Attachment 26

General Atomics-Electronics Systems Inc. redacted non-proprietary document 04038800-1SP, "RM-1000 EMC Test Report Supplement 1," Revision A (Letter Item 9)

REVISIONS

REV	DESCRIPTION	DATE	APPROVED

BECHTEL POWER CORPORATION	Job Number: 25402
SUPPLIER DOCUMENT REVIEW STATUS	

STATUS CODE:

1 ☐ Work may proceed.
1C ☐ Work may proceed. Editorial comments need only be incorporated if revised for other purposes.
2 ☐ Revise and resubmit. Work may proceed subject to incorporation of changes indicated.
3 ☐ Rejected. Revise and resubmit.
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PO 77469 Release 77448

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Reviewed by	Arch	Civil	CS	Elect	Mech	MET	PD	Constr	Startup	STE
	N/A	N/A	JTT	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Status By: Joe Temples Joe T. Temples DATE 11/11/11

Document Classification Change

[redacted]

NUCLEAR SAFETY RELATED

SEISMIC CATEGORY I

GENERAL ATOMICS
ELECTRONIC SYSTEMS

4990 GREENCRAIG LANE
SAN DIEGO, CA 92123-1675

DRAWN DICK DOYLE	DATE 9/26/2011	RM-1000 EMC TEST REPORT SUPPLEMENT 1				
CHECKED	10/10/11					
ENGR	10-7-11					
ENGR REV	10-10-11					
PROJ MGR	10-10-11	SIZE A	CAGE CODE 58307	DRAWING NUMBER 04038800-1SP		REV A
QUAL MGR	10-10-11					
RELEASE	10-10-11			DRW LEVEL 3	SCALE NONE	SHEET 1 OF 43

GA-ESI-0258 FORM-A Rev. 08-26-11

CHANGE RECORD

Issue	Date	Description of Change
Rev. A	September 2011	Original Issue

[redacted]

Document Classification Change

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1. INTRODUCTION

This report establishes the basis for Electromagnetic Compatibility (EMC) qualification of the RM-1000 Area radiation monitors. Specifically these are the RM-1000 radiation monitors for the Tennessee Valley Authority's (TVA) Watts Bar Nuclear Plant Unit 2 purchased under TVA [redacted]. The replacement radiation monitors must meet TVA specification 25402-011-MRA-HARA-00001 for non-safety monitors or TVA specification 25402-011-MRA-HARA-00002 for safety related monitors. Table 1-1 identifies the radiation monitors by TVA tag number, monitor service, GA-ESI part number (P/N), and safety class, containing a RM-1000.

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Table 1-1 EMC Qualified RM-1000 Radiation Monitors

TVA Tag	Monitor Service	GA-ESI P/N	Class
2-RE-90-002	Personal Lock	04034401-001	Non-Safety
2-RE-90-059	Upper Compartment Refueling Floor	04034401-001	Non-Safety
2-RE-90-060	Upper Compartment	04034401-001	Non-Safety
2-RE-90-061	Lower Compartment Instrument Room	04034401-001	Non-Safety
2-RE-90-255	Turbine Building Extended Range Area	04034201-001	Non-Safety
2-RE-90-256	Turbine Building Extended Range Area	04034201-001	Non-Safety
2-RE-90-271	Upper Inside Containment Post Accident	04034101-001	Safety
2-RE-90-272	Lower Inside Containment Post Accident	04034101-001	Safety
2-RE-90-273	Upper Inside Containment Post Accident	04034101-001	Safety
2-RE-90-274	Lower Inside Containment Post Accident	04034101-001	Safety

This report is a supplement to the principle GA-ESI RM-1000 EMC report, Document number 04038800 (November 1999). Also included in this supplement are additional RM-1000 EMC test data from GA-ESI's report number 04509050 (April 2003). The changes to the equipment since the EMC testing was performed are addressed and the changes are qualified by similarity to the parts tested.

This report describes the Electromagnetic Compatibility (EMC) testing and analysis performed by General Atomics – Electronic Systems, Inc. (GA-ESI) for the RM-1000 radiation monitoring equipment supplied to Tennessee Valley Authority (TVA).

1.1 BASIS OF THIS REPORT

The report primarily concentrates on the one type of radiation monitor: The Safety Related 04034101-001 Inside Containment Post Accident RM-1000 radiation monitor (High Range Area Monitoring System). However, the 04034201-001 and 04034401-001 non-safety series of RM-1000 radiation monitors are qualified in Section 6 of this Report.

1.2 REPORT CONTENTS

This report consists of the following sections.

Section 1. INTRODUCTION. This section describes the reason for the report, its organization, identification of the radiation monitors being qualified, its safety category, the applicable qualification standards, a statement of qualification, and a description of the contents of each section.

Section 2. EQUIPMENT DESCRIPTION. This section describes the equipment being modified from the EMC tested equipment in the 04038800 and 04509050 reports.

Section 3. QUALIFICATION REQUIREMENTS. This section describes the functional, environmental and seismic requirements for the generic radiation monitors in which the replacement Printed Wiring Assemblies, Relay Panel and I-F Converter will be used.

Section 4. GA QUALIFICATION PROGRAM. This section delineates the generic qualification program established by GA-ESI and the application of that program to the components supplied.

Section 5. EMC QUALIFICATION BASIS. This section demonstrates the qualification of the equipment modifications by analysis and similarity to equipment and components successfully tested to requirements equal to or greater than the requirements of the generic radiation monitors.

Section 6. OTHER RADIATION MONITORS QUALIFIED. This section provides the qualification for similar systems in the RM-1000 Non Safety Radiation Monitors.

Section 7. REFERENCE DOCUMENTS. This section lists the GA-ESI supplied documents and drawings referenced in the body of this supplement.

