from the ALL CLOSE pushbutton hand switch on the Main Control Board (separate switches for MSIVs and MFIVs). The ***All Close*** command shall place the **CLOSE** output state for all four valves for the respective switch, MSIV or MFIV.

The output state shall remain **CLOSE** for 60sec +/- 1sec after ***All Close*** command was initiated. After the 60sec time delay the output shall be changed to **KEEP CLOSED**.

The ***ESFAS*** command is generated from the Solid State Protection System. The Solid State Protection System provides the inputs to the MSFIS from a separate slave relay for each the MSIVs and MFIVs. Each slave relay provides four contacts into the MSFIS, one contact for each valve. The four contacts from a particular slave relay for either the MSIVs or MFIVs shall be evaluated using 2-out-of-4-voting. The 2-out-of-4 vote shall be required for a valid ***ESFAS*** command. The ***ESFAS*** command shall place the **CLOSE** output state for the particular valve based on the contact inputs from the SSPS slave relay, and the particular system MSIV or MFIV. Note: Under Normal Operating conditions the four ***ESFAS*** commands will come in at the same time, as they are derived from the same slave relay coil. The output state shall remain **CLOSE** for 60sec +/- 1sec after the ***ESFAS*** command was initiated. After the 60sec time delay the output shall be changed to **KEEP CLOSED**.

The ***Close*** command is defined as a close signal to one valve, MSIV or MFIV, initiated by the valve's assigned individual NORMAL-CLOSE-OPEN pushbutton hand switch on the Main Control Board. The ***Close*** command shall place the **CLOSE** output state for the particular valve associated with the NORMAL-CLOSE-OPEN pushbutton hand switch that was actuated. The output state shall remain **CLOSE** for 60 sec +/- 1 sec after the ***Close*** command was initiated. After the 60sec time delay the output shall be changed to **KEEP CLOSED**.

The ***Open*** command is defined as an open signal to one valve, MSIV or MFIV, initiated by the valve's assigned individual NORMAL-CLOSE-OPEN pushbutton hand switch on the Main Control Board. The ***Open*** command shall place the **OPEN** output state for the particular valve associated with the NORMAL-CLOSE-OPEN pushbutton hand switch that was actuated.

b. Command Priorities

1) The command priorities are as follows when the MSFIS system is in OPERATE mode (see section 5.2.6 for OPERATE mode).

All Close, ***Close***, and ***ESFAS*** have equal priority. The ***Open*** command will be ignored while the ***All Close***, ***Close***, or ***ESFAS*** command(s) are present. Further the ***Open*** command will be ignored until the **CLOSE** to **KEEP CLOSE** time delay has expired.

2) The command priorities are as follows when the MSFIS system is in BYPASS mode (see section 5.2.6 for BYPASS mode).

All Close, ***Close***, ***ESFAS***, and ***Open*** commands shall not cause a change in system outputs while the system is in BYPASS mode.

5.2.6 Provisions for System Test of the Safety Function

The existing MSFIS System includes provision to permit complete testing of the safety function (***ESFAS*** command) of each actuation train for each valve. The Replacement MSFIS System shall also have such provision for complete testing of the safety function of each actuation train for each valve.

Overlapping of test schemes may be utilized in order to ensure complete coverage of the test program. It shall be possible to conduct all tests during plant operation. Performance of fully automatic system tests shall not interfere with the system's operation during presence of any actuation input.

Controls Seller shall provide three test types or detection capabilities to verify the proper operation of the Replacement MSFIS System to perform the intended safety function. The three types of tests or detection capabilities shall be;

1) Manual System Test:
   a. Ability to manually test required inputs and/or outputs required to perform the safety function
2) Manually Initiated Automatic Test:
   a. Ability to manually initiate automatic test(s) and/or detection capabilities which monitor or test the ability of the system to perform the required safety function.
3) Automatic Exception Detection:
   a. The system shall be designed such that the system is fully deterministic and shall automatically detect improper operation of the system's ability to perform the required safety function.

All system test and detection capabilities shall be validated & verified by Buyer.

The MSFIS test circuits shall provide one contact set for each actuation train for each valve. The contacts shall be open for normal operation and shall close at the appropriate test step as described below. These contacts will be used to enable test circuits in the Safeguards Test Cabinets to verify proper transmission and to verify the response to the ***ESFAS*** command.

a. BYPASS / OPERATE Mode Selection

1) Selection

Means shall be provided to select BYPASS or OPERATE mode for each actuation train for each valve. The selection of BYPASS shall maintain the valve in the as found condition and shall not cause a change in system outputs.. The selection of BYPASS shall only impact the particular actuation train and particular valve for which the BYPASS is selected. Except as indicated in the following paragraph, each change in mode shall require a positive manual action such as pushing a button, flipping a switch, or turning a switch (releasing a pushbutton or switch is not considered to be positive action, and shall cause no change in mode).

The actuation train for a particular side of a particular valve shall enter BYPASS mode upon command. There shall be one exception to this, which is the situation where the output state is CLOSE and the 60 sec delay is active, in this situation the CLOSE state must be completed and the 60 sec time complete prior to entering the BYPASS mode. BYPASS mode shall be entered automatically in the event of the Automatic Exception Detection circuitry, as described in 5.2.6 3) a, detecting an improper operation preventing the system to perform it's required safety function.

2) Indication

An indicating light / LED shall be provided for each actuation train for each valve. This light / LED shall be "ON" whenever BYPASS mode is in effect.

3) BYPASS Mode Initiation

Upon initiation of BYPASS mode for a particular actuation train for a particular valve, the following must be accomplished:

a) Latch the actuation outputs to the as found state.

b) De-energize the status output.

c) Light the BYPASS mode indicator light / LED
d) Close the test contacts described in Section 5.2.6 to enable the test circuits in ESFAS.

To prevent accidental valve operation, "a" must occur prior to "d."

4) Return to OPERATE Mode

Upon return to OPERATE mode, the following must be accomplished:

a) Open the test contacts (see Section 5.2.6).

b) Unlatch the actuation outputs, extinguish the BYPASS mode indicating light/LED, and release the status output.

b. Testing of Replacement MSFIS System

1) Controls Seller may modify or replace the existing Manual Test Panel as necessary to effectively interface with the Replacement MSFIS System logic-controller-based system and meet all specified requirements.

2) Provisions for testing of the Replacement MSFIS may include portable test equipment and capability to temporarily connect the portable test equipment to the Replacement MSFIS System during performance of testing.

5.2.7 Electronics Architecture

a. Existing Configuration

The attached drawing package depicts the existing electronic architecture. The Cabinet Assembly drawing 9N53 Sheets 1 and 2 depicts double card rack A1 with 32 card positions as part number 3 and single card rack A2 with 16 card positions as part number 4. Double card rack A1 is further detailed on drawing KH7299. Single card rack A2 is further depicted on drawing KJ7299.

The signal flow block diagram drawings KAF8909 Sheets 1 through 8 depict the location of every card in the card racks in the lower corners of the rectangles depicting the cards. The signal flow block diagrams also depict the card terminal numbers for all functions except power supply. Some card positions in the card racks are left vacant.

The three types of cards are input buffer, valve control module, and output relay driver. Drawing S6N231 depicts a schematic of the input buffer cards. Drawing S6N232 depicts a schematic of the output relay driver cards. Drawing S6N338 depicts a schematic of the valve control module cards. These schematic drawings depict the card terminal numbers for all functions, including power supply.

The signal flow block diagram drawings KAF8909 Sheets 1 through 8 depict signal flow between the circuit cards and to and from the output relays and cabinet terminal blocks. These drawings also depict wiring harnesses and connector and pin numbers. Interconnections are discussed further in Section 5.6.4.

b. Replacement MSFIS System Configuration

The replacement MSFIS System shall be an advanced-hardware-based solid-state control system which will receive defined inputs and develop defined outputs as specified to control the valves. The Replacement MSFIS System shall include the overall electronic functions of input buffers, system logic, and then output relay drivers. However, the Controls Seller shall configure the system, logic elements, circuit cards, and interconnections to perform the required system functions and meet all requirements such as sufficient drive capacity for the actuator solenoids.

Controls Seller may choose to re-use the existing card racks and interconnecting wiring to any extent feasible or to replace it all.

In each Cabinet, Controls Seller shall place the operating logic for the four MSIVs on a separate card(s) from the card(s) where the MFIV logic is placed.

5.3 Material Requirements

No specific requirement.

5.4 Environmental Requirements

The MSFIS cabinets are located in the Control Room equipment cabinet area, which will normally be air conditioned; however, the system and components shall be selected to function continuously at ambient temperatures ranging from 65°F to 84°F at a relative humidity from 20 to 70 percent.

5.5 Structural Requirements

5.5.1 Cabinets - Existing Configuration

The existing MSFIS System is contained in two independent cabinets, one cabinet for each separation group.

The drawings included in this specification document the existing cabinets' physical arrangement. These drawings are the best available information in document form, but there is no guarantee of their accuracy. Controls Seller is responsible for field measurement of all factors affecting interface of the replacement equipment with the existing equipment not replaced. Buyer can arrange access to the cabinets for Controls Seller's personnel to observe the cabinets and perform measurements. The cabinets are energized and in operation except during brief, precisely scheduled "maintenance window" periods during plant outages. Access can be arranged during operation or during a maintenance window. Such access will be under close supervision, and Controls Seller's personnel shall take precautions to prevent injury to themselves and also to prevent damage to, or inadvertent operation of, the equipment in the cabinets.

The existing cabinets to house the MSFIS are freestanding NEMA 12 enclosures, and they conform to the seismic qualifications of Attachment D. The cabinets are 90 inches high and 30 inches deep. Each cabinet is 24 inches wide with at least 19-inch doors. Each cabinet has a lock, and one key opens all cabinet locks. Cabinets were designed for stitch welding to imbedded floor channels. The bottom angle of the equipment has been stitch welded on the outside of the cabinet along the front and rear to concrete-imbedded channels that protrude 1 inch outside the cabinet face.

Flush or semi-flush panel-type hinged doors with resilient gasketing have been used on the cabinets.

Doors are equipped with a handle, latch, and lock sufficiently strong to hold the door in alignment when closed.

Door panels on the front and back are clear Lexan 1/4 inch thick.

Doors have hinges that permit them to swing approximately 180 degrees, are easily removed, and have sufficient members to ensure rigidity and prevent weaving or warping.

Mechanisms are provided in order to maintain cabinet doors in the open position during testing and maintenance.

Requirements for replacement doors are stated in Section 5.5.3.

Channel identification is required throughout the system.

Engraved lamicoid nameplates shall be used to identify all cabinets, channels, and devices. Colors for the nameplates shall be white letters on a red background in Channel I / Cabinet SA075A and black letters on a yellow background in Channel IV / Cabinet SA075B. Nameplates for non-safety-related Groups 5 and 6 items in both cabinets shall have white letters on a black background. See Attachment E for details of nameplates.

Cabinets have been designed to permit both top and bottom cable entry.

5.5.2 Seismic Requirements

Seismic requirements shall be in accordance with Attachments D and H, IEEE 323, IEEE 344, Regulatory Guide 1.100, and the damping values of Regulatory Guide 1.92. Seismic qualification may be performed by test or analysis, or a combination thereof. Attachment H invokes Attachment D for seismic qualification of "devices" rather than "control panel assemblies."

The MSFIS is designated as Seismic Category I and shall be selected, configured, and analyzed accordingly.

Actual shake tests of components, assemblies, subassemblies, and systems shall be performed in accordance with Attachment H.

Equipment procured under this Specification J-105A is designated Qf-1 with respect to Attachment D Section 3, that is, the equipment shall remain functional before, during, and after an OBE or an SSE.

Further notes on application of Attachments D and H:

a. The name Bechtel Power Corporation shall be understood to be the Buyer, Wolf Creek Nuclear Operating Corporation.

b. The names Supplier and Bidder shall be understood to be the Qualification Seller.

c. The Attachment H (Specification 10466-J-821) Section 5.3 cross reference to "Section 6.2" shall be considered a cross reference to Section 5.2.

Prior to testing, test procedures shall be submitted for Buyer's approval. Buyer shall be notified of all tests and offered the opportunity to witness the tests. All test anomalies shall be promptly reported to the Buyer and resolution sought before continuation of testing.

5.5.3 Replacement Doors

The Controls Seller may provide replacement doors for the existing cabinets to pass the EMI / RFI requirements. The replacement doors shall include hinges, latches, and latch operating rods and handles which meet the seismic requirements of Section 5.5.2. Welding shall not be required to mount the hinges and latch provisions of the replacement doors.

5.6 Electrical Requirements

5.6.1 Noise Rejection and Tolerance

The Replacement MSFIS System shall comply with the EMI / RFI requirements of EPRI TR-102323 as modified by Regulatory Guide 1.180. Testing is specified in Section 10.7. The Controls Seller's scope of work includes any required corrective action.

5.6.2 Electrical Wiring

a. Wiring within the cabinet enclosure shall be suitable for a general-purpose, non-hazardous location. The wiring shall be capable of meeting all requirements of IEEE 383 as modified by Regulatory Guide 1.131.

b. Wiring shall be so arranged that instruments or devices may be removed and / or serviced without undue disturbance.

c. No wiring shall be routed across the face or rear of an instrument, junction box, or other device in a manner that will prevent or hinder the opening of covers or obstruct access to leads, terminals, devices, or instruments.

d. Wiring shall be installed as shown on the Controls Seller's wiring diagrams. During installation, wiring that is found to be in nonconformance with the wiring diagrams shall be reworked at the Controls Seller's cost. Any wire that is disconnected as a result of rework shall be completely removed from the system.

e. All wiring to field terminal blocks, except coaxial and triaxial, shall be made with solder-less ring-tongue, compression-type connectors with insulated ferrules.

f. Where wiring must cross sharp metal edges, protection in the form of grommets or similar devices shall be provided. Wires shall be grouped in bundles and secured with nonflammable, nonmetallic tie bands.

g. Wiring shall not cross a panel door opening or be fixed to a panel door.

h. Internal wiring shall be identified with the Controls Seller's wire number at each termination to field terminal blocks by means of a plastic sleeve or similar permanent-type marker.

i. All wiring shall be subject to Buyer's approval.

5.6.3 Power Supply

a. Sources

Two separate sources currently supply nominal 125 Volt DC power, one to each MSFIS Channel / Cabinet. These redundant supplies are used throughout the plant, and complete physical and electrical isolation shall be maintained between them within the Controls Seller's equipment.

The incoming voltage level on all power supply modules will be a nominal 125 Volts DC, normally operated at 135 Volts DC. The designed operating range of the existing 125 Volt DC System is 140 Volts DC to 105 Volts DC.

b. Replacement Power Supply Modules

In the existing configuration, each cabinet has two output voltage levels, nominal 48 Volts DC and nominal 15 Volts DC. For the Replacement MSFIS System, the Controls Seller shall provide replacement power supply modules rated at DC voltage level(s) appropriate to feed all of the electrical loads in the Replacement MSFIS System plus any components retained from the existing design. The replacement power supplies shall have an input voltage operating range of 105VDC – 140VDC. The Controls Seller shall also determine whether any separate supplies are required at a given voltage level to separate electronic circuits from the effects of high-current switched loads.

