RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST TO IMPLEMENT PRNM/ARTS/MELLLA
Attachment 5

NEDO-33789
Revision 0

November 2012

NUMAC Power Range Neutron Monitoring (PRNM) Components 268X1331TCG001, 268X1332TCG001, G002 268X1333TCG001 Qualification Summary for Energy Northwest (ENW) Columbia Generating Station (CGS)

HITACHI

GE Hitachi Nuclear Energy

NEDO-33789
Revision 0
DRF Section 0000-0151-0121 R1
November 2012

Non-Proprietary Information – Class I (Public)

NUMAC POWER RANGE NEUTRON MONITORING (PRNM) COMPONENTS 268X1331TCG001, 268X1332TCG001, G002 268X1333TCG001 QUALIFICATION SUMMARY FOR ENERGY NORTHWEST (ENW) COLUMBIA GENERATING STATION (CGS)

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IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

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REVISION SUMMARY

Revision No.	Change Summary
0	This initial revision was created to add proprietary markings and to provide a public version (NEDO-33789) of the Enclosure 1 Qualification Summary transmitted via Energy Northwest Letter GO2-12-135, dated October 5, 2012 (ADAMS Accession No. ML122920735).

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1. Purpose and Scope

1.1 Purpose

This document summarizes the qualification status (environmental, seismic and EMC) for the NUMAC Power Range Neutron Monitor (PRNM) installation at ENW, Columbia Generating Station. The original plant equipment power range neutron monitor system housed in Panel P608 is replaced with the NUMAC PRNM equipment. [[

]] The equipment covered by this report is identified in paragraph 1.2.1.

1.2 Scope

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1.2.1 Equipment Covered

The conclusions and equipment capability documented in this Qualification Summary apply to CGS for the specific equipment items identified in Table 1.1.

Table 1.1 -- Equipment Covered

Component Name	Note	Identification
[[		
		]]

Notes:
(1) [[

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1.2.2 Qualification Approach

1.2.2.1 CGS Instrument Qualification

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1.2.2.2 CGS PRNM Panel Qualification

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1.2.3 Organization of This Report

The remainder of this Qualification Summary is organized as follows:

Section 2	Listing of documents providing the basis for or supporting conclusions documented in this qualification summary.
Section 3	Identification of the qualification requirements for the CGS equipment.
Section 4	Summary of instrument and CGS PRNM panel qualification results and conclusions, including supplemental analysis where required.

2. Reference Documents

2.1 Specifications

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2.2 PRNM Qualification

2.2.1 Generic PRNM Qualification Analysis, Tests and Results

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2.2.2 CGS Qualification Analysis, Tests and Results

The following documents provide the results of CGS specific analyses and testing performed to support qualification of the CGS PRNM equipment as installed in CGS.

a) [[

]].

2.3 Qualification Standards

2.3.1 IEEE Standards

The following Institute of Electrical and Electronic Engineers (IEEE) Standards, included here for reference, are the primary standards used for environmental and seismic qualification of both generic and CGS specific PRNM equipment.

a)	IEEE Std 323-1974	IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations
b)	IEEE Std 344-1975	IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

2.3.2 Other Standards and Industry Guidelines for EMC Qualification

The following United States Military (MIL) and International Electrotechnical Commission (IEC) standards and industry guidelines, included here for reference, are the primary standards used for EMC qualification of both generic and CGS specific PRNM equipment.

2.3.2.1 United States Military Standards

a)	MIL-STD-461D	Requirements for the Control of Electromagnetic Interference Emissions and Susceptibility
b)	MIL-STD-462D	Measurement of Electromagnetic Interference Characteristics

2.3.2.2 International Electrotechnical Commission

a)	IEC 801-2	Electromagnetic compatibility for industrial-process measurement and control equipment, Part 2: Electrostatic discharge requirements
b)	IEC 801-4	Electromagnetic compatibility for industrial-process measurement and control equipment, Part 4: Electrical fast transient/burst requirements
c)	IEC 801-5	Electromagnetic compatibility for industrial-process measurement and control equipment, Part 5: Surge immunity requirements

2.3.2.3 Industry Guidelines

a)	EPRI TR-102323, September 1994	Guidelines for Electromagnetic Interference Testing in Power Plants
b)	EPRI TR-102323, November 2004	Guidelines for Electromagnetic Interference Testing of Power Plant Equipment: Revision 3 to TR-102323

2.3.3 Regulatory Guidelines for EMC Qualification

The following USNRC Regulatory Guideline, included here for reference, is used in this Qualification Summary as guidance in confirming the adequacy of the EMC qualification of the CGS-specific PRNM equipment for application at the CGS plant.