2. EQUIPMENT DESCRIPTION

This report describes the Electromagnetic Compatibility (EMC) testing and analysis performed by General Atomics – Electronic Systems, Inc. (GA-ESI) for the RM-1000 radiation monitoring equipment supplied to Tennessee Valley Authority (TVA). This study is based on the RM-1000 EMC report, Document number 04038800 (November 1999) and additional RM-1000 EMC test data from GA-ESI's report number 04509050 (April 2003). Changes to the equipment have been made since the EMC testing was performed. Therefore, this section addresses those changes and qualifies the changes by similarity to the parts tested.

2.1 Major Subassemblies Previously Tested

This section compares the major modules of the Safety Related Inside Containment Post Accident RM-1000 radiation monitor (High Range Area Monitoring System) (04034101-001) with similar modules that were previously EMC tested. The TVA radiation monitor (04034101-001) uses upgraded versions of the Printed Wire Assemblies (PWAs), Display and other components as described in this document. As will be shown, these are all very similar and in many cases electronically identical to the components tested.

These assemblies are mounted in the Safety Related RM-1000 Radiation Monitor (GA-ESI P/N 04034101-001). Table 2-1 presents a comparison of the current GA-ESI part numbers with the part numbers that were EMC tested for the various assemblies.

Table 2-1 Part Numbers for the Original and P/N 04034101 Business Sensitive

[redacted]

As noted in the table above, the tested assemblies are either similar to or electronically identical to the assemblies mounted in the Safety Related RM-1000 Radiation Monitor [redacted] and the section describing the similarity is presented in the table. Business Sensitive

This report provides a detailed comparison of the EMC tested assemblies with the current TVA assemblies used in the Safety Related RM-1000 Radiation Monitor [redacted] The section that describes each assembly is identified as follows: Business Sensitive

- RM-1000 Section 2.2
- I/F Converter Section 2.3
- Power Supply Section 2.4
- Det. RD-23 Ion Chamber Section 2.5
- Filter/Surge Suppressor Section 2.6

2.2 Description of RM-1000 Module

The RM-1000 Module (GA-ESI P/N 04501000-001) and I-F Converter Module (GA-ESI P/N 04506150-001), were tested as a unit connected to an ion chamber detector as reported in EMC report 04038800. However, the RM-1000 Module (GA-ESI P/N 04501200-002) as tested and reported in EMC report 04509050 is very similar to the RM-1000 Module (GA-ESI P/N 04501200-004) used in the TVA radiation monitor (04034101-001). A comparison of the major assemblies in the various RM-1000 Modules is presented in Table 2-2. This table presents a comparison of the current PWAs with the PWAs that were EMC tested in the various assemblies and the section describing the similarity is presented in the table.

Table 2-2 RM-1000 Part Numbers for Tested and WBN U2 PWAs Business Sensitive

[redacted]

[redacted]

- MAIN ASSEMBLY,W/RLY INTFC BOARD Section 2.2.2 Business Sensitive
- FRONT PANEL ASSEMBLY, (SAFETY) Section 2.2.3

The Printed Wiring Assemblies (PWAs) are designed and built by GA-ESI. Some are upgraded versions of the PWAs tested as part of original GA-ESI's RM-1000 EMC testing reported in GA-ESI document 04508800. The new Printed Wiring Assemblies are form, fit and function

replacements for the originally qualified assemblies. The latest versions of these assemblies are mounted in the TVA RM-1000 Microprocessor assembly (GA-ESI P/N 04501200-004).

2.2.1 RM-1000 Module Background Information

The TVA RM-1000 module (GA-ESI P/N 04501200-004) is similar to the RM-1000 module (GA-ESI P/N 04501200-002) except for paint color. 04501200-002 was EMC tested and reported in GA-ESI document 04509050. A detail comparison between the GA-ESI P/N 04501000-001 & 04501200-002 follows.

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The original RM-1000 module (GA-ESI P/N 04501000-001) was EMC tested and reported in GA-ESI document 04038800 and differs from the GA-ESI P/N 04501200-002 module as described in GA-ESI document 04508905-1SP. The significant differences are listed below:

[redacted]

The new RM-1000 [redacted] display (GA-ESI P/N 50016021-001) and the three associated PWAs were EMC tested and reported in GA-ESI document 04509050. The new display is Safety Related, Class 1E and Seismic Category I qualified.

Business Sensitive

2.2.2 Main Assembly PWA with Relay Interface Board

The Main Assembly PWA with Relay Interface Board (GA-ESI P/N 04501050-003) that was EMC tested in an RM-1000 is similar to the new PWA (GA-ESI P/N 04501050-005) used in the Safety Related RM-1000 Radiation Monitor (GA-ESI P/N 04034101-001).

[redacted]

Business Sensitive

[redacted]

As noted in the table above, most of the parts that were EMC tested with the 04501200-002 RM-1000 assembly are electronically identical to the 04501200-004 TVA assembly in the Safety Related RM-1000 Radiation Monitor (GA-ESI P/N 04034101-001). [redacted]

Business Sensitive

2.2.3 Front Panel Assembly, (Safety) Green

The Front Panel Assembly, (Safety) Black (GA-ESI P/N 04501260-001) that was EMC tested in an RM-1000 is similar to the new Front Panel Assembly, (Safety) Green (GA-ESI P/N 04501260-005) used in the Safety Related RM-1000 Radiation Monitor (GA-ESI P/N 04034101-001). A comparison of the major components of the tested system with the new TVA PWA (04501260-005) is presented in Table 2-4

Business Sensitive

.

[redacted]

[redacted]

Business Sensitive

Business Sensitive

[redacted]

2.2.3.1 Front Plate (Safety), Green (P/N 04502000-005)

[redacted]

2.2.3.2 Keypad/Display PWA (P/N 04503070-001)

[redacted]

2.2.3.3 Display Module (P/N 50016021-001)

Business Sensitive

The RM-1000 [redacted] display was EMC tested (04509050) and is qualified for Class 1E safety related Radiation Monitoring Systems. [redacted]. Details of the new display (500160021-001) are presented in Table 2-5.