The existing 125 Volt DC System has the capability to deliver a short circuit current of 11,070 Amperes. All electrical protective devices provided by the Controls Seller shall be capable of clearing this short circuit current.

Each voltage level in each cabinet shall have a pair of redundant and parallel power supply modules and capability to shift all load to one module in case of failure of the other one. Each pair of redundant power supply modules shall have provision for hot replacement "swapping" of one module while the other continues in service. Hot replacement by front-pull-out is preferred, but other configurations may be considered. Controls Seller may choose to modify or totally replace the existing power supply rack. Final configuration of the power supply rack and final configuration of the provisions for hot replacement are subject to Buyer's approval.

Each replacement power supply module shall have sufficient capacity to supply all assigned loads with 15% spare capacity while the redundant power supply module is out of service. The system shall have the capability ("health") to detect loss of each power supply module's capability to assume the full load assigned to the redundant pair. Loss of any power supply module's capability ("health") shall be one of the inputs to the Replacement MSFIS System's new summary trouble alarm circuit. Each pair of redundant power supply modules shall have provision for load sharing whenever both are in service and both have no failure detected.

Drawings of the existing power supply distribution scheme are attached as a reference for power supply module capacity. Drawings J-104-00295 and J-104-00296 show the existing power supply scheme before replacement by the redundant power supply modules with hot replacement capability. Drawing J-104-00296 shows the existing distribution of 48 Volts DC power to the output relays as well as to the existing electronic control system. Drawing J-104-00295 shows that the only existing use of 15 Volts DC power is to feed the electronic controller cards of the existing MSFIS System.

c. Outputs

The system outputs shall be fused as shown in Appendix B.

d. Operation

The MSFIS shall operate as required with the stated power supply without producing spurious actuation or failure to produce a required response to accident conditions.

5.6.4 Interconnections

Controls Seller shall provide wiring harnesses as required to interconnect all equipment provided. Controls Seller may re-use existing connectors and wiring harnesses connected to cabinet terminal blocks and components not replaced. The Signal Flow Block Diagrams and the Schematic of the Manual Test Panel provide information about the existing connectors and wiring harnesses. Wrap-type terminals are not permitted on new connectors / wiring harnesses. The connectors of the existing wiring harnesses have been identified as ITT Cannon type DL5, Zero Insertion Force (ZIF) 96-pin connectors with polarizing posts. The polarizing post orientation is defined on the assembly drawings for the Card Racks and Manual Test Panel. If Controls Seller uses new connectors, the connectors shall be a type which will meet seismic and noise requirements as specified elsewhere in the specification.

5.6.5 Replacement Relays

N/A

5.6.6 Metal Oxide Varistors - MOVs

N/A

5.6.7 Trouble Alarm

a. Controls Seller shall develop a summary trouble alarm in each system cabinet. The alarm shall provide a normally-open, open-to-alarm dry contact or equivalent. The alarm shall be wired to spare points on an existing terminal block in each cabinet. Buyer will provide a field cable and connect the trouble alarm to the plant annunciator.

b. The following items are suggested as a minimum list of conditions which should be alarmed:

Any DC power supply module loss of capability

Any circuit card removed

Any external test apparatus is connected to the system

Any output sequence incomplete

c. The trouble alarm logic shall include a means to indicate which trouble condition caused the alarm. The indication shall be displayed at the MSFIS Cabinet.

d. The trouble alarm shall include the equivalent of a "reflash" feature. When the alarm logic is already indicating an alarm to the plant annunciator, and another input condition alarms, the logic shall clear the alarm transmitted to the plant annunciator for approximately three seconds and then reinitiate the alarm to the plant annunciator.

5.6.8 Fuses and Fuse Blocks

Distribution of 125 Volt DC power to the output solenoid valves is shown in Appendix B. The distribution scheme includes separate assigned fuses for each output solenoid valve in the field. Additional nominal 3.2 ampere fuses and fuse blocks are required to meet this requirement. Appendix C shows the existing and modified fuse functions and number assignments. The scope of work includes procurement, location, seismic qualification, and all other pertinent factors for the additional fuses and fuse blocks.

The fuses and fuse blocks described in the previous paragraph and Appendix C are in addition to any fuses and fuse blocks that may be required by section 5.6.3 Power Supply or any other specific requirement or by good practice in the selection and configuration of the Replacement MSFIS System.

5.6.9 EMI / RFI Requirements

The Replacement MSFIS System shall comply with the EMI / RFI requirements of EPRI TR-102323 as modified by Regulatory Guide 1.180. Testing is specified in Section 10.7. The Controls Seller's scope of work includes any required corrective action.

5.7 Instrumentation and Control Requirements

No specific requirement.

5.8 Maintenance

No specific requirement. See also section 5.12, Accessibility for Maintenance and section 6.2, Special Tools.

5.9 Redundancy, Separation, and Diversity

5.9.1 Independence

Separation Groups (trains) are be electrically and physically isolated from each other so that events (including faults) affecting one element do not affect the others in any way. Independence is provided between redundant elements to preclude any interaction between different separation groups during maintenance or as a result of channel malfunction.

The Controls Seller shall provide electrical isolation and physical separation to develop the required independence on the Replacement MSFIS System.

5.9.2 Isolation

N/A

5.9.3 Separation

a. Physical separation shall be in accordance with IEEE 384 as modified by Regulatory Guide 1.75.

b. Equipment for one actuation channel or one measurement channel shall be separated physically by a barrier from any other actuation channel or measurement channel. The wiring and terminal block

arrangement within a given cabinet or isolated compartment shall allow for a minimum physical separation of six inches or use of fireproof barriers. Suitable means to implement IEEE 384 are contained in IEEE 420. Wiring separated by barriers shall maintain a 1-inch separation (or an equivalent of thermal insulation) between the barrier and the wire.

c. Wiring of any separation group shall be separated from any other group except as permitted by IEEE Standard 384 and except that Group 5 and Group 6 wiring do not have to be separated from each other, but must be separated from the other groups.

5.10 Testability

No specific requirement. See also section 5.2.b, Provision for System Test.

5.11 Interface Requirements

See section 5.2.4.

5.12 Accessibility for Maintenance, Repair, and In-service Inspection

No specific requirement. See also section 6.2, Special Tools.

5.13 Fire Protection Requirements

The Main Steam Isolation Valve, Main Feedwater Isolation Valves, and MSFIS System are required to function as part of the 10CFR50 Appendix R Safe Shutdown design. However, there are no specific requirements on the Replacement MSFIS System from the plant's Appendix R requirements. The existing and replacement MSFIS Systems meet the requirements of the plant's channel and group separation scheme.

6.0 SPARE PARTS AND SPECIAL TOOLS

6.1 Spare Parts

6.1.1 Special Spare Parts

Due to the specialized nature of the equipment supplied under this Specification, the following provisions are required:

a. Per Section 1.1 item 9, the initial stock of spare parts included in the basic scope shall be the quantity of each item reasonably estimated as necessary for twenty years' consumption. The initial stock of spare parts is the responsibility of the Controls Seller.

b. Controls Seller shall maintain the documentation, tooling, personnel expertise, access to materials, and any other necessary factor to enable the Controls Seller to produce additional spare parts items, within a reasonable lead time and at a reasonable price. Parts shall be provided as Commercial Grade items. Controls Seller shall maintain this capability for the foreseeable future.

6.1.2 List

A list of all repair parts and replaceable modules for the Replacement MSFIS System is required as part of the project documentation in Section 13.10.

6.2 Special Tools

6.2.1 Test Regime

Controls Seller shall develop a portable test regime for use during production and prototype testing. After Factory Testing is completed, Controls Seller shall turn over the test regime to the Buyer.

The test regime shall have the capability to test the complete Replacement MSFIS System from input to final output. This test regime is intended to perform complete system functional testing or individual card by card testing. The test regime will be used for performing the Site Acceptance Test (SAT) of the MSFIS control system.

6.2.2 Other Special Tools

Controls Seller shall provide to Buyer one set of any special tools required for maintenance or testing of the Replacement MSFIS System. Special tools are defined as tools not commonly available to the trade, involving non-standard dimensions, offsets, or shapes, specialized tools for holding parts in place for assembly, or specialized handling and lifting tools. The special tools also include electrical test equipment involving non-standard ranges of parameters or signals formats. The special tool scope also includes submittal of test or calibration procedures or set-point documents, if required by the configuration of any special tools. If no special tools are required, then no special tools need be supplied.

7.0 STAMPING REQUIREMENTS

All engineering documents developed specifically for this project shall be stamped by a Kansas Professional Engineer. It is anticipated that all documents developed specifically for this project will be Wolf Creek internal design documents. Therefore, it is not anticipated that the design documents from both the Controls Seller and the Qualification Seller will be developed specifically for this project, as the Replacement MSFIS System is not unique to Wolf Creek.

8.0 FABRICATION

8.1 Welding

No specific requirement.

8.2 Protective Coatings

No specific requirement.

8.3 Identification

No specific requirement.

9.0 INSTALLATION

Installation will be performed by the Buyer. However, Controls Seller shall provide documentation of an appropriate assembly and installation sequence to the Buyer. See Section 12.

10.0 TESTING

For the Replacement MSFIS System, the Qualification Seller shall meet the requirements for all testing, inspection, quality assurance, documentation, and equipment preparation for shipment set forth here. Prior to shipment, the assembled and wired equipment shall be tested at the factory in the presence of the Buyer. In consideration of the Replacement MSFIS System scope, the system configuration to be tested and the scope of testing is defined below.

10.1 Seismic

Required seismic tests are specified in Section 5.5.2 and the Attachments. Test documentation is specified in Section 13.6.

10.2 System Reliability Analysis

10.2.1 The Buyer or Buyer's consultant will perform failure-mode-and-effects analysis and reliability predictions. The final report of analysis-and-reliability data will be in accordance with IEEE 352.

The failure-mode-and-effects analysis will be presented in tabular form and shall list the following for each module, component or element:

a. Descriptive name of each element

b. A concise statement of the function performed by the element

c. A statement of the possible failure modes such as open, short circuit, high voltage, or burnout applicable for that element

d. The failure mechanism(s) for each failure mode

e. The effect of each postulated failure on the system performance

f. Method of detection for component failure

10.2.2 Components and modules used in the manufacture of the actuation system shall exhibit a quality consistent with the nuclear power plant 40-year-life objective of minimum maintenance and low failure rate.

10.2.3 Scope of the analysis shall be limited to the elements of the MSFIS required to perform the safety-related functions shown in Appendix A.

10.2.4 The basis for module reliability estimates shall follow the method described in MIL-HDBK-217B, December 1974, Section 4.5, Part Class and Part Type technique.

10.2.5 The Buyer will incorporate into an MSFIS reliability analysis the module reliability prediction values obtained by calculation.

10.2.6 The Buyer will assume that the time from the detection of a failure to normal after repair is eight hours, and shall list the reference(s) used in his analysis.

10.2.7 For the purposes of this analysis, the Buyer will use a MTBF value of five years for each channel of DC power supplied to the MSFIS.

10.2.8 The Buyer will provide a reliability analysis defining the system unreliability, assuming one system challenge a year, for both manual testing on a 30-day schedule and for automatic testing.

10.2.9 The Buyer will also supply a failure effects analysis arranged according to type of failure or effect and shall list the possible causes for each failure.

10.2.10 The Controls Seller shall not substitute any alternate or equivalent components in the system that would degrade the system reliability as approved by the Buyer in the Failure Modes and Effects Analysis or on the Reliability Analysis. If a change or modification must be made, for any reason, the Controls Seller shall advise the Buyer of the impact on these analyses (including quantitative impact on the Reliability Analysis) and shall obtain Buyer approval before implementing the change. A revised copy of the respective report, incorporating the revised analysis, must then be completed prior to final acceptance of the change. The Buyer reserves the right to require that complete revisions to the analyses be presented prior to determining the acceptability of a proposed change.

10.3 Components

10.3.1 Replacement MSFIS System components shall be tested in accordance with the Controls Seller's and Qualification Seller's standard test procedure.

10.3.2 All Controls Seller wiring outside of the card rack shall be given a dielectric test in accordance with NEMA Standard Publication ICS-1-2000. The dielectric testing shall be performed by the Qualification Seller.

10.3.3 Wiring tests shall include point-to-point continuity tests.

10.3.4 The Controls Seller shall be responsible for proper preparation of instruments and devices that may be damaged by high-voltage tests.

10.4 Actuation (Manual)

10.4.1 The Qualification Seller shall submit, for Buyer's approval, the proposed factory acceptance test procedures for both manual and automatic actuation testing (See Section 10.5) to demonstrate compliance with the functional requirements of this Specification. The procedures shall be approved by Buyer prior to the completion of system fabrication and assembly.

10.4.2 The MSFIS equipment shall undergo a complete functional test that shall prove the correct performance according to the specification of each individual module of the sensor and actuation channels. Tests shall be initiated in manual mode, applying simulated signals at the input terminals.

10.4.3 The MSFIS equipment shall be tested at the input terminals by applying all possible trip combinations as input signals for all possible system states.

10.4.4 Each actuation interface shall be individually tested through manual inputs and through the relative actuation logic.

10.5 Actuation (Automatic)

10.5.1 After successfully performing the tests in manual mode, the MSFIS equipment shall be tested in the automatic mode.

10.5.2 The duration of the test in the automatic mode shall be determined by the Qualification Seller but shall not be less than 120 hours continuous.

10.5.3 Combinations of trip signals shall be supplied at the input terminals during the automatic mode to test the MSFIS response for all possible system states.

10.6 Environmental Qualification

The environment at the equipment location is considered MILD with respect to the Equipment Qualification (EQ) program. Thus, the equipment is not subjected to the EQ program. However, the equipment's environment is stated in Section 5.4, and the equipment is required to operate in that environment for its 40 year lifetime.

10.7 EMI / RFI Testing

Testing shall be conducted to demonstrate compliance with the EMI / RFI requirements of EPRI TR-102323 as modified by Regulatory Guide 1.180. Testing may be performed on a suitable structure in a laboratory environment, or the final installed configuration in Buyer's plant, or an appropriate combination or these configurations.

11.0 INSPECTION

Inspection requirements are specified in Appendix R.

12.0 HANDLING, SHIPPING, AND STORAGE

12.1 Preparation for Shipment

12.1.1 The equipment shall not be prepared for shipment or shipped before the Buyer has either inspected the equipment or waived inspection.

12.1.2 Handling, shipping, and storage procedures shall be in accordance with ANSI N45.2.2, Level B. The Buyer shall review the Qualification Seller's procedures prior to shipment.