2.3.3.1 Regulatory Guidelines

a) USNRC Regulatory Guideline 1.180, Rev. 1 — Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-related Instrumentation and Control Systems.

3. Qualification Requirements

3.1 General

Reference 2.1a provides the top level ENW requirements for the CGS PRNM system. Ref. 2.1a directly includes the environmental requirements for the CGS PRNM equipment, and indirectly includes the EMC and seismic requirements for the PRNM instruments by invoking Ref. 2.1b. Ref. 2.1b further invokes Ref. 2.1c. Reference 2.1d is the licensing basis for the CGS PRNM, so it is treated as a CGS requirement.

CGS-specific seismic spectra are not included in Ref. 2.1a, so the generic NUMAC requirements in Ref. 2.1c will be applied for the PRNM equipment. Seismic qualification of the PRNM P608 panel is documented in Refs. 2.2.2a, which also includes the CGS-specific seismic floor spectra. Qualification levels of the PRNM instruments are documented in this Qualification Summary. Seismic qualification of the P603 panel is not within the scope of this analysis, and must be confirmed by ENW. [[

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Reference 2.1a, which invokes Ref. 2.1b, is developed from the ENW project inputs to define the specific CGS PRNM system and equipment requirements. These requirements, in turn, provide the inputs to define the equipment for the project, documented in Ref. 2.1e, which includes the panel assembly, Ref. 2.1f.

Together, these references are used for this qualification summary to define the equipment that must be addressed and the qualification requirements for that equipment.

The CGS requirements apply to the equipment as installed at the site. However, to "partition" the design and qualification process and to support future spares qualification assessments, the GEH design documents (Ref. 2.1a and supporting documents) also define instrument level requirements for environmental and seismic qualification. To fully respond to the referenced requirements, this qualification summary must show that the environmental and seismic conditions are met both at the instrument level and at the "installed equipment" level. The EMC requirements apply only to the equipment as installed in the CGS panels.

3.2 Environmental Requirements

3.2.1 Instruments

In accordance with the CGS PRNM requirements specification (Refs. 2.1a and 2.1b), the CGS PRNM instruments (i.e., NUMAC instruments) are required to function without degradation when subjected to the environmental conditions imposed by the NUMAC design requirements specification (Ref. 2.1c). Those requirements are shown in Table 3.1. The instrument environmental requirements are the same as the requirements used for the generic PRNM qualification (Refs. 2.2.1a, b, c, f and i.). [[

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Table 3.1 -- Instrument Environmental Requirements

Parameter	Minimum	Nominal	Maximum	U/M
[[				
				]]

(1) [[ ]]

3.2.2 Panel

In accordance with the CGS PRNM requirements (references 2.1a), the CGS PRNM instruments when installed in the PRNM panels are required to function without degradation when the panels are subjected to the CGS plant control room environmental conditions provided in Table 3.2.

Table 3.2 -- PRNM Panel Environmental Requirements (1) (2)

Parameter	Minimum	Nominal	Maximum	U/M
[[				
				]]

(1) [[

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3.3 Seismic

3.3.1 Instruments

In accordance with the PRNM requirements specification for CGS (reference 2.1a invoking Ref. 2.1b), CGS PRNM instruments are to function without degradation when subjected to the seismic response spectra defined by the NUMAC design requirements specification (reference 2.1c). The seismic Required Response Spectra (RRS) for both horizontal and vertical motion (3% damping) is defined by the "break" points in Table 3.3. The instrument seismic requirements are the same as the requirements used for the generic PRNM qualification (Refs. 2.2.1a, b, d, f and i.). While Table 3.3 gives the minimum qualification levels, the actual qualification Test Response Spectrum (TRS) exceeded those levels over the frequency range. [[