[redacted]

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Business Sensitive

[redacted]

2.3 I-F Converter Module

Only the original I-F Converter Module (GA-ESI P/N 04506150-001) was subjected to EMC testing. This was performed originally as follows: the RM-1000 Module (GA-ESI P/N 04501000-001) and I-F Converter Module (GA-ESI P/N 04506150-001) were tested as a pair and connected to an ion chamber detector as reported in EMC report 04038800. However, the new I-F Converter Module (GA-ESI P/N 04501351-003) used in the TVA radiation monitor (04034101-001) is [redacted] A listing and analysis of all the detailed changes between the tested model (GA-ESI P/N 04506150-001) and the TVA model (GA-ESI P/N 04501351-003) is presented in 04508905-2SP.

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A parts listing for the original I-F Converter Module (GA-ESI P/N 04506150-001) is not available [redacted] resulted in the current I-F Converter Module (GA-ESI P/N 04501351-003) of which GA now owns the design. It has similar and electronically identical parts.

Business Sensitive

[redacted]

The current design of the I-F Converter Module (GA-ESI P/N 04501351-003) was extensively tested and was shown to be extremely accurate as reported in GA-ESI document 04508807. Per Table 1 of the 04508807 document, the [redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

Business Sensitive

[redacted]

2.3.1 Details of I-F Converter Module

[redacted]

Business Sensitive

[redacted]

Business Sensitive

[redacted]

[redacted]

[redacted]

2.4 RM-1000 24 Volt Power Supply

[redacted]

[redacted]

Business Sensitive

2.5 RD-23 Ion Chamber Detector

The RD-23 detector (GA-ESI P/N 03602062-001) is qualified for a Harsh environment and post accident monitoring. Refer to GA-ESI report 02818905-QSR for qualification basis. RD-23 detector (GA-ESI P/N 03602062-001) is EMC qualified based on EMC test report GA-ESI document 04038800.

2.6 EMI/RFI Filter and Surge Suppressor

[redacted]

[redacted]

2.7 RM-1000 EMC Improvements

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The following RM-1000 EMC Improvements were made to the unit before and during the RM-1000 EMC tests that were performed and reported in GA-ESI Document No. 04509050 (April 2003).

Based on previous EMC testing, the RM-1000 design was modified to provide enhanced EMC performance as follows:

a. Installed a filter insert on the contacts of the 50-pin motherboard D connector

b. Installed an aluminum/Mylar Faraday cage inside the rear cavity of the module

c. Grounded the shields of the signal and HV coax cables inside module

d. Installed interposing relays for Operate (failure), Trip 1 and Trip 2 alarm functions

The tested RM-1000 modules included above items a through d. ECO-17656A documents these modifications. Items a, b, and c provide filtering and shielding internal to the RM-1000 modules, in lieu of the external EMI boot kit on the previous-tested design.

The ferrite collar on display ribbon cable behind front door (previously tested with the old display unit) was deleted from the RM-1000 production units using the new panel display.

Table 2-11 shows the location and number of ferrite beads that were added to pass specific immunity tests.

Table 2-11 Ferrite Bead Placement on Cables

[redacted]

3. QUALIFICATION REQUIREMENTS

The Watts Bar Nuclear Power Plant Unit 2 replacement radiation monitors qualification requirements are delineated in TVA [redacted] Section 3 describes those requirements as they apply to the General Qualification, specifically to the Electromagnetic Compatibility Qualification. Business Sensitive

3.1 TVA ELECTROMAGNETIC COMPATIBILITY QUALIFICATION REQUIREMENTS

The Electromagnetic Compatibility (EMC) requirements for both Safety Related and Non-Safety Related radiation monitors shall be in accordance with TVA specification SS-E18.14.01 Revision 3 unless this requirement is waivered by TVA based on appropriate justifying documentation. SS-E18.14.01 Revision 3 requires that all analog and digital electronic equipment is required to meet all sections if any one of the following conditions is met:

- Class 1E
- Post Accident Monitoring category 1 and 2 for all types
- Emergency Operating Procedure equipment
- Equipment that can initiate a plant trip or operational transient
- Equipment under the augmented Quality Assurance program

All other electronic equipment shall meet the emission requirements of sections 8.6, *Radiated Emissions,* and 8.7, *Conducted Emissions.*

Any or all specific tests may be waivered using operating experience. The waiver shall be based on a vendor submitted justification report; the waiver must be in writing and approved by the TVA Corporate EMI Specialist or his designate. Alternate tests or vendor standard test reports may be submitted for approval by the TVA Corporate EMI Specialist or his designate.

The following tests are required per SS-E18.14.01 Revision 3:

Radiated Susceptibility Verify the device is not susceptible to radiated electromagnetic signals.	Tests to be conducted in accordance SS-E18.14.01 R3 Section 8.1 as the following or MIL-STD-461C (RS-03, Class 3A), MIL-STD-461D (RS103), IEC 801 Part 3-1991, or PMC33.1-1978. • Frequency: 10 kHz to 1 GHz • Amplitude: 10 volts rms per meter • Modulation Frequency: 1 kHz • Modulation Percent: >80% • Modulation Waveform: Amplitude 50% duty cycle • Sweep Rate: 1.5 x 10^3 decades/second The device is acceptable if no malfunction, undesired response, degradation of performance, or permanent damage to the device occurs.
Conducted Susceptibility Verify that the device is not susceptible to conducted electromagnetic signals.	Tests per SS-E18.14.01 R3 Section 8.2 as follows: **Low Frequencies** (Power Conductors Only) • Frequency: 30 Hz to 50 kHz • Amplitude: 6.3 volts rms average • Alternate procedures MIL-STD-461C (CS-01, CS-02, and RS-02 Part II Class A3 or MIL-STD-461D (CS-101) **High Frequencies** (All Conductors) • Frequency: 50 kHz to 400 MHz • Amplitude: 7 volts rms • Modulation Frequency: 1 kHz • Modulation Percent: >80% • Modulation Waveform: Square Wave, 50% duty • Alternate procedures MIL-STD-461D (CS-114) or IEC-801 (Part 6-1992) The device is acceptable if no malfunction, undesired response, degradation of performance, or permanent damage to the device occurs.