13.0 DOCUMENTATION REQUIREMENTS

The following types of documentation shall be submitted for engineering and quality verification. Controls Seller's and Qualification Seller's failure to comply with these requirements may result in order cancellation or withholding of payment until compliance is established:

13.1 Drawings - Outline

Drawings providing external envelope, including lugs, center line(s), location of center of gravity, location and size for electrical cable, conduit, fluid, and other service connections, isometrics, and details related to foundations and mountings.

13.2 Assembly, Erection, and Installation

Detailed written procedures, instructions, and drawings required to erect or install material or equipment.

13.3 Wiring Diagrams

Drawings which show the schematic wiring and connection information for electrical items.

13.4 Logic Diagrams

Drawings which show all the functional capabilities of the system, including all alarm, testing, bistable, bypass, coincidence logic, interface logic, and actuation logic.

13.5 Instruction Manuals

Instruction Manuals shall contain, as a minimum, a discussion of the theory of operation of the system and its components, copies of all interface and assembly drawings and parts lists, all written procedures, instructions, and drawings required for operation, maintenance, storage, and handling to ensure proper operation and to prevent any damage or deterioration during storage and handling at the job site.

13.6 Seismic Data Report and Test Procedures

Seismic requirements are stated in Section 5.5.2 and the Attachments. Required documentation discussed in Section 5.5.2 and the Attachments, including test procedures and analytical or test data which provide physical response information on an item, material, component, or system in relation to the conditions imposed by the stated seismic criteria of Attachment D shall be submitted for review or for record.

13.7 Engineering Performance Test Procedures and Quality Verification Reports

Engineering performance test procedures and quality verification reports of electrical tests, including continuity checks, channel actuation tests, system checks with and without imposed single failures, system tests with temperature and / or power supply variances, and all other test requirements of Section 10.

13.8 Schedule

The Controls Seller shall furnish a complete schedule forecasting engineering, fabrication, and testing, 60 days after the receipt of the purchase order.

13.9 Inspection Requirements

All inspection requirement details are described by Appendix R.

13.10 Repair Parts List

A list of all repair parts and replaceable modules for the Replacement MSFIS System in the Controls Seller's scope beyond commonly available "commodity" items. The list shall state for each item the name, Controls Seller's part

number, unit price, recommended quantity to stock for five years' use, and lead time for additional production. This document shall also include ordering information and shipping options.

APPENDICES

Replacement MSFIS System

Appendix A - Input Signals and Sources

AB-HV-14 – MSIV for Steam Generator A

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	1	ALL CLOSE	AC	AB-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group I**
		CLOSE	C	AB-HIS-14 Group I C contact
		OPEN	O	AB-HIS-14 Group I O contact
MV2, 4, 6	4	ALL CLOSE	AC	AB-HS-79 Group IV contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group IV**
		CLOSE	C	AB-HIS-14 Group IV C contact
		OPEN	O	AB-HIS-14 Group IV O contact

AB-HV-17 – MSIV for Steam Generator B

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	4	ALL CLOSE	AC	AB-HS-79 Group IV contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group IV**
		CLOSE	C	AB-HIS-17 Group IV C contact
		OPEN	O	AB-HIS-17 Group IV O contact
MV2, 4, 6	1	ALL CLOSE	AC	AB-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group I**
		CLOSE	C	AB-HIS-17 Group I C contact
		OPEN	O	AB-HIS-17 Group I O contact

*AB-HS-79, AB-HS-80, AE-HS-80, and AE-HS-81 each provide signals to four valves. One set of contacts is provided in each switch.

**A separate MSIS or FWIS signal is provided for each separation group for each valve.

Replacement MSFIS System

Appendix A - Input Signals and Sources

AB-HV-20 – MSIV for Steam Generator C

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	1	ALL CLOSE	AC	AB-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group I**
		CLOSE	C	AB-HIS-20 Group I C contact
		OPEN	O	AB-HIS-20 Group I O contact
MV2, 4, 6	4	ALL CLOSE	AC	AB-HS-79 Group IV contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group IV**
		CLOSE	C	AB-HIS-20 Group IV C contact
		OPEN	O	AB-HIS-20 Group IV O contact

AB-HV-11 – MSIV for Steam Generator D

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	4	ALL CLOSE	AC	AB-HS-79 Group IV contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group IV**
		CLOSE	C	AB-HIS-11 Group IV C contact
		OPEN	O	AB-HIS-11 Group IV O contact
MV2, 4, 6	1	ALL CLOSE	AC	AB-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (MSIS) Group I**
		CLOSE	C	AB-HIS-11 Group I C contact
		OPEN	O	AB-HIS-11 Group I O contact

Replacement MSFIS System

Appendix A - Input Signals and Sources

AE-FV-39 – MFIV for Steam Generator A

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	1	ALL CLOSE	AC	AE-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group I**
		CLOSE	C	AE-HIS-39 Group I C contact
		OPEN	O	AE-HIS-39 Group I O contact
MV2, 4, 6	4	ALL CLOSE	AC	AE-HS-81 Group IV contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group IV**
		CLOSE	C	AE-HIS-39 Group IV C contact
		OPEN	O	AE-HIS-39 Group IV O contact

AE-FV-40 – MFIV for Steam Generator B

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	4	ALL CLOSE	AC	AE-HS-81 Group IV contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group IV**
		CLOSE	C	AE-HIS-40 Group IV C contact
		OPEN	O	AE-HIS-40 Group IV O contact
MV2, 4, 6	1	ALL CLOSE	AC	AE-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group I**
		CLOSE	C	AE-HIS-40 Group I C contact
		OPEN	O	AE-HIS-40 Group I O contact

Replacement MSFIS System

Appendix A - Input Signals and Sources

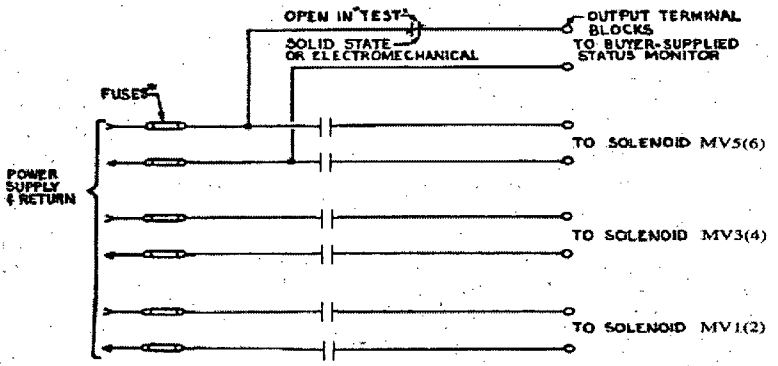
AE-FV-41 – MFIV for Steam Generator C

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	1	ALL CLOSE	AC	AE-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group I**
		CLOSE	C	AE-HIS-41 Group I C contact
		OPEN	O	AE-HIS-41 Group I O contact
MV2, 4, 6	4	ALL CLOSE	AC	AE-HS-81 Group IV contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group IV**
		CLOSE	C	AE-HIS-41 Group IV C contact
		OPEN	O	AE-HIS-41 Group IV O contact

AE-FV-42 – MFIV for Steam Generator D

SIDE	SEP GRP	COMMAND	SIGNAL	SOURCE
MV1, 3, 5	4	ALL CLOSE	AC	AE-HS-81 Group IV contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group IV**
		CLOSE	C	AE-HIS-42 Group IV C contact
		OPEN	O	AE-HIS-42 Group IV O contact
MV2, 4, 6	1	ALL CLOSE	AC	AE-HS-80 Group I contact*
		ALL CLOSE	AC	ESFAS (FWIS) Group I**
		CLOSE	C	AE-HIS-42 Group I C contact
		OPEN	O	AE-HIS-42 Group I O contact

Appendix B - Power Supply Fusing and Supply to the Buyer-Supplied Status Monitor



NOTE:

THE ARRANGEMENT SHOWN IS TO BE DUPLICATED FOR EACH ACTUATION TRAIN FOR EACH MSIV AND MFIV; THE OUTPUT CONTACT ARRANGEMENT FOR A MFIV HAS BEEN SHOWN AS AN EXAMPLE.

*3 AMPERE NOMINAL RATING

Replacement MSFIS System

Appendix C - Modified Power Supply Fuses and Functions Assigned

SA075A Separation Group 1 Circuits / Fuses / Functions				
Valve	Existing Fuses / Functions		Modified Fuses / Functions	
MSIV 1	F111, 2	Sol A + Status Panel Input Relay	F111,2	Sol MV1
	F113, 4	Sol B + Sol C + Sol D	F113,4	Sol MV3
			F115,6	Sol MV5 + Status Panel Input Relay
MSIV 2	F115, 6	Sol A + Status Panel Input Relay	F117,8	Sol MV2
	F117, 8	Sol B + Sol C + Sol D	F119,20	Sol MV4
			F121,2	Sol MV6 + Status Panel Input Relay
MSIV 3	F119,20	Sol A + Status Panel Input Relay	F123,4	Sol MV1
	F121,2	Sol B + Sol C + Sol D	F125,6	Sol MV3
			F127,8	Sol MV5 + Status Panel Input Relay
MSIV 4	F123,4	Sol A + Status Panel Input Relay	F129,30	Sol MV2
	F125,6	Sol B + Sol C + Sol D	F131,2	Sol MV4
			F133,4	Sol MV6 + Status Panel Input Relay
MFIV 1	F151,2	Sol A + Status Panel Input Relay	F151,2	Sol MV1
	F153,4	Sol B + Sol C + Sol D	F153,4	Sol MV3
			F155,6	Sol MV5 + Status Panel Input Relay
MFIV 2	F155,6	Sol A + Status Panel Input Relay	F157,8	Sol MV2
	F157,8	Sol B + Sol C + Sol D	F159,60	Sol MV4
			F161,2	Sol MV6 + Status Panel Input Relay
MFIV 3	F159,60	Sol A + Status Panel Input Relay	F163,4	Sol MV1
	F161,2	Sol B + Sol C + Sol D	F165,6	Sol MV3
			F167,8	Sol MV5 + Status Panel Input Relay
MFIV 4	F163,4	Sol A + Status Panel Input Relay	F169,70	Sol MV2
	F165,6	Sol B + Sol C + Sol D	F171,2	Sol MV4
			F173,4	Sol MV6 + Status Panel Input Relay

SA075B Separation Group 4 Circuits / Fuses / Functions				
Valve	Existing Fuses / Functions		Modified Fuses / Functions	
MSIV 1	F411,2	Sol A + Status Panel Input Relay	F411,2	Sol MV2
	F413,4	Sol B + Sol C + Sol D	F413,4	Sol MV4
			F415,6	Sol MV6 + Status Panel Input Relay
MSIV 2	F415,6	Sol A + Status Panel Input Relay	F417,8	Sol MV1
	F417,8	Sol B + Sol C + Sol D	F419,20	Sol MV3
			F421,2	Sol MV5 + Status Panel Input Relay
MSIV 3	F419,20	Sol A + Status Panel Input Relay	F423,4	Sol MV2
	F421,2	Sol B + Sol C + Sol D	F425,6	Sol MV4
			F427,8	Sol MV6 + Status Panel Input Relay
MSIV 4	F423,4	Sol A + Status Panel Input Relay	F429,30	Sol MV1
	F425,6	Sol B + Sol C + Sol D	F431,2	Sol MV3
			F433,4	Sol MV5 + Status Panel Input Relay
MFIV 1	F451,2	Sol A + Status Panel Input Relay	F451,2	Sol MV2
	F453,4	Sol B + Sol C + Sol D	F453,4	Sol MV4
			F455,6	Sol MV6 + Status Panel Input Relay
MFIV 2	F455,6	Sol A + Status Panel Input Relay	F457,8	Sol MV1
	F457,8	Sol B + Sol C + Sol D	F459,60	Sol MV3
			F461,2	Sol MV5 + Status Panel Input Relay
MFIV 3	F459,60	Sol A + Status Panel Input Relay	F463,4	Sol MV2
	F461,2	Sol B + Sol C + Sol D	F465,6	Sol MV4
			F467,8	Sol MV6 + Status Panel Input Relay
MFIV 4	F463,4	Sol A + Status Panel Input Relay	F469,70	Sol MV1
	F465,6	Sol B + Sol C + Sol D	F471,2	Sol MV3
			F473,4	Sol MV5 + Status Panel Input Relay

Replacement MSFIS System

Appendix R - Buyer's Inspection Procedures

1.0 SCOPE

This appendix details the responsibilities with regard to the inspection of material / equipment covered by this Specification and outlines the activities to be performed by the Buyer's inspector all in accordance with General Conditions, Clause 6, titled, Inspection.

2.0 RESPONSIBILITY

The prime responsibility for inspection of all material and work rests with the Qualification Seller. The inspection or its waiver by the Buyer does not relieve the Controls Seller and the Qualification Seller of any obligations or responsibility to perform in accordance with all requirements of the Specification.

3.0 ACCESS

The Buyer's representative shall be given free access to the Controls Seller's and Qualification Seller's, and their sub-supplier's manufacturing facilities to inspect and report on work in all phases of selection, manufacture, examination, or testing.

4.0 INSPECTION POINTS

4.1 Inspection observations on material produced under this Specification shall include, but not be limited to, the witness and hold points listed in Paragraph 4.2 and 4.3.

4.2 Witness Points

Witness points are defined as critical steps in manufacturing and testing where the Controls Seller and Qualification Seller is obligated to advise the inspector 5 days in advance of the start of the operation so that it may be witnessed by the inspector. However, the work may proceed past the witness point if the inspector is not available at the appointed time.

The following activities are classified as witness points and will be witnessed on a first-operation basis for each approved procedure and periodically thereafter.

a. Wire dielectric test

b. Wiring

c. Component testing

4.3 Hold Points

Hold points are defined as critical steps in manufacturing and testing where the Controls Seller and Qualification Seller is obligated to advise the inspector 5 days in advance of the operation so that is may be witnessed by the inspector. The Controls Seller or the Qualification Seller shall not proceed with the work past the hold point except by written waiver (agreement by the inspector).

The following activities are classified as hold points and will be witnessed or performed by the inspector for each item manufactured:

a. Functional / performance testing.

b. Final inspection of materials for construction, dimensions, general workmanship, cleanliness, marking, tagging, and preparation for shipment.

c. Review and sign-off of supplier's quality verification documents for completeness and accuracy.

d. Release for shipment.

5.0 ACCEPTANCE

The Buyer's release of any material furnished by the Controls Seller or Qualification Seller, or their subcontractor's shall not imply acceptance of the material or in any way relieve the Controls Seller or Qualification Seller of their responsibility. Final acceptance of all materials is made at the job site.