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During seismic qualification test of the generic PRNM System, [[

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Table 3.3 -- Instrument Seismic Requirements

Frequency	Acceleration	
	Fault (SSE)	Upset (OBE)
[[		
		]]

3.3.2 Panels

In accordance with the PRNM requirements specification for CGS (see Ref. 2.1a), CGS PRNM instruments when installed in the PRNM panels are to function without degradation when the panels are subjected to the CGS seismic spectrum for SSE and OBE accelerations. That spectrum and a comparison to the instrument RRS (Table 3.3) as well as the actual instrument TRS are documented in Refs. 2.2.2a for panel P608. Qualification of Control Room Panel P603 will be confirmed and documented by ENW. The qualification level of the instruments mounted in Control Room P603 is documented in this Qualification Summary, Section 4. [[

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3.4 Electromagnetic Compatibility (EMC)

References 2.1b, invoked by Ref. 2.1a, and 2.1d provide the generic PRNM EMC requirements. Those are used as the requirements applicable to qualification of the PRNM instruments. However, where additional qualification work beyond that required to meet those References has been completed, those results to the extent they apply to CGS are also included to more completely document the qualified level of the equipment. [[

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Since the PRNM equipment qualification was performed using earlier revisions of the EMC tests, and since no CGS specific site survey is available, adequacy of the PRNM EMC will be determined by comparing the actual qualification test levels/frequencies used to the more restrictive of those identified in Ref. 2.1d (LTR) and Ref. 2.3.3.1a (latest revision of USNRC Reg. Guide 1.180)

Table 3.6 compares the test methods used for the PRNM qualification to those identified in Ref. 2.3.3.1a.

Tables 3.4 and 3.5 include the EMC qualification requirements based on Ref. 2.1d, which are equivalent to those in Ref. 2.1b, plus recommended test levels for comparable tests identified in Ref. 2.3.3.1a. The analyses comparing actual qualification performed against these requirements are included in Section 4 of this report. [[ ]]

Table 3.4 -- Susceptibility Requirements

EMC	Test	Test Levels
[[		
		]]

(1) [[

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Table 3.5 -- Emissions Requirements

EMI	Test	Test Levels
[[		
		]]

(1) [[

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Table 3.6 – Comparison of EMC Test Methods, PRNM Instruments

EMC aspect	PRNM Test	Reg. Guide 1.180 (Ref. 2.3.3.1a) (1)
[[		
		]]

(1) [[

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Table 3.7 – EMC Tests, NUMAC Interface Computer (NIC)

EMC aspect	NIC Test	Reg. Guide 1.180 (Ref. 2.3.3.1a) (1)
[[		
		]]

(1) [[

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4. Qualification Results

4.1 CGS Instrument Qualification

4.1.1 CGS PRNM Instrument Requirements

The environmental, seismic, and EMC conditions applicable to the CGS PRNM instruments are defined in paragraphs 3.2.1, 3.3.1, and 3.4, respectively. The first two are to be met by the instruments alone (in addition to the panel level conditions covered in section 4.2). The EMC conditions are addressed only for instruments installed in the panel.

4.1.2 Generic PRNM Instrument Qualification Levels

Environmental and seismic qualification of [[

]] Each instrument in a set of NUMAC PRNM instruments (collectively termed the "generic" PRNM instruments) was qualified. The environmental and seismic requirements used as the minimum acceptance level for the generic PRNM instruments are the same as the requirements listed in paragraphs 3.2.1 and 3.3.1.

[[

]] it is concluded that all of the generic PRNM equipment are qualified to the CGS environmental requirements in Tables 3.1 and 3.2.

[[

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The qualified levels of the generic PRNM instruments are the same as the requirements in paragraphs 3.2.1, 3.3.1, and 3.4 (Tables 3.4 and 3.5, Ref. 2.1d values only). In some cases, the actual qualification testing or additional analysis supports qualification of the generic PRNM instruments and similar CGS instruments to higher levels.

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4.1.3 CGS Requirements vs. Generic Qualification Levels

4.1.3.1 Environmental and Seismic Qualification Levels

As discussed in paragraphs 3.2.1 and 3.3.1, and 4.1.2, the CGS environmental and seismic requirements at the instrument level are the same as the requirements met for the generic PRNM instrument qualification. Therefore, the generic PRNM instruments are qualified to the CGS instrument environmental and seismic requirements.