Surge Susceptibility Verify that the device is not susceptible to surges relatively high energy surges, unidirectional pulses caused by lightning, load switching and line faults on AC power lines.	Tests per SS-E18.14.01 R3 Section 8.3 as follows. Apply to power lines and outer conductors/shields of all cables that connect to external structures or facilities. • Wave Shape: Open Circuit. 0.5 µs (at 50% amplitude), pulse width double exponential. • Amplitude: 3 kV • Repetition: Allow 30 to 120 seconds between surges. • Alternate procedures MIL-STD-461C (CS-06), MIL-STD-461D (CS-116), IEC-801 (Part 5-1991), or ANSI/IEEE C62.45-1991. SWC Class B: Device shall not incur any permanent damage or require component replacement to resume operation.
Impulse and Burst of Impulses Susceptibility Verify that the device is not susceptible to low energy impulses from nearby switching on short power lines.	Tests per SS-E18.14.01 R3 Section 8.4, as follows. • Wave Shape: 3 ηs rise time, 50 min. and 500 ηs width @ 50% peak, double exponential. • Power line Amplitude Bulk Current: 60 A into a 50 Ω load Voltage: 3 kV into a 50 Ω load • Data/Control Line Amplitude Bulk Current: 40 A into a 50 Ω load Voltage: 2 kV into a 50 Ω load • Alternate procedures MIL-STD-461C (CS-05), MIL-STD-461D (CS-115), or IEC-801 (Part 4-1991). The device is acceptable if no malfunction, undesired response, degradation of performance, or permanent damage to the device occurs.

Electrostatic Discharge Susceptibility Verify that the device is not susceptible to a sudden transfer of charge resulting in a spark.	Tests per SS-E18.14.01 R3 Section 8.5, as follows. • Excitation: In accordance with IEC-801 (Part 2, Class 3-1991) • Test Points: Surfaces that accessible during operation. • Alternative procedures per ANSI/IEEE C63.16-1993. The device is acceptable if no malfunction, undesired response, degradation of performance, or permanent damage to the device occurs.
Radiated Emissions Verify that the device does not radiate electromagnetic emissions to the environment in excess of the limit.	Tests per SS-E18.14.01 R3 Section 8.6, as follows. • The device shall be operating normally when the test is performed. • Procedure in accordance with EPRI TR-102323. • Alternate procedures MIL-STD-461D (RS-102) or CFR-47 (Part 15-1993). The device is acceptable if the electromagnetic emission do not exceed the values in EPRI TR-102323-1994, Figure 7.4 between 1 MHz and 1 GHz.
Conducted Emissions Verify that the device does not generate electromagnetic emissions on the power leads.	Tests per SS-E18.14.01 R3 Section 8.5, as follows. • The device shall be operating normally when the test is performed. Relays, disk drives, etc shall be operated during the test. • Procedure in accordance with EPRI TR-102323-1994. • Alternate procedures MIL-STD-461D (CE-102, Figure CE102-1) or MIL-STD-461C (CE-03, Figure 4.4, Curve 2). The device is acceptable if the electromagnetic emission on the power lines do not exceed the values in EPRI TR-102323-1994, Figure 7.2 between 10 kHz and 400 MHz.

3.2 EMI/RFI Qualification Procedures

The purpose of this section is to present acceptable EMI/RFI qualification methods and requirements to demonstrate that electrical and I & C (Instrument and Control) equipment can perform their important-to-safety functions for all data inputs and respond with all appropriate signals, warnings, data outputs and related information. As outlined in GA-ESI Doc. No. E-115-0699, this EMI/RFI qualification is only a part of the equipment qualification. In support of the Federal laws and to provide guidance to the nuclear industry, a number of standards and regulatory guides have been issued relative to EMI/RFI analysis and testing. These are as follows: 1) NRC RG 1.180, Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems, 2.) MIL-STD-461E, Requirements for the control of electromagnetic interference characteristics of subsystems and equipment, 3.) IEC 60880-2, Electromagnetic compatibility (EMC), Part 2, Environment – Compatibility levels in industrial plants for low-frequency conducted disturbances, 4.) IEC 60880-4, Electromagnetic compatibility (EMC), Part 4, Testing and measurement techniques, 5.) IEC 60880-6, Electromagnetic compatibility (EMC), Part 6, Immunity for industrial environments, and 6.) NRC NUREG/CR-6782, Comparison of U.S. Military and International Electromagnetic Compatibility Guidance.

3.3 Additional EMI/RFI Qualification Requirements

The NRC RG 1.180 Rev. 1, 2003 is a very complete document and no equivalent IEEE standard exists. RG 1.180 endorses both Military Standard MIL-STD-461E and the International Electrotechnical Commission (IEC) 61000 series of EMI/RFI test methods. It extends the guidance to cover signal line testing, incorporating frequency ranges where portable communications devices are experiencing increasing use, and relaxing the operating envelopes (test levels) when experience and confirmatory research warrants it. The following sections of Regulation Guide 1.180 show the relationship between MIL-STD-461E and IEC 61000.

Section 3 of Regulation Guide 1.180 for emissions testing states "The specific test methods acceptable to the NRC staff in regard to emissions testing for safety-related I&C systems in nuclear power plants are presented in Tables 2 and 3. Table 2 (8-1) lists the EMI/RFI emissions test methods in MIL-STD-461E while Table 3 (8-2) lists the corresponding criteria in IEC 61000-6-4, "Electromagnetic Compatibility (EMC) – Part 6: Generic Standards – Section 4: Emission standard for industrial environments." These test methods cover conducted (along power leads) and radiated interference emitted from equipment under test."