Form APF-05-004-03, Rev. 1

DOCUMENTATION SUBMITTAL REQUIREMENTS

Specification Number J-105A Rev. .1
Sheet 1 of 7

A. The following documentation shall be submitted to WCNOC within 60 days after the issuenace of the Controls Seller PO for the Replacement MSFIS System

DOCUMENT CATEGORY NUMBER	SPECIFICATION PARAGRAPH REFERENCE	TYPE & QTY COPIES REQUIRED	DESCRIPTION AND REMARKS
5.0	13.8	1 hc	Schedule of Engineering, Fab'n, Test, and Delivery

B. The following documentation shall be submitted to WCNOC prior to start of manufacture of production items for WCNOC Engineering review and approval:

DOCUMENT CATEGORY NUMBER	SPECIFICATION PARAGRAPH REFERENCE	TYPE & QTY COPIES REQUIRED	DESCRIPTION AND REMARKS
1.1	13.1	1 elec + hc	Outline Drawings
1.5	13.4	1 elec + 1 hc	Control Logic diagram
1.2	13.2	1 elec + 1 hc	Assembly Drawings
1.4	13.3	1 elec + 1 hc	Wiring Diagrams
7.0	13.6	1 elec + 1 hc	Seismic Test Procedures for review
8.0	10.2.1	1 elec + 1 hc	Preliminary FMEA and Reliability Analysis

C. The following documentation shall be submitted to WCNOC prior to shipment for WCNOC Engineering review and approval:

DOCUMENT CATEGORY NUMBER	SPECIFICATION PARAGRAPH REFERENCE	TYPE & QTY COPIES REQUIRED	DESCRIPTION AND REMARKS
7.0	13.6	1 hc	Seismic Test Data Reports
26.0	10.4.1 and 13.7	1 elec + 1 hc	Performance Test Procedures and Reports aka FAT
28.0	12.1.10	1 elec + 1 hc	Handling, Shipping, and Storatge Procedures

D. The following documentation shall be submitted to WCNOC with shipment of the item. Prior WCNOC Engineering review and approval is not required:

DOCUMENT CATEGORY NUMBER	SPECIFICATION PARAGRAPH REFERENCE	TYPE & QTY COPIES REQUIRED	DESCRIPTION AND REMARKS
2.0	13.10	1 elec + 1 hc	Repair Parts List – 20 Years' Consumption
4.0,.1, .2,.3,.4	13.5	8 hc	Instruction Manual
8.0	10.2.1	1 elec + 1 hc	Final FMEA and Reliability Analysis

DOCUMENTATION SUBMITTAL REQUIREMENTS

DOCUMENT CATEGORY DEFINITIONS FOR FORM APF-05-004-03

(E) Engineering Documents - This term comprises procedures, drawings, specifications, QA plans, prototype qualification test reports, and other similar documents that require approval prior to use of the document in the design, fabrication, installation or other work process. The term is also applied to price lists and instructional documents for handling, storage, maintenance, etc., that are informational interest only to engineering.

(V) Quality Verification Documents - This term comprises material test reports, heat treatment charts, welding reports, NDE results, performance test reports, etc., which demonstrate or certify conformance to the technical or inspections requirements of the procurement documents.

1.0 DRAWINGS (E)

1.1 Outline Dimensions, Services and Foundation/Mounting Details - Drawings providing external envelope, including lugs, center line(s), location and size for electrical cable, conduit, fluid and other service connections, isometrics and details related to foundations and mountings.

1.2 Assembly Drawings - Detailed drawings indicating sufficient information to facilitate assembly of the component parts of an equipment item.

1.3 Shop Detail Drawings - Drawings which provide sufficient detail to facilitate the fabrication or manufacture of the equipment item. This includes but is not limited to, spool drawings, heat exchanger internal details, internal piping and wiring, cross-sectional details and architectural details.

DOCUMENTATION SUBMITTAL REQUIREMENTS

DOCUMENT CATEGORY DEFINITIONS FOR FORM APF-05-004-03

1.4 Wiring Diagrams - Drawings which show the schematic wiring and connection information for electrical items.

1.5 Control Logic Diagrams - Drawings which show the paths which input signals must follow to accomplish the required responses.

1.6 P & IDs - Piping and instrumentation diagrams which show piping system details and the basic control elements.

2.0 PARTS LIST AND COST (E) - Exploded view with identified parts and recommended spare parts for one year's operation with unit cost.

3.0 COMPLETED DATA SHEETS (E) - Information provided by a supplier on data sheets furnished by WCNOC which states serial number, operating ranges, etc., of equipment that the supplier intends to deliver to satisfy the specification requirements.

4.0 INSTRUCTIONS (E)

4.1 Erection/Installation - Detailed written procedures, instructions, and drawings required to erect or install material or equipment.

4.2 Operating - Detailed written instructions describing how an item or system should be operated.

4.3 Maintenance - Detailed written instructions required to disassemble, reassemble and maintain items or systems in an operating condition.

4.4 Site Storage and Handling - Detailed written instructions which define the requirements and time period for lubricating, rotating, heating, lifting or other handling requirements to prevent damage or deterioration during storage and handling at jobsite.

5.0 SCHEDULES ENGINEERING AND FABRICATION/ERECTION (E) - Bar charts, critical path methods, etc., which chronologically detail the sequence of activities.

6.0 QUALITY ASSURANCE MANUAL PROCEDURES (E) - The documents which describe the planned and systematic measures that are used to assure that structures, systems and components will meet the requirements of the procurement documents.

DOCUMENTATION SUBMITTAL REQUIREMENTS

DOCUMENT CATEGORY DEFINITIONS FOR FORM APF-05-004-03

7.0 SEISMIC DATA REPORT (E) - The analytical or test data which provides physical response information on an item, material, component or system in relation to the conditions imposed by the stated seismic criteria.

8.0 ANALYSIS AND DESIGN REPORT (E) - The analytical data (stress, electrical loading, fluid dynamics, etc.) which assures that an item satisfies specified requirements.

9.0 ACOUSTIC DATA REPORT (E) - The noise, sound and other vibration data required by specification which is the audible range and above the seismic frequency.

10.0 SAMPLES (E) - A representative sample of the material to be used or a representative data package which will be submitted for the items purchased as required in the specification.

11.0 MATERIAL DESCRIPTION (E) - The technical data describing a material which a supplier proposes to use for a specific order. This usually applies to architectural items, e.g., metal siding, decking, doors, paints, and coatings.

12.0 WELDING PROCEDURES AND QUALIFICATION (E) AND VERIFICATION REPORTS (V) - The welding procedure specification and supporting welding procedure qualification test records required for welding hard facing, overlay, brazing and soldering. A verification report of welds performed includes the identification of the qualified welders, and the procedures used, and certification that the welders were qualified.

13.0 WELD ROD CONTROL PROCEDURES (E) AND VERIFICATION REPORTS (V) - The procedures for controlling issuance, handling, storage and traceability. Verification report(s) for weld rod are defined as certified material test reports which include the requirements defined by the code and material specification imposed by the procurement documents.

DOCUMENTATION SUBMITTAL REQUIREMENTS

DOCUMENT CATEGORY DEFINITIONS FOR FORM APF-05-004-03

14.0 REPAIR PROCEDURES (E) AND MAJOR REPAIR VERIFICATION REPORTS (V) - The procedures for controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection. Verification reports may include weld repair locations (maps), material test reports for filler metal, pre-and-post-weld heat treatment records, NDE records, etc. The resolution of whether a repair is major or not is a WCNOC responsibility.

15.0 CLEANING AND COATING PROCEDURES (E) AND VERIFICATION REPORTS (V) - The procedures for removal of dirt, grease or other surface contamination and includes application of protective coatings. Verification reports include certification of visual examination for surface preparation, surface profile, materials, etc., humidity data, temperature data and coating thickness data as required by the procurement documents.

16.0 HEAT TREATMENT PROCEDURES (E) AND VERIFICATION REPORTS (V) - The procedures for controlling temperature, time at temperature as a function of thickness, furnace atmosphere, cooling rate and method, etc. Verification reports normally include furnace charts or similar records which identify and certify the item(s) treated, the procedure used, furnace atmosphere, time at temperature, cooling rate, etc. Verification data may be in either narrative or tabular form.

17.0 CERTIFIED MATERIAL PROPERTY REPORTS (V)

17.1 CMTR (Certified Material Test Reports) - These reports include all chemical, physical, mechanical and electrical property test data required by material specification and applicable codes. This is applicable to cement, concrete, metals, cable jacket materials, rebar, rebar splices, etc. The certified MTR shall include a statement of conformance that the materials meet the specification requirements.

17.2 Impact Test Data - Results of any Charpy or drop weight tests including specimen configuration, test temperature and fracture data.

17.3 Ferrite Data - Report of the ferrite percentage for stainless steel materials used, including castings and welding filler metals as deposited.

17.4 Material Certificate of Compliance - Verification document which certifies conformance to the requirements of the applicable material specification.

17.5 Electrical Property Reports - Report of electrical characteristics, e.g., dielectric, impedance, resistance, flame test, corona, etc.

DOCUMENTATION SUBMITTAL REQUIREMENTS

DOCUMENT CATEGORY DEFINITIONS FOR FORM APF-05-004-03

18.0 CODE COMPLIANCE (V) - Verifying documents (such as data Forms U-1, N-2, State, etc.) which are prepared by the manufacturer or installer and certified by the Authorized Code Inspector.

19.0 UT - ULTRASONIC EXAMINATION PROCEDURES (E) AND VERIFICATION REPORTS (V) - Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by the use of high frequency acoustic energy.

20.0 RT - RADIOGRAPHIC EXAMINATION PROCEDURES (E) AND VERIFICATION REPORTS (V) - Method of detection and examination results of presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film.

21.0 MT - MAGNETIC PARTICLE EXAMINATION PROCEDURES (E) AND VERIFICATION REPORTS (V) - Method of detection and examination results of surface (or near surface) discontinuities in magnetic materials by distortion of an applied magnetic field.

22.0 PT - LIQUID PENETRANT EXAMINATION PROCEDURES (E) AND VERIFICATION REPORTS (V) - Method of detection and examination results of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.

23.0 EDDY CURRENT EXAMINATION PROCEDURES (E) AND VERIFICATION REPORTS (V) - Method for detection and examination results of discontinuities in material by distortion of an applied electromagnetic field.

24.0 PRESSURE TEST - HYDRO, AIR, LEAK, BUBBLE OR VACUUM TEST PROCEDURE (E) AND VERIFICATION REPORTS (V) - Method for evaluating the structural and mechanical adequacy or integrity by application of differential pressure and report of the test results.

25.0 INSPECTION PROCEDURE (E) AND VERIFICATION REPORTS (V) - Organized process followed for the purpose of determining that specified requirements (dimensions, properties, performance results, etc.) are met. Documented findings resulting from an inspection are included in the verification report.

DOCUMENTATION SUBMITTAL REQUIREMENTS

DOCUMENT CATEGORY DEFINITIONS FOR FORM APF-05-004-03

26.0 PERFORMANCE TEST PROCEDURES (E) AND VERIFICATION REPORTS (V) - Tests performed to demonstrate that functional design and operational parameters are met and the report of the test results.

26.1 Mechanical Tests, e.g., pump curves, valve stroking, load, temperature rise, calibration, environmental, etc.

26.2 Electrical Tests, e.g., load, impulse, overload, continuity, voltage, temperature rise, calibration, saturation, loss, etc.

27.0 PROTOTYPE TEST REPORT (E AND V) - Report of a test which is performed on a standard or typical example of equipment, material or item, and is not required for each item produced in order to substantiate the acceptability of equal items. This normally includes tests which may, or could be expected to, result in damage to the item(s) tested.

28.0 SUPPLIER SHIPPING PREPARATION PROCEDURE (E) - The procedure used by the supplier to prepare finished materials or equipment for shipment from his facility to the jobsite.

5.1E

Gaithersburg Power Division

Specification No. 10466-J-820 (Q)
Job No. 10466

TECHNICAL SPECIFICATION

FOR

SEISMIC QUALIFICATION REQUIREMENTS FOR

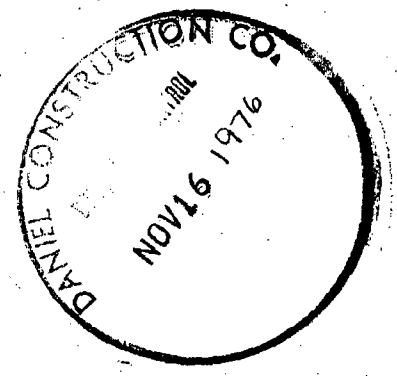
CLASS 1E CONTROL AND INSTRUMENTATION DEVICES

FOR THE

STANDARDIZED NUCLEAR UNIT

POWER PLANT SYSTEM

(SNUPPS)



BECHTEL POWER CORPORATION
GAITHERSBURG, MARYLAND

NO.	DATE	REVISIONS	BY	CH'K	GS	PE
0	3/12/75	Issued for Client Comments	PJR	REB		
1	5/27/75	Issued for Use	PJR	REB		

DC44

SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.
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9	0												
10	1												
11	0												
Fig.1	0												
Fig.2	0												
Fig.3	1												
Fig.4	0												

NO.	DATE	REVISIONS	BY	CK'D	APP'D	NO.	DATE	REVISIONS	BY	CK'D	APP'D
△0	5/12/75	Issued for Client Comments	PJR	RLB		△					
△1	5/27/75	Issued for Use	PJR	REB		△					
△						△					
△						△					
△						△					
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△						△					
△						△					

WO-A-40172

REVISION STATUS SHEET

STANDARDIZED NUCLEAR UNIT POWER PLANT SYSTEM

JOB NO. 10466

Specification J820(Q)

REV. 1

TABLE OF CONTENTS

SEISMIC QUALIFICATION REQUIREMENTS

FOR

CLASS 1E CONTROL AND INSTRUMENTATION DEVICES

1. SCOPE

1.1 General

This specification attachment establishes acceptable qualification methods and the requirements to verify that Class 1E and other safety-related control and instrumentation devices can perform their specified safety-related functions during and/or following a safe shutdown earthquake, SSE.

The safety-related function of a device will be specified in the device data sheet or procurement specification by using the classifications defined in this document.

The qualification procedure is to test the device on a vibration table which duplicates or exceeds the anticipated vibratory motions of the actual mounting surface on which the device will be mounted. The actual mounting surface may be a control panel, cabinet, console, instrument rack, building wall, piping system, etc. Ultimately, the devices may be located anywhere throughout the power plant, e.g., in the control room area or in the process area.

Although this specification is written primarily for electrical devices, it provisions apply equally to mechanical and electromechanical equipment, e.g., pneumatic instrumentation and air-operated control devices.

1.2 Responsibilities

The Buyer, Bechtel Power Corporation, will be responsible for defining the maximum vibratory motions throughout the power plant structure. The testing or analysis facility shall have direct access to the Buyer's project or staff personnel for obtaining explanatory information about this specification, however, any such information will not alter any existing contractual agreements.

Seismic qualification of each Class 1E device shall be the responsibility of the Supplier.

The device purchaser shall be responsible for assuring that the maximum anticipated vibratory motions at the actual device

mounting location do not exceed the motions for which the Class 1E device is qualified.

A list of testing facilities will be furnished upon request. However, selection of the test facility shall be the responsibility of the Supplier.