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4.1.3.2 EMC Qualification Levels

As discussed in section 3.4, the CGS EMC requirements at the instrument level are the same as the requirements met for the generic PRNM instrument qualification. Therefore, the generic PRNM instruments are qualified to the CGS instrument EMC requirements.

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The evaluation in Section 4.2.2.3 addresses applicability of the EMC qualification to the CGS installed configuration.

4.1.4 Comparison of CGS PRNM Instruments to Generic PRNM Instruments

The CGS PRNM instruments are identified in Table 1.1. The Table 4.1 below correlates the qualified generic PRNM instruments [[ ]]

Table 4.1 -- CGS Instruments vs. Generic PRNM Instruments

	Instrument	Generic Version	CGS Version
a.	[[		
b.			
c.			
d.			
e.			
f.			
g.			
h.			
i.			
j.			
k.			
l.			
m.			
n.			
o.			
p.			
q.			]]

[[

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4.1.4.1 Evaluation of Differences vis-à-vis Environmental Qualification

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Table 4.2 -- Component Qualified Life

Component	GEH Drawing Number	Qualified Life
[[		]]

As a result of the analysis above, it is concluded that the instruments listed in Table 1.1 are qualified for operation in the CGS environment shown in paragraph 3.2.1.

4.1.4.2 Evaluation of Differences vis-à-vis Seismic Qualification

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As a result of the analysis above, it is concluded that the instruments listed in Table 1.1 are qualified for operation in the seismic environment shown in paragraph 3.3.1. Seismic qualification of the instruments as installed in the panels is addressed in section 4.2.

4.1.4.3 Evaluation of Differences vis-à-vis EMC Qualification.

Following is an evaluation of differences between CGS PRNM instruments compared to the generic PRNM instruments to determine the EMC qualification levels for the CGS PRNM instruments.

a) [[

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As a result of the analysis above, it is concluded that the instruments listed in Table 1.1 [[
]] are qualified for operation in an installed configuration in the EMC environment shown in paragraphs Tables 3.4 and 3.5, provided the installed configuration is similar to that used for the generic PRNM EMC qualification. [[

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4.2 Panel and Installed Equipment Qualification

4.2.1 CGS PRNM Panel Requirements

The requirements for the CGS PRNM panels are shown in paragraph 3.2.2 (environmental), paragraph 3.3.2 (seismic), and paragraph 3.4 (EMC).

4.2.2 Comparison of Qualification Levels to Conditions at Instrument Mounting Locations

4.2.2.1 Evaluation of Environmental Conditions vis-à-vis Qualification Levels

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4.2.2.2 Evaluation of Seismic Conditions vis-à-vis Qualification Levels

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4.2.2.3 Evaluation of EMC Conditions vis-à-vis Qualification Levels

The EMC qualification levels for the CGS PRNM instruments are equal to the requirements in paragraph 3.4 provided the configuration of the CGS PRNM instruments, when installed in the CGS PRNM panels, is similar to the configuration tested for the generic PRNM instrument EMC qualification.

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Table 4.3 -- Equipment Included in EMC Testing

Qty	Description	Part No.	Bay
[[			
			]]

Note 1: [[ ]]

[[

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It is concluded that the CGS PRNM instrument installed configuration is sufficiently similar to the configuration used in the generic PRNM instrument EMC qualification tests that the results apply to the CGS PRNM instruments as installed in the CGS PRNM panels. Therefore, the CGS PRNM instruments, when installed in the panels, meet the CGS EMC requirements.

4.3 Evaluation Conclusions

Based on the evaluation documented in the previous sections of this qualification summary, it is concluded that the environmental and EMC qualification levels for the CGS PRNM equipment identified in Table 1.1 envelop the CGS "installed equipment" requirements, and are, therefore, qualified for the CGS application relative to environmental and EMC conditions. It is also concluded that the seismic qualification levels of the PRNM equipment identified in Table 1.1 and CGS panel P608 with PRNM equipment installed envelop the CGS "installed equipment" requirements, and are, therefore, qualified for the CGS application relative to seismic conditions.

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