The GA-ESI Doc. No. E-115-0699 further expands on these requirements. They are followed at GA when the customer has not specified requirements or when GA uses these as generic requirements.

4. GA-ESI's QUALIFICATION PROGRAMS

4.1 GA-ESI's GENERIC QUALIFICATION PROGRAM

GA-ESI's qualification program for radiation monitors was initiated in the mid-1970s. The first qualification programs related to environmental and seismic qualification of analog radiation monitors. In the late 1970s, the digital RM-80 and RM-23 were developed and EMI/RFI qualification was added. Software for the RM-80 and RM-23 was prepared under the control of a 10 CFR 50 Appendix B quality program. Verification and Validation (V&V) of this software to RG 1.152-1996 requirements were performed in 1997 after the regulatory guide was first issued. Development of the RM-2000, RM-2300, and RM-1000 included qualification of the monitors to the latest standards at the time of their development. These include environmental, seismic, Electromagnetic Compatibility (EMC), and software V&V. All qualification is performed by test, similarity to components that have been tested, or by design for mild environment conditions. Components required to operate in a harsh environment are qualified by testing only.

The following subsections describe specific subsection of Environmental program area (EMC) in more detail and describe the methods used to qualify the TVA replacement radiation monitors to the requirements in Section 3.

4.2 GA-ESI's ENVIRONMENTAL QUALIFICATION PROGRAM

GA-ESI's environmental qualification program is described in Section 4 of GA-ESI document 02818905-QSR. OP-7-3-240 Rev. F and OP-7-3-250 Rev. E are used for this qualification. The steps taken in this qualification are as follows:

1. An analysis is performed to identify the differences between the monitor being qualified by this report and the monitor qualified by GA-ESI document 02818905-QSR and its supplements. As appropriate the assemblies, modules, components, and parts (items) are listed in a table in the Qualification Basis of this report.

2. The items that differ from those in GA-ESI document 02818905-QSR and its supplements will be identified and qualified in the manner described in section 4.2 of GA-ESI document 02818905-QSR.

4.3 GA-ESI's ELECTROMAGNETIC COMPATIBILITY QUALIFICATION PROGRAM

RM-1000 modules were developed in the late 1990's and the former EMC test program was expanded to include the latest standards as well as TVA specification SS E18.14.01 and the guidance given by EPRI TR-102323, September 1994 issue. The testing program included:

- Conducted Emissions to MIL-STD-461E CE101 and CE102;
- Radiation Emissions to Cenelec EN 55011 (1991) (Group 1, Class A);
- Conducted Susceptibility to MIL-STD-461E CS101and IEC 1000-4-6 (1996) (IEC 801-6);
- Radiated Susceptibility to IEC 1000-4-3 (1995) (IEC 801-3);
- Surge Susceptibility to IEC 1000-4-5 (1995) (IEC 801-5);
- Electrical Fast Transient Immunity to IEC 1000-4-4 (1995) (IEC 801-4); and
- Electro-static Discharge (ESD) to IEC 1000-4-2 (1995) (IEC 801-2).

The RM-1000 module was tested again in 2003 as follows:

- Conducted Emissions to MIL-STD-461E CE101 and CE102;
- Radiation Emissions to MIL-STD-461E RE101;
- Radiation Emissions to Cenelec EN 55022 (1994) (Class A);
- Conducted Susceptibility to MIL-STD-461E CS101and EN 61000-4-6 (1995) (IEC 1000-4-6);
- Radiated Susceptibility to MIL-STD-461E RS101 and EN 61000-4-3 (1995) (IEC 1000-4-3);
- Magnetic Field Susceptibility to EN 61000-4-8 (1995) (IEC 1000-4-8);
- Surge Susceptibility to EN 61000-4-5 (1995) (IEC 1000-4-5);
- Electrical Fast Transient Immunity to EN 61000-4-4 (1995) (IEC 1000-4-4);
- Voltage Fluctuation Ride Through Ability to EN 61000-4-11 (1994) (IEC 1000-4-11); and

- Electro-static Discharge (ESD) to EN 61000-4-2 (1995) (IEC 1000-4-2).

The qualification basis for EMC is performed for the RM-1000 digital monitors in the following sections, where the following steps are performed.

1. The TVA specification requirements are compared to the test results of the same type monitor.
2. Differences are evaluated and justification provided to demonstrate that the monitor will perform satisfactorily.
3. For each monitor the configuration of the monitor is compared to the test article. Differences in configuration are evaluated and justification provided to demonstrate that the monitor will perform satisfactorily

5. EMC QUALIFICATION BASIS

Section 5 of the GA-ESI 04038903-7SP report demonstrates that GA-ESI P/N 04034101-001 (High Range Area Monitor System) Electromagnetic Compatibility (EMC) is qualified for operation in an industrial environment similar to that found at TVA's Watt Bar Unit 2. For detailed elaboration of these qualification bases please refer to the above mentioned document.

6. EMC QUALIFICATION OF 04034201-001 AND 04034401-001

This section qualifies the EMC capabilities of radiation monitors GA-ESI P/Ns 04034201-001 and 04034401-001 (Multi-Channel Area Monitor System) by similarity to the radiation monitor qualified in Section 5 (04034101-001). These other two radiation monitors are Electromagnetic Compatibility (EMC) qualified for operation in an industrial environment [redacted] The EMC qualification basis is established by demonstrating that GA-ESI's EMC qualification tests on the radiation monitoring systems meets the intent of the requirements for replacement radiation monitors. Business Sensitive

6.1 DIFFERENCES IN RADIATION MONITORS

The major differences in the three types of radiation monitors above are their detectors. These detectors are identified and the major components are presented for the three radiation monitors in Table 6-1Table 6-2 andTable 6-3 as follows: Business Sensitve

[redacted]

Business Sensitive

[redacted]

Table 6-3 Major Assemblies of the Multichannel Area Monitors (GA-ESI P/N 04034401-001)

[redacted]

6.2 LATEST RM-1000 DETECTOR TESTS

Business Sensitive

The system configuration as tested and reported in EMC Report 04509050 (April 2003) consisted of two RM-1000 channels; an area monitor channel connected to a [redacted] detector and a process monitor channel connected to a [redacted] Both channels use the same identical RM-1000 controller/monitor (04501200-002) with the same software but running different routines.