1.3 Intent

The intent of this specification attachment is to specify qualification procedures and acceptance criteria that conform to IEEE Standard 344-1975, Recommended Practices for Seismic Qualifications of Class 1E Equipment for Nuclear Power Generating Stations.

1.4 Acceptable Qualification Methods

It is recommended that the device manufacturer perform comprehensive, generic, one-time types of tests of standard devices which are used repeatedly in nuclear safety-related applications rather than to requalify the devices for each power plant project. Such a test program shall be based on a representative number of standard devices.

An acceptable generic qualification method is to perform fragility-level tests to determine the maximum vibratory motions which can be tolerated before malfunction occurs.

Another acceptable generic qualification method is to qualify a device for most U.S. plant locations as defined by the RRS shown in Figure 1 or the RIM shown in Figure 2 as appropriate for the device in question.

Alternatively, a device can be qualified at or above the seismic conditions for a specific power plant. The appropriate project curves are shown in Figures 3 and 4.

These three alternative test methods are defined further in Section 5.6.

Certain items in a nuclear power plant will be supplied in a number of similar configurations which do not significantly alter the item's response to a given seismic event. Qualification by testing a representative unit and, subsequently, analytically comparing each specific unit with the representative unit, will be acceptable.

1.5 Control Panel Assembly Qualification

Seismic qualification of Class 1E control panels, consoles, and cabinet assemblies is covered by Specification Attachment 10466-J821.

1.6 Environmental Exposure Prior to Seismic Testing

Certain devices, denoted in the procurement specification, must be qualified to withstand long-term exposure to severe ambient conditions. Examples are devices to be located within the reactor containment structure which may be exposed to aging effects of high ambient temperature and radiation. Such devices shall undergo the appropriate aging exposure prior to seismic qualification tests.

2. DEFINITIONS

This section defines words in the context in which they are used in this specification. The portions in quotations marks were excerpted from IEEE Standard 344.

Definitions of other terms used in this specification are given in IEEE Standard 344.

2.1 Device

An individual item of equipment with specific operational functions. Examples are sensors, transmitters, controllers, bistables, indicators, recorders, relays, control switches, etc. Devices may be mounted in two general categories: (a) on the building structure, control panels, racks, pressure vessels, etc., or (b) line mounted directly in or on piping systems.

2.1.1 Class 1E Devices

Devices which are in nuclear safety-related service and to which is applied "The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment." For the purpose of this document, Class 1E is defined further to include all devices classified as Seismic Category 1.

2.2 Fragility Level

"The highest level of input excitation, expressed as a function of frequency, that an equipment can withstand and still perform the required Class 1E functions."

2.3 Required Input Motion (RIM)

"The required input motion to the equipment under test is the amplitude of acceleration expressed as a function of frequency that an equipment shall withstand and still perform the required Class 1E functions."

2.4 Required Response Spectrum (RRS)

"The response spectrum issued by the user or his agent as part of his specifications for proof testing, or artifically created to cover future applications. The RRS constitutes a requirement to be met."

2.5 Safe Shutdown Earthquake (SSE)

"That earthquake which produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional. These structures, systems, and components are those necessary to assure: (1) The integrity of the reactor coolant pressure boundary, (2) The capability to shut down the reactor and maintain it in a safe shutdown conditions, or (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of Code of Federal Regulations, Title 10, Part 100 (December 5, 1973)."

2.6 Test Response Spectrum (TRS)

"The response spectrum which is constructed using analysis, or derived using spectrum analysis equipment based on the actual motion of the shaker table. When qualifying equipment by utilizing the response spectrum, the TRS is to be compared to the RRS."

3. DEVICE CLASSIFICATIONS

Devices requiring seismic qualification are designated as either Qf-1 or Qf-2 as a part of the procurement specification.

Qf-1 shall remain functional during and after an SSE.

Qf-2 shall remain functional after, but not necessarily during, an SSE.

4. FUNCTIONAL REQUIREMENTS

4.1 Operational Conditions

All devices shall be tested while in their normal operating condition, i.e., energized or de-energized, pressurized or depressurized. Operating pressure, voltage etc., shall be applied during and after the tests to determine that vibratory conditions shall not produce a malfunction or failure of the device.

The device qualification test shall consider the extremes of possible variations from nominal values which could result in incipient malfunction,e.g., when the relay coil voltage drops below its lower operating value, the relay contacts may chatter. Published operating limits for the device shall be used in the direction which is more likely to produce malfunction.

4.1.1 Qf-1 Classification

Devices that are classified as Qf-1 on data sheets shall be operated during testing to demonstrate that vibratory motions can be tolerated without malfunction or failure. Operability shall be monitored and recorded during and after vibratory excitation.

The Qf-1 devices shall be caused to change state during the test, e.g., de-energize the relay coil or trip a bistable unit. The measured parameter, or input signal, shall be varied as necessary to demonstrate compliance with the acceptance criteria specified in Section 4.2.

4.2 Acceptance Criteria

The acceptance criterion for qualification tests is that there be no device malfunction or failure that would inhibit the nuclear safety-related function of the device.

Unrestricted acceptance shall require that the following minimum conditions shall not occur, as applicable:

a. Loss of output signal, e.g., open or short circuit

b. Output variations greater than the published accuracy over the full range

c. Spurious or unwanted output, e.g., relay contact bounce. NOTE: If contact bounce is detected, the specific data of the test shall be recorded and submitted to the Buyer for written disposition of the deviation.

d. Drift of set point or trip setting greater than the published accuracy over the full range

e. Calibration shift greater than the published accuracy over the full range; this parameter need not be determined during vibratory excitation.

f. Structural failure, e.g., broken or loosened parts or deformation resulting in device failure

g. Loss of required performance characteristic,e.g., ability to change state

h. Loss of pressure-boundary integrity, e.g., leakage.

Sufficient instrumentation shall be provided to monitor and record device performance during vibratory excitation, i.e., that each of the above criteria has been satisfied. Malfunctions shall be analyzed to establish causative factors, and suitable remedial steps shall be undertaken prior to retest.

Whenever these criteria are not met, the specific deviation data shall be submitted formally to the Buyer for evaluation of acceptability for specific applications.

5. SEISMIC QUALIFICATION CONDITIONS

5.1 Test Procedures

Written test procedures shall be prepared for all tests and submitted to the Buyer as described in the Documentation Section, below. The test procedure shall require the use of a vibration table to produce vibratory motion.

The vibration table motion shall simulate conservatively, both in amplitude and frequency content, the anticipated seismic motions of the actual surfaces on which the device will (can) be mounted in the power plant.

Equipment shall be subjected to the acceleration values described in Section 5.6. Vibratory tests shall be conducted over the range of 1 to 40 Hz. However, 1 to 33 Hz shall be acceptable for tests performed prior to the receipt of the purchase order to which this seismic qualification specification is attached.

Figure 1 is an RRS and corresponds, in acceleration and frequency values, to the response of single-degree-of-freedom oscillators attached to the vibration table surface on which the test specimen is mounted. The three percent critical damping spectrum shall be used as the RRS unless written permission to deviate is granted by the Buyer. Line-mounted devices shall refer to Figure 2, which is the RIM of the test table.

5.2 Vibration Table Excitation (Wave Form)

The preferred excitation wave form is random motion; line-mounted devices may also be qualified by a resonance search and a sine dwell at each resonance. The resonance search shall consist of a sine sweep at two octaves per minute and with an amplitude at least 20 percent of the RIM. Testing with other wave form characteristics than those described in this paragraph may be acceptable, depending upon the particular test in question. However, test wave forms other than these shall be justified adequately for each type of device being qualified and its intended mounting arrangements.

The wave-form characteristics of the proposed test input motion shall be such that the TRS equals or exceeds the RRS for nonline-mounted devices or that the test table motion equals or exceeds the RIM for line-mounted devices. Test motions other than random shall be in conformance with the criteria of IEEE-344, Section 6.6, Test Methods.

5.3 Direction of Vibratory Motion

5.3.1 RRS Testing

The input motion shall be applied simultaneously to the vertical axis and a horizontal axis parallel to the front surface of the equipment when the equipment is in its normal mounting position. Independent random inputs are preferred, and, if used, the test shall be performed in two steps with the equipment rotated 90^{o} in the horizontal plane for the second step. If in-phase inputs are used, four tests should be run: first, with the inputs in phase; next, with one input 180^{o} out of phase; next, with the equipment rotated 90^{o} horizontally and the inputs in phase; and, finally, with the same equipment orientation but with one input 180^{o} out of phase. Any other methods of qualification shall require acceptable justification and written permission from the Buyer before proceeding with the tests.

5.3.2 RIM Testing

The input motion should be applied to each of the three mutually orthogonal axes individually.

5.4 Duration of Test Run

The duration of each test run, i.e., each combination of acceleration amplitude and frequency pattern, shall be not less than 30 seconds, except that the sine sweep described in Section 5.2 shall be of a duration dictated by the sweep rate and frequency range.

5.5 Test Acceleration Level

The required maximum test acceleration of the vibration table surface shall be determined from the curves shown in Figures 1 through 4, except for devices that will be qualified to the curve shown in Figure 3, and will be mounted in a panel. See Level C following.

5.6 Qualification Levels

Any of the three levels of acceleration herein specified are acceptable:

5.6.1 Level A

Conduct fragility tests to determine the maximum acceleration that the device can tolerate before malfunction or failure occurs. The Supplier shall assure that fragility level test amplitudes exceed the project acceleration levels of Figures 3 and 4, as applicable.

An acceptable method of fragility testing is to approach the level of Figure 1 RRS or the Figure 2 RIM incrementally in steps between 10 and 25 percent of the RRS or RIM. If the equipment failed at less than full level, the equipment would qualify for any RRS or RIM that the test data exceeded.

5.6.2 Level B

Subject the device to the worst-case test acceleration that will qualify the device for most plant sites in the continental United States. See Figure 1 for nonline-mounted devices and Figure 2 for line-mounted devices.

5.6.2.1 Nonline-Mounted Devices

Generic qualification of devices for use in virtually all continental United States power plant sites is covered by Level B. The results of generic qualification shall demonstrate that the TRS exceeds (in amplitude) the envelope of worst-case RRS shown in Figure 1, which applies both to horizontal and vertical directions.

5.6.2.2 Line-Mounted Devices

Generic qualification of devices for use in virtually all continental United States power plant sites is covered by Level B. The results of generic qualification shall demonstrate that the maximum qualification acceleration equals or exceeds the worst-case RIM shown in Figure 2, which applies to both the horizontal and vertical directions.

5.6.3 Level C

Proof test the device to the particular test acceleration which is unique to its mounting location in the specific power plant structure. Level C reflects the reference SSE for the specific power plant site. The appropriate curves are attached as Figure 3 for nonline-mounted devices and Figure 4 for line-mounted devices. In cases where nonline-mounted devices are mounted in a control panel assembly, the qualification TRS must equal or exceed the amplitude values of Figure 3 multiplied by the vibration amplification factor (1.4) (Refer to J-821, Paragraphs 3.2.1 and 3.2.2).

5.7 Test Facility Limitations

Figures 1 through 4 depict the dynamic characteristics of the device-mounting locations. It is recognized that the dynamic capability of actual vibration tables may be limited in some way. The figures do not attempt to anticipate such limitations. The Bidder shall describe in his proposal the extent of any limitations.

5.8 Testing Requirements

The devices shall be tested in all the physical orientations in which they can be used normally. If a standard mounting fixture will be used in the actual plant installation, that fixture shall be used during vibratory testing. Any additional attachments to the vibration table shall be dynamically rigid and shall not change the input motion at the device undergoing the test. If a special mounting fixture is required for actual installation, the dynamic properties of that fixture shall be conservative relative to the fixture used during the test.

6. DOCUMENTATION

6.1 Submittals

The Bidder shall provide with his proposal the proposed qualification procedure delineating the steps to achieve qualification.

After purchase order award, the Supplier shall submit his qualification procedure for Buyer approval. Sufficient detail shall be used to demonstrate adequacy of the selected method (see Section 6.2).

Prior to the seismic testing of any device, the Supplier shall inform the Buyer of the time and place of the tests so that the Buyer may have his representatives witness these tests.

6.2 Documentation Requiring Approval

The following seismic qualification data for each device type shall be provided for Buyer approval and shall demonstrate that the device meets the requirements of this specification attachment. All engineering documentation shall have been approved by the Buyer prior to shipment of any device to the jobsite.

6.2.1 The identification of each device being qualified by a type test shall be included in the report for that device type.

6.2.2 Record of compliance with the applicable acceptance criteria or specific deviations. Show that the TRS envelope exceeds the RRS envelope for nonline-mounted devices and that the table motion exceeds the RIM for line-mounted devices.

6.2.3 Identification of the device features which were qualified by generic tests; also justification and certification that the devices being supplied are sufficiently similar in performance, size, material, or other characteristics so that requalification is not needed.

6.2.4 Limitations of the device application, such as possible limitation to physical orientation, etc.

6.2.5 Description of the test method, including justification if other than random motion input is employed (see Section 5.2).

6.2.6 Test data, including graphs and/or tables, and the TRS.

6.2.7 Test results and the analyses or conclusions achieved from those results.

6.2.8 Approval signature and date. Approval shall be by an engineer qualified in the field of dynamic response testing/analysis.

6.3 Additional Documentation

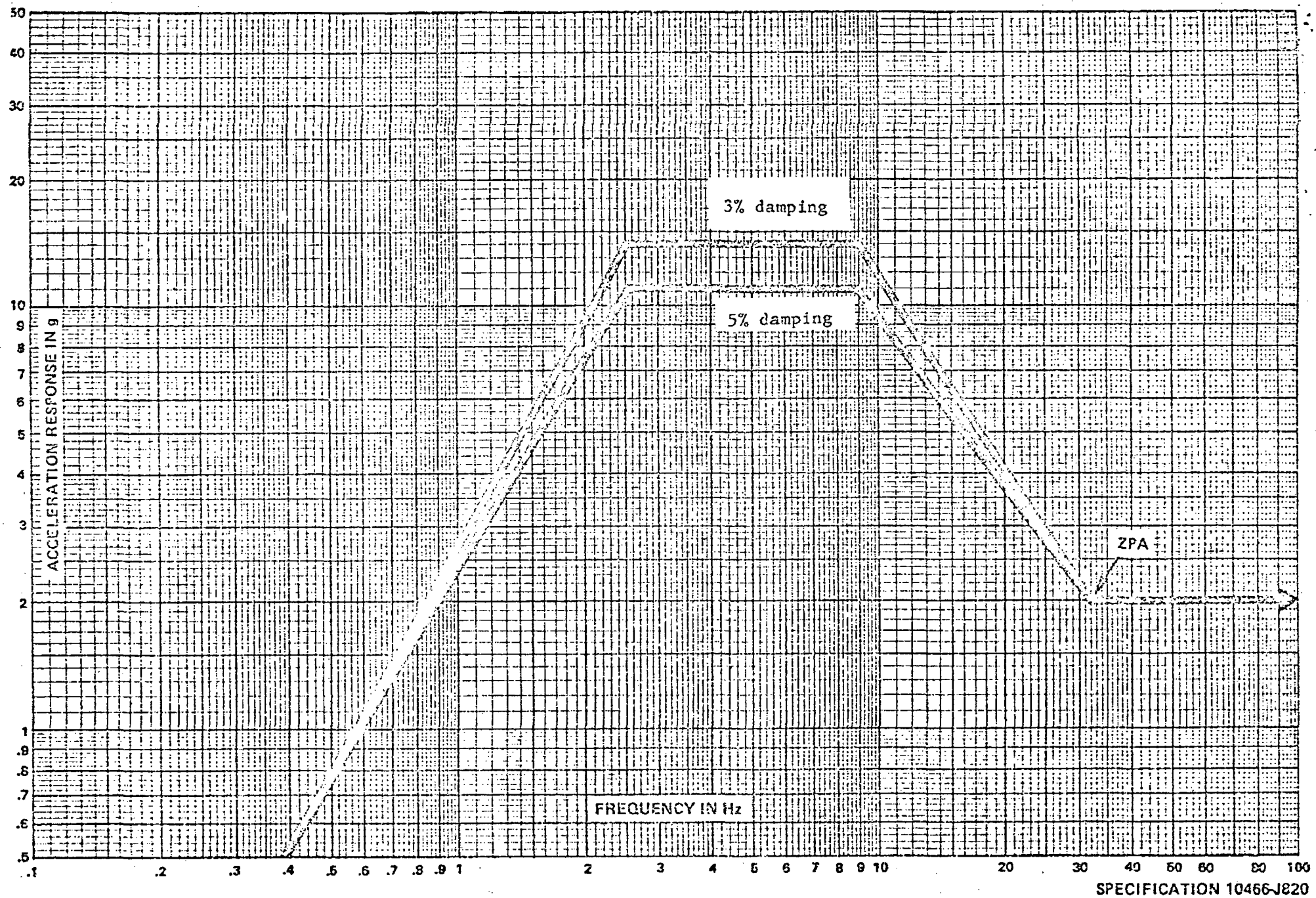
In addition to the documentation required by Section 6.2, the following documentation shall be provided. This documentation is for information and engineering design. Approval by the Buyer is not required.

6.3.1 Test facility identification: location and test equipment

6.3.2 Calibration records of test instrumentation

6.3.3 Total weight of the device to within ±5 percent

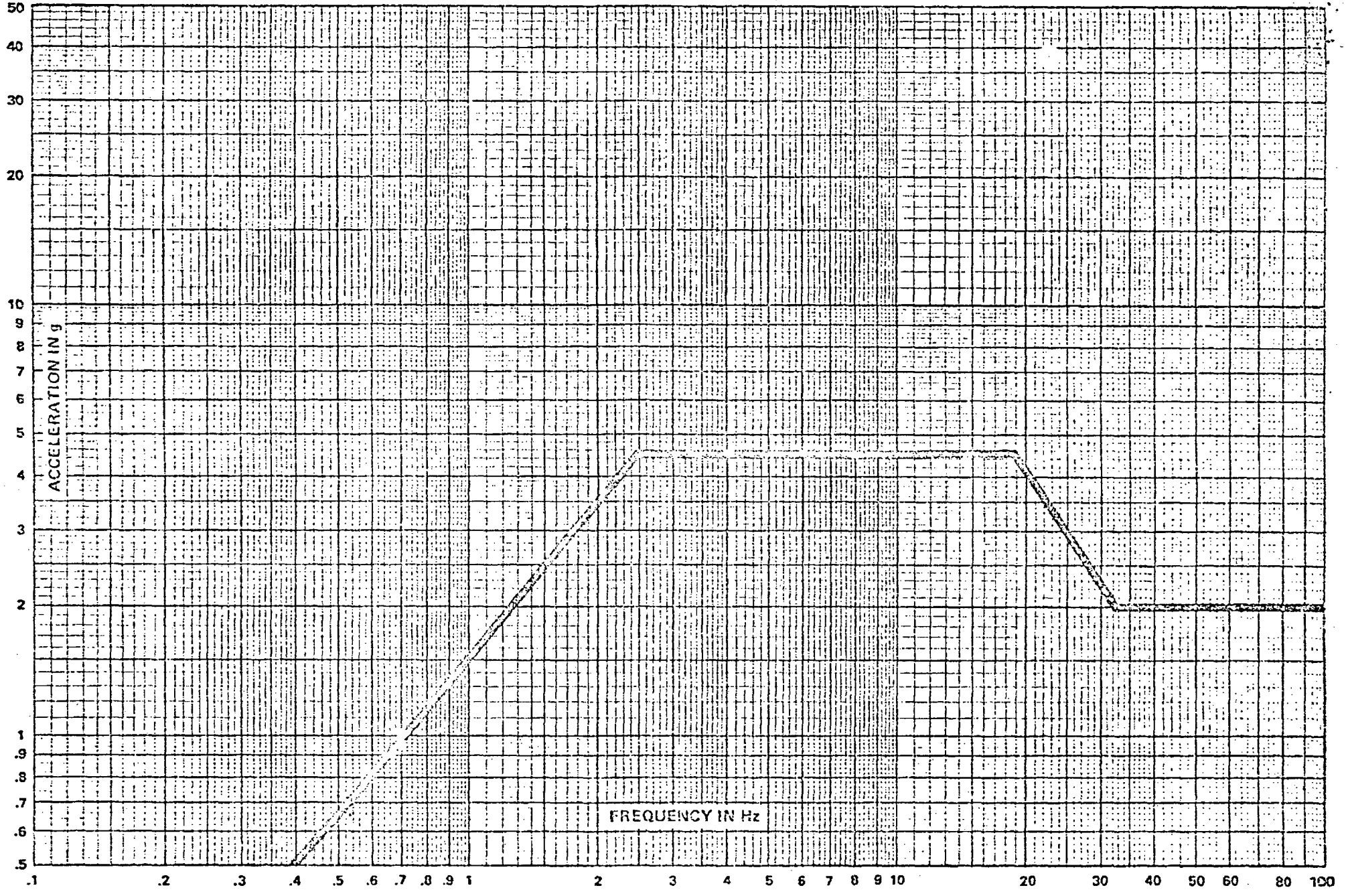
6.3.4 Location of the center of gravity to within ±2 percent



SPECIFICATION 10466-J820

Required Response Spectrum (RRS) for Control Systems Purposes for the Majority of Nuclear Power Plant Locations in the Continental United States.

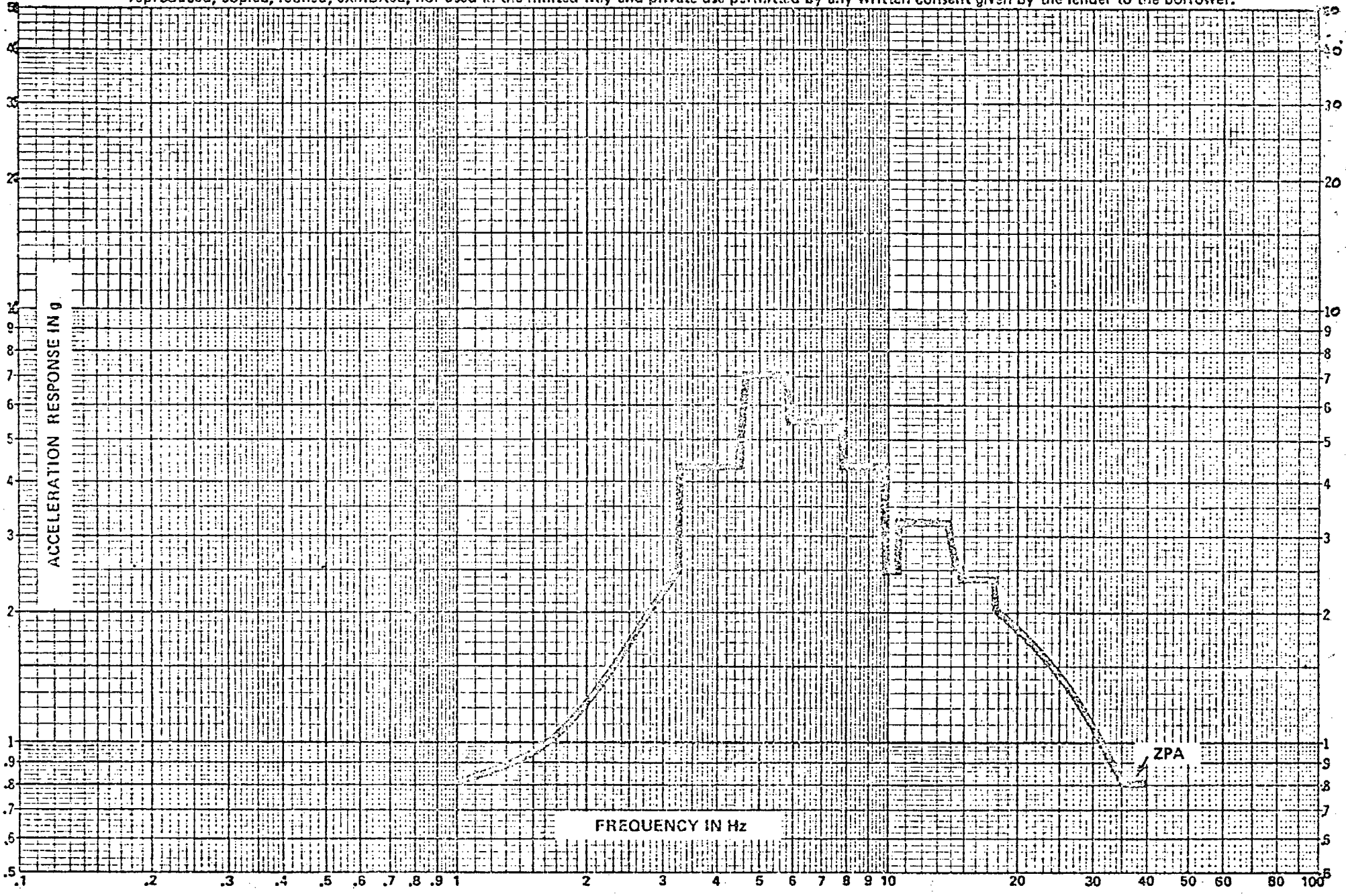
FIGURE 1
REVISION 0



SPECIFICATION 10466-J82

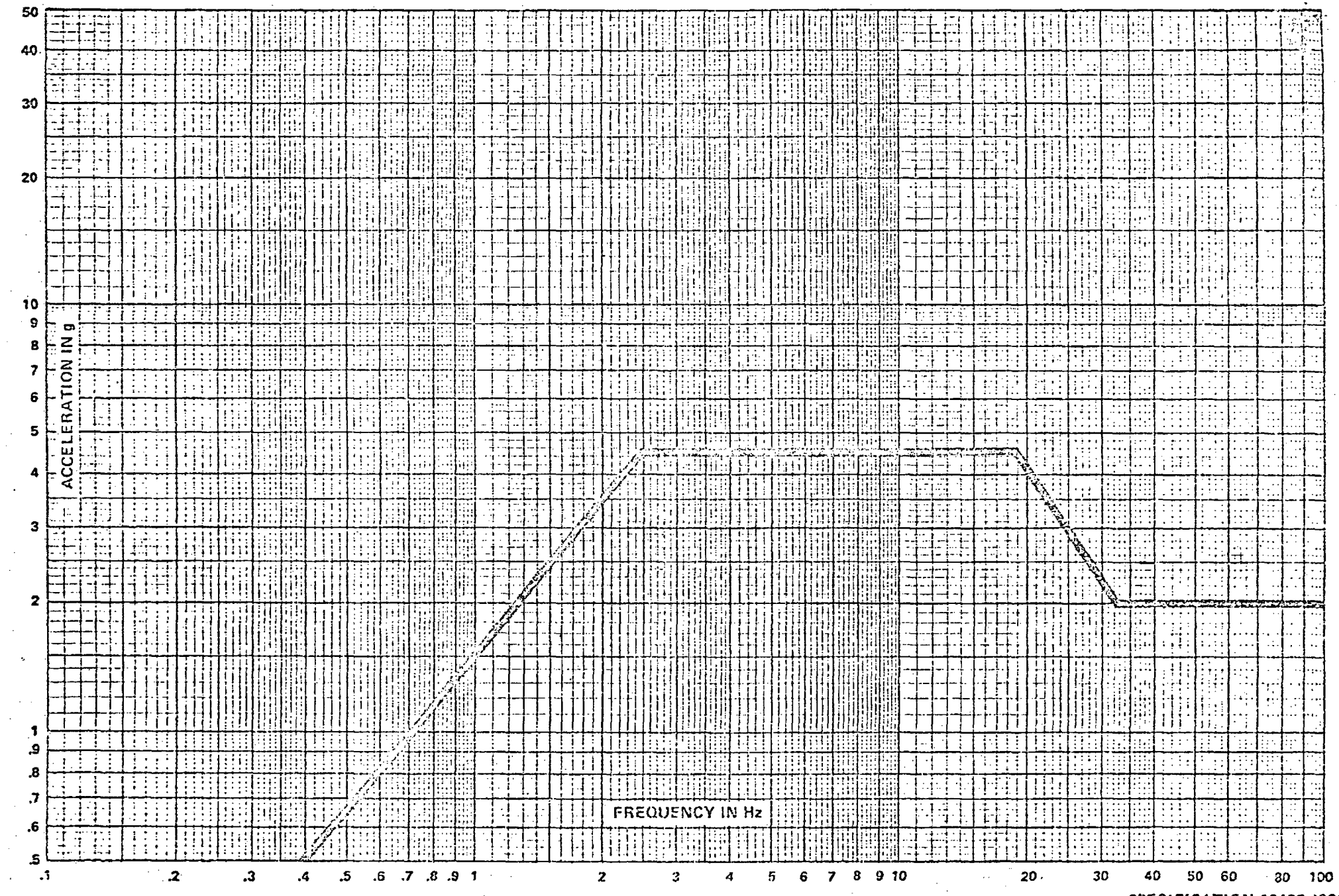
Required Input Motion (RIM) for Control Systems Purposes for Line Mounted Devices for the Majority of Nuclear Power Plant Locations in the Continental United States.

FIGURE 2
REVISION 0



Required Response Spectrum (RRS) for Control Systems Purposes for the SNUPPS Project (Preliminary)

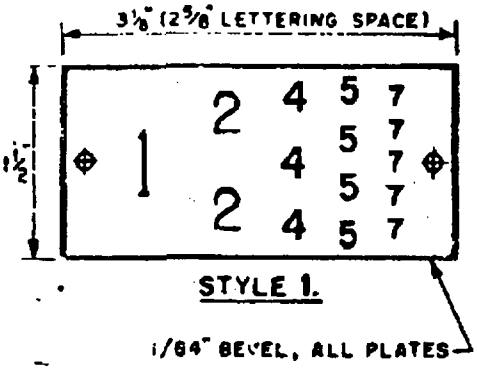
SPECIFICATION 10466-J820
FIG. 3 REV. 1



SPECIFICATION 10466-J320

Required Input Motion (RIM) for Control Systems Purposes for Line Mounted Devices for the Majority of Nuclear Power Plant Locations in the Continental United States.