The following systems were tested in the EMC Report 04509050:

Business Sensitive

[redacted]

[redacted]

6.3 LATEST RM-1000 DETECTOR TEST RESULTS Business Sensitive

The detectors tested and reported in EMC Report 04509050 (April 2003) consisted of a [redacted] detector and a [redacted] scintillation detector.

The tests results as presented in 04509050 are shown in Table 6-4 and Table 6-5 after Section 6.4

6.4 LATEST RM-1000 TEST RESULTS W/O I-F CONVERTER

The RM-1000 EMC tests without an I-F Converter are reported in EMC Report 04509050 (April 2003). It is believed that the I-F Converter would not impact the EMC results since it is powered by the RM-1000[redacted] Business Senstive

The tests results are shown in Table 6-4 and Table 6-5 on the following pages at the end of this section.

Table 6-4 EMC TEST RESULTS FOR RM-1000 SYSTEM (GMT DETECTOR)

Business Sensitive

TEST PARAMETER	STANDARDS	FREQUENCY RANGE	TEST LEVEL/LIMIT	ANTENNA DISTANCE
LF Conducted Immunity	MIL-STD-461E CS-101	100 Hz to 5 kHz 5 kHz to 50 kHz	142 dBμA 142 – 122 dBμA	NA
HF Conducted Immunity	EN61000-4-6 (1996) (IEC 1000-4-6)	10 kHz to 200 MHz	10 V open ckt. (unmod. rms) 80% AM, 1 kHz	NA
LF Radiated Immunity	MIL-STD-461E RS-101	30 Hz to 60 Hz 60 Hz to 100 kHz	180 dBpT 180 – 116 dBpT	5 cm
HF Radiated Immunity	EN 61000-4-3 (1998) (IEC 1000-4-3)	30 MHz to 10 GHz	10 V/meter, 80% AM, 1 kHz	3 meters
Surge Immunity	EN 61000-4-5 (1995) (IEC 1000-4-5)	NA	± 2 kV common mode; ± 1 kV differential mode	NA
EFT/Burst Immunity	EN 61000-4-4 (1995) (IEC 1000-4-4)	NA	Power leads: ± 2kV Data/control leads: ± 1 kV	NA
Electrostatic Discharge Immunity	EN 61000-4-2 (1995) (IEC 1000-4-2)	NA	Contact discharge: ± 4 kV Air discharge: ± 8 kV	NA
Magnetic Field Immunity	EN 61000-4-8 (1994) (IEC 1000-4-8)	50 Hz	30 A (RMS) /meter	NA
Voltage Dips, Short Interruptions & Voltage Variations Immunity	EN 61000-4-11 (1994) (IEC 1000-4-11)	NA	70% for 10 ms, 40% for 100 ms, 0 V for 5 sec	NA
LF Conducted Emissions	MIL-STD-461E CE-101	100 Hz to 1 kHz 1 kHz to 10 kHz	110 dBμA 110 – 90 dBμA	NA
HF Conducted Emissions	MIL-STD-461E CE-102	10 kHz to 100 kHz 100 kHz to 10 MHz	90 – 60 dBμA 60 – 40 dBμA	NA
LF Radiated Emissions	MIL-STD-461E RE-101	30 Hz to 60 Hz 60 Hz to 100 kHz	160 dBpT 160 – 96 dBpT	7 cm
HF Radiated Emissions	EN 55022, Class A (Table 5)	30 MHz to 230 MHz 230 MHz to 1 GHz	40 dBμV/meter 47 dBμV/meter	10 meters

[redacted]

Table 6-5 EMC TEST RESULTS FOR RM-1000 SYSTEMS (SCINTILLATION DETECTOR)

Business Sensitive

TEST PARAMETER	STANDARDS	FREQUENCY RANGE	TEST LEVEL/LIMIT	ANTENNA DISTANCE
LF Conducted Immunity	MIL-STD-461E CS-101	100 Hz to 5 kHz 5 kHz to 50 kHz	142 dBμA 142 – 122 dBμA	NA
HF Conducted Immunity	EN61000-4-6 (1996) (IEC 1000-4-6)	10 kHz to 200 MHz	10 V open ckt. (unmod. rms) 80% AM, 1 kHz	NA
LF Radiated Immunity	MIL-STD-461E RS-101	30 Hz to 60 Hz 60 Hz to 100 kHz	180 dBpT 180 – 116 dBpT	5 cm
HF Radiated Immunity	EN 61000-4-3 (1998) (IEC 1000-4-3)	30 MHz to 10 GHz	10 V/meter, 80% AM, 1 kHz	3 meters
Surge Immunity	EN 61000-4-5 (1995) (IEC 1000-4-5)	NA	± 2 kV common mode; ± 1 kV differential mode	NA
EFT/Burst Immunity	EN 61000-4-4 (1995) (IEC 1000-4-4)	NA	Power leads: ± 2Kv Data/control leads: ± 1 kV	NA
Electrostatic Discharge Immunity	EN 61000-4-2 (1995) (IEC 1000-4-2)	NA	Contact discharge: ± 4 kV Air discharge: ± 8 kV	NA
Magnetic Field Immunity	EN 61000-4-8 (1994) (IEC 1000-4-8)	50 Hz	30 A (RMS) /meter	NA
Voltage Dips, Short Interruptions & Voltage Variations Immunity	EN 61000-4-11 (1994) (IEC 1000-4-11)	NA	70% for 10 ms, 40% for 100 ms, 0 V for 5 sec	NA
LF Conducted Emissions	MIL-STD-461E CE-101	100 Hz to 1 kHz 1 kHz to 10 kHz	110 dBμA 110 – 90 dBμA	NA
HF Conducted Emissions	MIL-STD-461E CE-102	10 kHz to 100 kHz 100 kHz to 10 MHz	90 – 60 dBμA 60 – 40 dBμA	NA
LF Radiated Emissions	MIL-STD-461E RE-101	30 Hz to 60 Hz 60 Hz to 100 kHz	160 dBpT 160 – 96 dBpT	7 cm

[redacted]

Business Sensitive

TEST PARAMETER	STANDARDS	FREQUENCY RANGE	TEST LEVEL/LIMIT	ANTENNA DISTANCE	[redacted]
HF Radiated Emissions	EN 55022, Class A (Table 5)	30 MHz to 230 MHz 230 MHz to 1 GHz	40 dBμV/meter 47 dBμV/meter	10 meters	

7. REFERENCE DOCUMENTS

GA-ESI DRAWINGS

04034100	OUTLINE, HIGH RANGE AREA MONITOR SYSTEM
04034101	HIGH RANGE AREA MONITOR SYSTEM
04034120	CUSTOMER CONNECTION DIAGRAM, HIGH RANGE AREA MONITOR SYSTEM

GA-ESI DOCUMENTS

02818905-QSR	ENVIRONMENTAL QUALIFICATION SUMMARY REPORT FOR CLASS 1E EQUIPMENT FOR WATTS BAR UNITS 1 & 2
03608917-3SP	QUALIFICATION SUMMARY REPORT FOR RADIATION MONITOR REPLACEMENT PARTS
04038800	RM-1000 EMC TEST REPORT, TVA
04038903-QSR	QUALIFICATION SUMMARY REPORT FOR WATTS BAR NUCLEAR PLANT UNIT 2 REPLACEMENT RADIATION MONITORS
04238905-QSR	ENVIRONMENTAL QUALIFICATION SUMMARY REPORT FOR CONTAINMENT ATMOSPHERE, R-11/12
04238908	SURGE PROTECTOR/FILTER SEISMIC ANALYSIS
04507000	RM-1000 SYSTEM REQUIREMENTS SPECIFICATION
04507001	RM-1000 SOFTWARE REQUIREMENTS SPECIFICATION
04507006	RM-1000 SYSTEM TEST PROCEDURE SPECIFICATION
04507007-1TR	RM-1000 SYSTEM VERIFICATION TEST RESULTS
04507040	RM-1000 SYSTEM TEST PLAN / TEST DESIGN SPECIFICATION
04507042	RM-1000 SOFTWARE VERIFICATION AND VALIDATION PLAN
04507043	RM-1000 COMPUTER PROGRAM DEVELOPMENT PLAN
04507047	RM-1000 SOFTWARE QUALITY ASSURANCE PLAN
04508807	RM-1000 I-F CONVERTER UNCERTAINTY ANALYSIS
04508904	FUNCTIONAL TEST PROCEDURE FOR RM-1000 AND I/F CONVERTER

04508905-QR	QUALIFICATION TEST REPORT FOR RM-1000 PROCESSOR MODULE AND CURRENT-TO-FREQUENCY CONVERTER
04508905-1SP	SUPPLEMENT TO QUALIFICATION TEST REPORT FOR RM-1000 PROCESSOR MODULE AND CURRENT-TO-FREQUENCY CONVERTER
04508905-2SP	SUPPLEMENT TO QUALIFICATION TEST REPORT FOR RM-1000 PROCESSOR MODULE AND CURRENT-TO-FREQUENCY CONVERTER
04509050	RM-1000 EMC TEST REPORT
E-115-0699	CLASS 1E EQUIPMENT QUALIFICATION AND AGING PLAN
E-254-0960	TEST REPORT CLASS 1E DESIGN QUALIFICATION TESTING OF ANALOG HIGH RANGE RADIATION MONITOR (RD-23, RP-2C, RP-23, AND RP-20-01)
OP-4.0-130	ENGINEERING CHANGE ORDERS
OP-4.0-190	MAINTENANCE OF THE ESI DATA BASE

Attachment 27

General Atomics-Electronics Systems Inc. letter GA-ESI 4496, Request by General Atomics Electronic Systems, Inc. to Withhold Certain Information from Public Disclosure under 10CFR2.390 dated October 28, 2011 (Letter Items 9 and 10)

GENERAL ATOMICS

October 28, 2011
GA/ESI-4496

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 2055

Subject: **Request by General Atomics Electronic Systems, Inc. to Withhold Certain Information from Public Disclosure under 10CFR2.390**

Reference: Tennessee Valley Authority / Watts Bar 2 Completion Project

To Whom It May Concern:

General Atomics Electronic Systems Inc., (GA-ESI) hereby submits the following documents related to its Radiation Monitoring System pursuant to the specific request of Bechtel Power Corp. Control Systems in support of the Tennessee Valley Authority's Watts Bar 2 Completion Project:

04038800-1SP RM-1000 EMC Test Report Supplement 1
04038903-QSR Qualification Summary Report for Watts Bar Nuclear Plant Unit 2 Replacement Radiation Monitors

Certain portions of the enclosed documents include GA-ESI proprietary commercially strategic information which GA-ESI has held in confidence, and which is not available through public sources. Accordingly, GA-ESI is submitting these documents in confidence and, as set forth in the enclosed affidavit of Mr. Paul G. Berner, GA-ESI requests that this information be treated as proprietary information under the provisions of 10CFR2.390 and be withheld from public disclosure. The enclosed affidavit addresses specifically the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the of the NRC's regulations.