FIGURE 4
REVISION 0



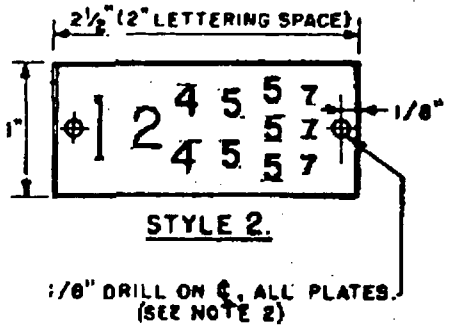
STYLE 1.

1/64" BEVEL, ALL PLATES

LETTER SIZE	1	2	3	4	5	6	7
HEIGHT (SEE DET. 'A') NO. PER INCH	1/2" 2-1/4	3/8" 3	5/16" 3-3/4	1/4" 4-1/2	3/16" 6-1/2	5/32" 7-1/2	1/8" 9-1/2
NO. PER LINE STY. 1	6	8	10	12	17	19	25
NO. PER LINE STY. 2, 3 & 4	4	6	7	9	13	15	19
NO. PER LINE STY. 5			1	2	3	3	4
NO. OF LINES MAX. STY. 1	2	3	3	3	4	4	5
NO. OF LINES MAX. STY. 2	1	1	1	2	3	3	3
NO. OF LINES MAX. STY. 3	1	1	1	1	2	2	3
NO. OF LINES MAX. STY. 4 & 5			1	1	1	1	2

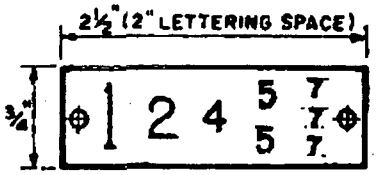
3I — LETTER HEIGHT MEASURED BETWEEN CENTER LINES

— DETAIL 'A' —

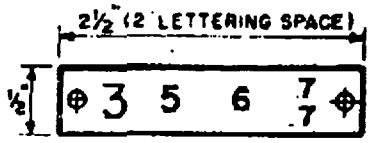


STYLE 2.

1/8" DRILL ON ℄, ALL PLATES. (SEE NOTE 2)



STYLE 3.



STYLE 4.

SEPARATION GROUP	NAMEPLATE MATERIAL (TWO OR THREE-PLY LAMICOID)
1	Red Face, White Core
2	White Face, Black Core
3	Blue Face, White Core
4	Yellow Face, Black Core
5	Black Face, White Core
6	Black Face, White Core
1 & 4	Red Face, Yellow Border, White Letters

4

NOTES:

1. **FOR ALL INSTRUMENTS USE STYLES 2, 3 OR 4 WHERE POSSIBLE WITH LETTERS NO SMALLER THAN SIZE 5.**
2. **THICKNESS OF NAMEPLATE IS 1/16".**
3. **FURNISH PLATES WITH DRILLED HOLES UNLESS SPECIFIED OTHERWISE.**
   (ALTERNATIVE APPLICATION): ADHESIVES MAY BE USED FOR MOUNTING NAMEPLATES ON THE REAR OF PANELS. IN THIS CASE NO HOLES WILL BE REQUIRED.)
4. ENGRAVE LETTERS THROUGH TO CORE WITH A ROUNDED OR SQUARE END CUTTER. V-SHAPED GROOVES ARE ACCEPTABLE IF FINISHED PRODUCT IS COMPARABLE TO THAT OBTAINED WITH A SQUARE-END CUTTER.

4

⊗ REVISED	INCORPORATED	WIP-J4-104-03-A R/1	CHANGE	04317	THIS DWG. SUPERSEDES REV.
○ ISSUED	CHG. DOC.		PKG. NO.		THIS DWG. SUPERSEDED BY REV.

REVISION NOTES:

WOLF CREEK NUCLEAR OPERATING CORPORATION

ELECTRONIC APPROVAL

NAMEPLATE STANDARDS

SCALE	DRAWING NUMBER	SHEET	REV
NONE	J4-104	1 OF 2	4

8 1/2X11 A SIZE

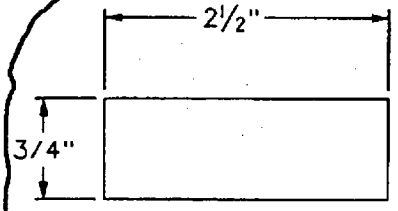
PSC-

DELETED

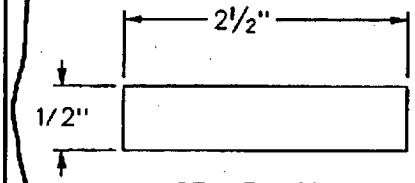
6.

7. MODIFIED STYLES 3 & 4 BOTH HAVE 1/16" MIN. BETWEEN FIRST & LAST LETTER/NUMBER & THE EDGE OF THE LAMICOID.

4



STYLE MOD 3



STYLE MOD 4

SCALE	DRAWING NUMBER	SHT	REV
NONE	J4-104	2 OF 2	4

8 1/2X11 A SIZE

PSC-

3.1E

Gaithersburg Power Division

Specification No. 10466-J-821(Q)
Job No. 10466

TECHNICAL SPECIFICATION

FOR

SEISMIC QUALIFICATION REQUIREMENTS FOR CLASS IE

CONTROL PANEL ASSEMBLIES

FOR THE

STANDARDIZED NUCLEAR UNIT

POWER PLANT SYSTEM

(SNUPPS)

BECHTEL POWER CORPORATION
GAITHERSBURG, MARYLAND

NO.	DATE	REVISIONS	BY	CH'K	GS	PE
0	4/29/75	Issued for Client Comments	PJR	RCB		
1	8-11-75	Issued for Use	PJR			
2	11-3-75	Revised Test Limits	PJR	BPS		

DC44

SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.	SHEET	LATEST REV.
1	0												
1	0												
2	0												
3	1												
4	0												
5	1												
6	0												
7	2												
8	2												
9	1												
10	0												
Fig.1	0												
Fig.2	0												

NO.	DATE	REVISIONS	BY	CK'D	APP'D	NO.	DATE	REVISIONS	BY	CK'D	APP'D
0	4/16/75	Issued for Client Comments	PJR								
1	8-1-75	Issued for Use	PJR								
2	11-3-75	Revised Test Limits	PJR								

W.O.A.40172

REVISION STATUS SHEET

STANDARDIZED NUCLEAR UNIT POWER PLANT SYSTEM

JOB NO. 10466

Specification J821(Q)

REV. 2

TABLE OF CONTENTS

SEISMIC QUALIFICATION REQUIREMENTS

FOR

CLASS 1E CONTROL PANEL ASSEMBLIES

1.0 SCOPE

1.1 General

This specification attachment establishes acceptable qualification methods and the requirements to verify that Class 1E control panel assemblies can perform their safety-related functions during and following a safe shutdown earthquake, SSE.

Where possible, control panel assemblies shall be designed with sufficient dynamic rigidity (with no structural resonances below 33 Hz) to keep at a minimum any amplification of floor motion within the panel assembly. Where it is not possible or economical to achieve sufficient rigidity, the control panel assembly amplification factor shall be limited as described in the Structural Response Test Section, below.

All Class 1E devices used on the control panel assemblies shall be qualified for this service.

1.2 Responsibilities

The Buyer, Bechtel Power Corporation, will be responsible for defining the required response spectrum at each control panel assembly mounting location. The testing or analysis facility shall have direct access to the Buyer's project or staff personnel for obtaining explanatory information about this specification; however, any such information will not alter existing contractual agreements.

The assurance of seismic qualification of the Class 1E devices shall be the responsibility of whoever purchases the devices - Bechtel Power Corporation, the control panel fabricator, or another entity.

A list of testing facilities will be furnished upon request. However, selection of the test facility shall be the responsibility of the Supplier.

1.3 Intent

The intent of this specification attachment is to specify qualification procedures and acceptance criteria that conform to IEEE Standard 344-1975, Recommended Practices for Seismic Qualifications of Class 1E Equipment for Nuclear Power Generating Stations.

It shall be acceptable for the Supplier to perform comprehensive generic, one-time qualification tests of standard control panel assembly structures. Then these standard structures can be adapted for specific control panel assemblies provided the structural elements can be shown to be sufficiently similar to the qualified, standard design.

Alternatively, control panel assemblies may be qualified to the particular floor response spectra of a specific power plant.

1.4 Device Qualification

Seismic qualification of Class 1E devices is covered by Specification Attachment 10466-J820.

Alternatively, Class 1E devices and the control panel assembly may be qualified simultaneously by vibratory testing of the completed control panel assembly and monitoring the Class 1E devices while they are in their normal operating condition.

2.0 DEFINITIONS

This section defines words in the context in which they are used in this specification. The portions in quotation marks were excerpted from IEEE Standard 344.

Definitions of other terms used in this specification are given in IEEE Standard 344.

2.1 Control Panel Assembly

An assembly consisting of a freestanding enclosure complete with all control and instrumentation devices and interconnecting wiring; the term, "control panel assembly," as used herein shall include benchboards, vertical-front panels, consoles, and cabinets.

2.2 Class 1E Control Panel Assembly

A control panel assembly that contains any Class 1E device.

2.3 Device

An individual item of equipment with specific operational functions. Examples are sensors, transmitters, controllers, bistables, indicators, recorders, relays, control switches, etc.

2.3.1 Class 1E Devices

Devices which are in nuclear safety-related service and to which is applied "The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment." For the purpose of this document, Class 1E is defined further to include all devices classified as Seismic Category 1.

2.4 Floor Acceleration

"The acceleration of a particular building floor (or equipment mounting) resulting from a given earthquake's motion. The maximum floor acceleration can be obtained from the floor response spectrum as the acceleration at high frequencies (in excess of 33 Hz), and is sometimes referred to as the zero period acceleration (ZPA)."

2.5 Response Spectrum

The maximum response (usually acceleration, but possibly displacement or velocity) of a second-order mechanical system, consisting of a spring, a damper, and a unit mass and having a specified damping ratio, expressed as a function of natural frequency, to some input motion defined over a specific time interval. 1

2.6 Required Response Spectrum (RRS)

"The response spectrum issued by the user or his agent as part of his specification for proof testing or artificially created to cover future applications. The RRS constitutes a requirement to be met."

2.7 Safe Shutdown Earthquake (SSE)

"That earthquake which produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional. These structures, systems, and components are those necessary to assure: (1) The integrity of the reactor coolant pressure boundary, (2) The capability to shut-down the reactor and maintain it in a safe shutdown condition, or (3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of Code of Federal Regulations, Title 10, Part 100 (December 5, 1973)."

2.8 Test Response Spectrum (TRS)

"The response spectrum which is constructed using analysis, or derived using spectrum analysis equipment based on the actual motion of the shaker table. When qualifying equipment by utilizing the response spectrum, the TRS is to be compared to the RRS."

3.0 QUALIFICATION PROCEDURES

Control panel assemblies may be qualified by an analytic method or by actual vibratory testing.

In applications where a nonseismically classified panel and a Class 1E control panel assembly are to be adjacent physically, the Supplier shall account for this condition and shall analyze the dynamic interaction of the two panels. Consideration should be given to physical separation of the panels to preclude any dynamic interaction.

3.1 Qualification by Analytic Method

An acceptable method is to design the control panel assembly as a dynamically rigid assembly without any resonance frequencies below 33 Hz. If the analysis of the panel structure and device-mounting surfaces confirms the dynamic rigidity of the assembly, the dynamic forces shall be considered to act through the assembly center of gravity and to be combined with gravitational forces in a static-coefficients analysis.

Alternatively, qualification by means of dynamic analysis may be used for a nonrigid control panel assembly.

In either case, at least one complete control panel assembly shall be subjected to a continuous sinusoidal sweep at a rate not greater than 2 octaves per minute over the frequency range equal to or greater than that to which the equipment is to be qualified according to the procedures in IEEE-344, Section 6.1.3, Exploratory Tests. If such exploratory tests are made, the acceleration levels must be at least 20 percent of the equipment design SSE, and the agency performing the analysis must certify that all critical responses of the equipment have been identified. The equipment shall be subjected at its resonant response frequencies to full-level single-frequency tests to verify the mathematical model used in each control panel assembly analysis. Only the seismic qualification conditions in Sections 4.1, 4.3, 4.5, and 4.6, as applicable, shall apply for qualification by this method. The test to verify the mathematical model used for the analysis shall be designed to verify the assembly resonant frequencies, predominant mode shapes, and damping factors and may be performed at low acceleration levels.

It is permissible to add structural elements to a control panel assembly to modify its response characteristics in order to achieve dynamic rigidity; however, the final analysis always shall reflect the assembly as-built state.

The acceptance criteria for qualification by analysis are the same as those for qualification by Structural Response Test, Paragraph 3.2.1. 1

3.2 Qualification by Test Method

Control panel assemblies may be qualified by actual vibratory testing.

3.2.1 Structural Response Test

An acceptable test method is to determine the dynamic response of the control panel assembly structure and the device-mounting surfaces by using a sufficient number of accelerometers attached at the location of the Class 1E devices. The vibratory testing shall be performed using either actual devices or simulated panel loads which duplicate the mass, stiffness, and volume of the actual devices and appropriate appurtenances, e.g., raceways, instrument tubing, and attachments, in order to simulate as closely as possible actual panel loading conditions. In either case, all devices, both Class 1E and non-Class 1E, shall be mounted on the control panel assembly under test.

The test frequency range and acceleration level shall be as specified in Section 4.

The acceptance critera for this test are:

a. That the maximum acceleration level at Class 1E device-mounting locations shall be less than 1.4 times the maximum base excitation acceleration.

b. That there be no control panel assembly structural failure.

c. That there be no structural deflection which can interfere with the safety-related function of Class 1E devices and circuits.

3.2.2 Functional (Operability) Proof Test

An alternate test method is to demonstrate the functional adequacy of all Class 1E devices while the control panel assembly is undergoing vibratory excitation.

For this test, all devices shall be mounted on the control panel assembly, and all Class 1E devices shall be in their normal operating condition, i.e., energized or de-energized, pressurized or depressurized. Operating pressure, voltage, etc., shall be applied during and after the tests to determine that vibratory conditions shall not produce a malfunction or failure.

The test frequency range and acceleration level shall be as specified in Section 4.

The acceptance criteria for control panel assemblies are:

a. That the maximum acceleration level at Class 1E device-mounting locations shall be less than 1.4 times the maximum base excitation acceleration.

b. That there be no control panel assembly structural failure which would inhibit or prevent performance of a safety-related function

c. That there be no structural deflection which could interfere with the safety-related function of Class 1E devices and circuits.