GA-ESI is submitting both a proprietary version of the documents plus a nonproprietary version of the same. In the proprietary versions of the documents, the proprietary material is delineated by "business sensitive" or "trade secret" designation on specific paragraphs and highlighted text, sentence, figure or drawing to which the designation applies. In the nonproprietary versions, the proprietary information has been obscured/blacked-out.

If you have questions regarding this submittal, please do not hesitate to contact Mr. Paul Berner at (858) 522-8246 or paul.berner@ga-esi.com, or me at (858) 455-2823 or keith.asmussen@ga.com.

Very truly yours,

Keith E. Asmussen

Keith E. Asmussen, Ph.D., Director
Licensing, Safety and Nuclear Compliance

Enclosures: 1) Documents as listed in text
2) Affidavit of Mr. Paul G. Berner

STATE OF CALIFORNIA)

) ss

COUNTY OF SAN DIEGO)

AFFIDAVIT OF PAUL G. BERNER

I, Paul G. Berner, Radiation Monitoring Systems Program Director of General Atomics Electronic Systems, Inc., do hereby affirm and state:

(1) I have been delegated the function of reviewing the information sought to be withheld by General Atomics Electronic Systems, Inc. and I am authorized to execute this affidavit on behalf of General Atomics Electronic Systems, Inc.

(2) The affidavit is submitted under the provisions of 10CFR Part 2.390 in order to withhold the enclosed confidential commercial information (as set forth in paragraph 3 following) of General Atomics Electronic Systems, Inc. from public disclosure or publication.

(3) The information sought to be withheld is related to General Atomics Electronic Systems' Radiation Monitoring System (i.e., RM-1000) and is contained in the documents designated as:

04038800-1SP RM-1000 EMC Test Report Supplement 1
04038903-QSR Qualification Summary Report for Watts Bar Nuclear Plant Unit 2 Replacement Radiation Monitors

The proprietary material in these documents is delineated by "business sensitive" or "trade secret" designation on specific paragraphs and highlighted text, sentence, figure or drawing to which the designation applies.

(4) In making this application for withholding of proprietary information of which it is the owner, General Atomics Electronic Systems, Inc. relies upon the exemption from disclosure set forth is the Freedom of Information Act ("FOIA"), 5 USC Sec. 552.(b)(4) and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10CFR Part 9.17(a)(4) and 2.390(a)(4) for "trade secrets and commercial or financial information obtained from a person and privileged or confidential." The material for which exemption from disclosure is hereby sought is all "confidential commercial information," and some portions also qualify under the narrower

definition of "trade secret," within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(5) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by General Atomics Electronic Systems, Inc.'s competitors without license from General Atomics Electronic Systems, Inc. constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his or her expenditure of resources or improve his or her competitive position in the design, manufacture, shipment, installation, assurance or quality, or licensing of a similar product.

c. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

(6) The information sought to be withheld is being submitted to the NRC in confidence. The information is of a sort customarily held in confidence, is of a sort customarily held in confidence by General Atomics Electronic Systems, Inc., and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by General Atomics Electronic Systems, Inc. No public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (7) and (8) following.

(7) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within General Atomics Electronic Systems, Inc. is controlled to protect it from unauthorized disclosure.

(8) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist or other equivalent authority, by the manager of the cognizant marketing function (or his designee), and by the Legal Department, for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside General Atomics Electronic Systems, Inc. are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements for protecting the information from further disclosure.

(9) The information classified as proprietary was developed and compiled by General Atomics Electronic Systems, Inc. at a significant cost to General Atomics Electronic Systems, Inc. This information is classified as proprietary because it contains detailed historical data and analytical results not available elsewhere. This information would provide other parties, including competitors, with information from General Atomics Electronic Systems, Inc. technical database and the results of evaluations performed using codes developed by General Atomics Electronic Systems, Inc. Release of this information would improve a competitor's position without the competitor having to expend similar resources for the development of the database. A substantial effort has been expended by General Atomics Electronic Systems, Inc. to develop this information.

(10) Public disclosure of the information sought to be withheld is likely to cause substantial harm to General Atomics Electronic Systems, Inc.'s competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of General Atomics Electronic Systems, Inc.'s comprehensive radiation monitoring system technology base, and its commercial value extends beyond the original development cost.

The value of the technology base goes beyond the extensive physical database and analytical methodology, and includes development of the expertise to determine and apply the appropriate evaluation process.

The research, development, engineering, and analytical costs comprise a substantial investment of time and money by General Atomics Electronic Systems, Inc.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it is clearly substantial. General Atomics Electronic Systems, Inc. competitive advantage will be lost if its competitors are able to use the results of the General Atomics Electronic Systems, Inc.'s experience to normalize or verity their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

GENERAL ATOMICS ELECTRONIC SYSTEMS, INC.

Paul G. Berner, Radiation Monitoring
Systems Program Director

State of California
County of San Diego

On October 31, 2011 before me, Lynne-Marie Vetters, Notary Public, personally appeared Paul G. Berner, who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and who acknowledged to me that he executed the same in their authorized capacity, and by his signature on the instrument the person, or entity upon behalf of which the person acted, executed the instrument.

I certify under PENALTY of PERJURY under the laws of the state of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

(Signature of Notary)

LYNNE-MARIE VETTERS
Commission # 1919792
Notary Public - California
San Diego County
My Comm. Expires Jan 1, 2015

BECHTEL POWER CORPORATION	Job Number: 25402

SUPPLIER DOCUMENT REVIEW STATUS

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1 ☐ Work may proceed.

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2 ☐ Revise and resubmit. Work may proceed subject to incorporation of changes indicated.

3 ☐ Rejected. Revise and resubmit.

4 ☒ Review not required. Work may proceed.

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Status By: Joe Temples Joe T. Temples

DATE 11/14/11