The acceptance criterion for qualification tests is that there be no Class 1E device malfunction or failure that would inhibit the nuclear safety-related function of the device. Unrestricted acceptance shall require that the following minimum conditions shall not occur, as applicable:

a. Loss of output signal, e.g., open or short circuit

b. Output variations greater than the published accuracy over the full range

c. Spurious or unwanted output, e.g., relay contact bounce. NOTE: If contact bounce is detected, the specific data of the test shall be recorded and submitted to the Buyer for written disposition of the deviation.

d. Drift of set point or trip setting greater than the published accuracy over the full range

e. Calibration shift greater than the published accuracy over the full range; this parameter need not be determined during vibratory excitation.

f. Structural failure, e.g., broken or loosened parts or deformation resulting in device failure

g. Loss of required function, e.g., ability to change state.

Sufficient instrumentation shall be provided to monitor and record device performance during vibratory excitation, i.e., that each of the above criteria has been satisfied. Malfunctions shall be analyzed to establish causative factors and suitable remedial steps shall be undertaken prior to retest.

Whenever these criteria are not met, the specific deviation data shall be submitted formally to the Buyer for evaluation of acceptability for specific applications.

4.0 SEISMIC QUALIFICATION CONDITIONS

4.1 Test Procedures

Written test procedures shall be prepared for all tests and submitted to the Buyer. The test procedures shall require the use of a vibration table to produce vibratory motion.

The vibration table motion shall simulate conservatively, both in amplitude and frequency content, the anticipated seismic motion of the actual floor surface on which the control panel assembly will be mounted.

Equipment shall be subjected to the acceleration values described in Section 4.6. Vibratory tests should be conducted over the range of 1 to 33 Hz. The acceleration and frequency values refer to the response of single-degree-of-freedom oscillators attached to the vibration table surface on which the test specimen shall be mounted. The three percent critical damping spectrum shall be used as the RRS unless written permission to deviate is granted by the Buyer. 2

4.2 Vibration Table Excitation (Wave Form)

The preferred excitation shall be random-motion wave form. Testing with other wave-form characteristics (frequency content) may be acceptable, depending on the RRS or assembly in question. However, test wave forms other than random motion shall be justified adequately for each control panel assembly being qualified.

The wave-form characteristics of the proposed test input motion shall be such that the TRS equals or exceeds the RRS. Test motions other than random shall be in conformance with the criteria of IEEE-344, Section 6.6, Test Methods.

4.3 Direction of Vibratory Motion

The input motion shall be applied simultaneously to the vertical axis and to a horizontal axis parallel to the front surface of the equipment when the equipment is in its normal mounting position. Independent random inputs are preferred, and, if used,

the test shall be performed in two steps with the equipment rotated 90° in the horizontal plane for the second step. If in-phase inputs are used, four tests should be run: first, with the inputs in phase; next, with one input 180° out of phase; next, with the equipment rotated 90° horizontally and the inputs in phase; and, finally, with the same equipment orientation but with one input 180° out of phase. Any other methods of qualification shall require acceptable justification and written permission from the Buyer before proceeding with the tests.

4.4 Duration of Test Run

The duration of each test run, i.e., each combination of acceleration amplitude and frequency pattern, shall be not less than 30 seconds.

4.5 Test Acceleration Level

The required maximum qualification acceleration of the control panel assembly mounting surface shall be determined from the RRS curve at a frequency greater than 33 Hz, i.e., at the ZPA level shown either in Figure 1 or 2.

4.6 Qualification Levels

Either of the two levels of acceleration herein specified are acceptable:

4.6.1 Level A

Subject the control panel assembly to the worst-case test acceleration that will qualify the panel for the most plant sites in the continental United States. See Figure 1.

Generic qualification of control panel assemblies for use in virtually all continental United States power plant sites is covered by Level A. The results of generic qualification shall demonstrate that the TRS exceeds, in amplitude, the envelope of worst-case RRS shown in Figure 1, which applies to both horizontal and vertical directions.

4.6.2 Level B

Subject the control panel assembly to an input motion which will result in a TRS equal to or greater than the RRS for its mounting location in the specific power plant. Level B reflects the reference SSE for the specific power plant site and is shown in Figure 2.

4.7 Test Facility Limitations

The RRS, either from Figure 1 or from Figure 2, depicts the dynamic characteristics of the panel mounting locations. It is 12

recognized that the dynamic capability of actual vibration tables may be limited in some way. The RRS does not attempt to anticipate such limitations. The Bidder shall describe the extent of any limitations in his proposal.

4.8 Testing Requirements

For vibratory testing, the control panel assembly shall be secured to the vibration table (or other mounting surface) with hardware similar to that which will be used in the actual plant installation. The Seller shall insure that the motion at the support points of the assembly (the points at which the assembly is supported when properly mounted on the floor) meets the requirements stated elsewhere in this Specification. The mounting hardware and the test table motion shall be designed accordingly. 1

5.0 DOCUMENTATION

5.1 Submittals

The Bidder shall provide with his proposal the proposed qualification procedure delineating the steps to achieve qualification.

Prior to fabrication, the Supplier shall submit his qualification procedure for Buyer approval. Sufficient detail shall be used to demonstrate adequacy of the selected method (see Section 5.2).

Prior to the seismic testing of any device, the Supplier shall inform the Buyer of the time and place of the tests so that the Buyer may have his representative witness these tests.

5.2 Documentation Requiring Approval

The following seismic qualification data for each control panel assembly shall be provided for Buyer approval and shall demonstrate that the control panel assembly meets the requirements of this specification attachment. All engineering documentation shall have been approved by the Buyer prior to shipment of equipment to the jobsite.

5.2.1 Control panel assembly identification

5.2.2 Control panel assembly specification number

5.2.3 A listing of Class 1E and nonseismically classified devices in each control panel assembly shall be included in the report for that assembly.

5.2.4 Amplification factor of each panel surface

5.2.5 Record of compliance with the applicable acceptance criteria or specific deviations; show that the TRS envelope exceeds the RRS envelope.

5.2.6 Identification of the control panel assembly features which were qualified by generic testing; also justification and certification that the qualified assemblies are sufficiently similar in performance, size, material, or other characteristics

5.2.7 Installation specification that shall detail the floor embedment and hardware characteristics necessary for installation.

5.2.8 Seismic qualification data for each Class 1E device. If these data are accumulated as a result of functional proof tests (Section 3.2.2), the data shall be supplied as denoted in Specification 10466-J820.

5.2.9 Description of the test method, including justification if other than random motion input is employed (see Section 4.2).

5.2.10 Test data, including graphs and/or tables, and the TRS

5.2.11 Results and conclusions (particularly natural frequencies and levels of maximum accelerations)

5.2.12 Approval signature and date; approval shall be by an engineer qualified in the field of dynamic response testing/analysis.

5.3 Additional Documentation

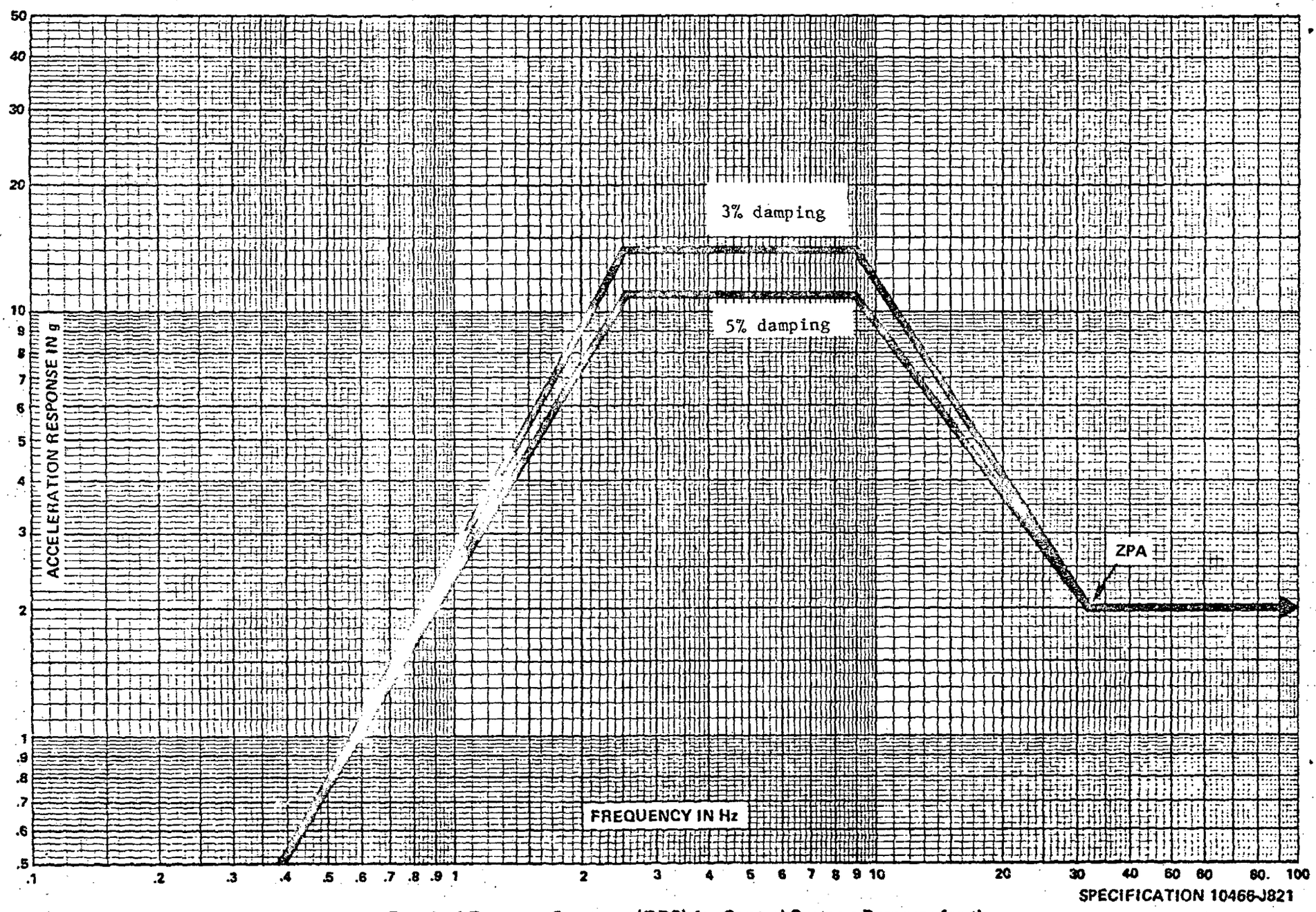
In addition to the documentation required by Section 6.2, the following shall be provided. This documentation is for information and engineering design. Approval by the Buyer is not required.

5.3.1 Test facility identification: location and test equipment

5.3.2 Calibration records of test instrumentation

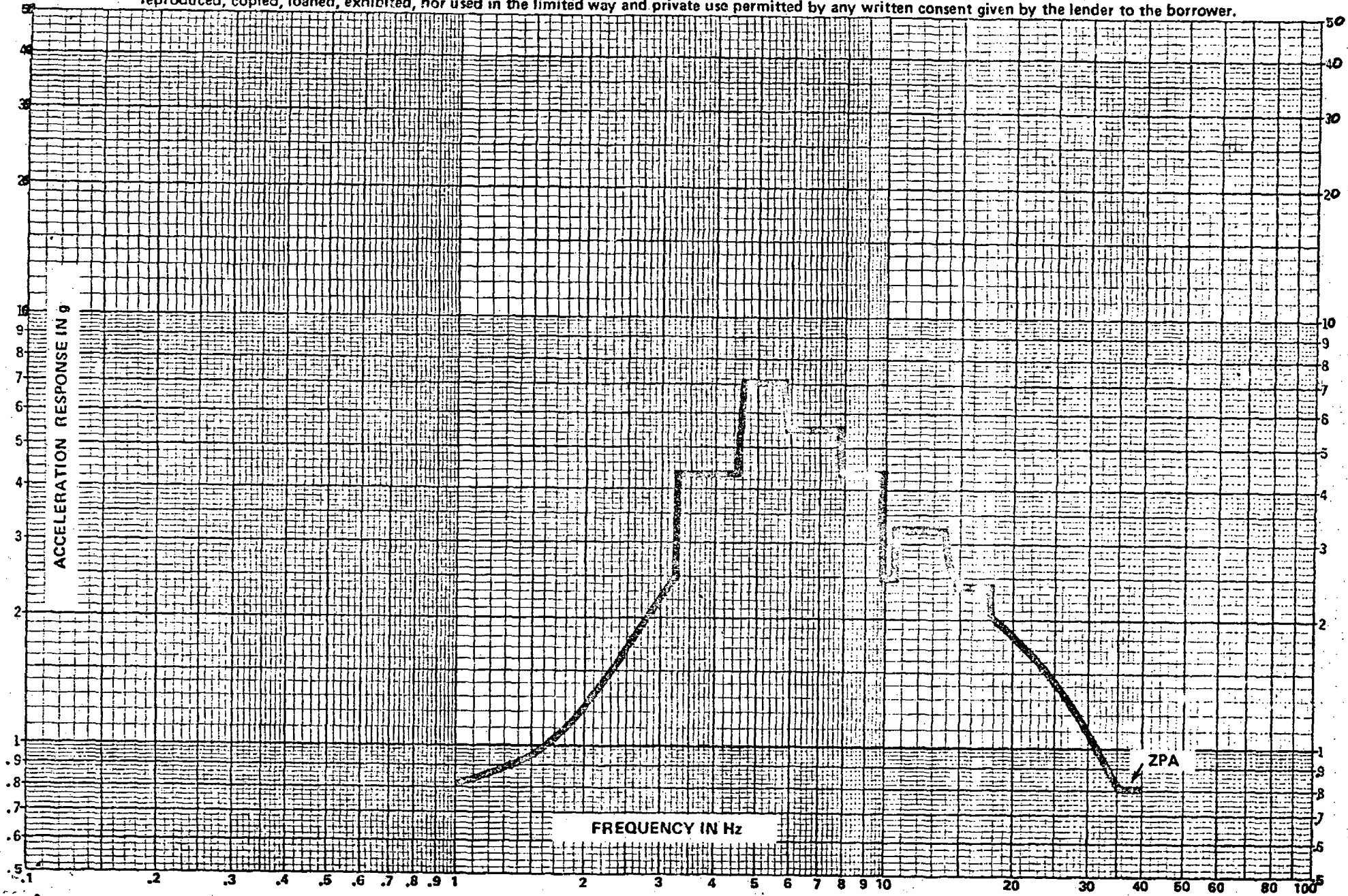
5.3.3 Total weight of the assembly to within ±5 percent

5.3.4 Location of the assembly center of gravity to within ±2 percent



Required Response Spectrum (RRS) for Control Systems Purposes for the Majority of Nuclear Power Plant Locations in the Continental United States.

FIGURE 1
REVISION 0



Required Response Spectrum (RRS) for Control Systems Purposes for the SNUPPS Project (Preliminary)

SPECIFICATION 10466-J821
FIG. 2 REV. 0