Enclosure 3

General Electric Hitachi (GEH) Calculation NEDC-33859

Non-Proprietary

Instrumentation Limits Calculation
Monticello Nuclear Generating Plant
Average Power Range Monitor NUMAC
PRNM Setpoints – Extended Flow Window Stability

Revision 0

July 2014

25 pages follow

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GE Hitachi Nuclear Energy

NEDO-33859
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Non-Proprietary Information-Class I (Public)

Instrument Limits Calculation
Monticello Nuclear Generating Plant

Average Power Range Monitor NUMAC PRNM Setpoints – Extended Flow Window Stability

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ACRONYM AND ABBREVIATIONS

Acronym	Description
AGAF	APRM Gain Adjustment Factor
AL	Analytical Limit
ALT	As Left Tolerance
APEA	Primary Element Accuracy-Accuracy Error
AV	Allowable Value
DL	Design Limit
DPEA	Primary Element Accuracy-Drift Error
EFWS	Extended Flow Window Stability
EMI	Electromagnetic Interference
LAT	Leave Alone Tolerance
LER	Licensee Event Report
LPRM	Local Power Range Monitor
M&TE	Maintenance and Testing Equipment
NTSP	Nominal Trip Setpoint
NUMAC	Nuclear Measurement Analysis and Control
OL	Operational Limit
PEA	Primary Element Accuracy
PMA	Process Measurement Accuracy
P_{BSP}	Power Breakpoint Setpoint
P_{BSP-RB}	Power Breakpoint Setpoint - Rod Block
$P_{BSP-Trip}$	Power Breakpoint Setpoint - Scram
RDF	Rated Drive Flow
RFI	Radio Frequency Interference
RTP	Rated Thermal Power
SLO	Single-Loop Operation
STA	Spurious Trip Avoidance
STP	Simulated Thermal Power
TLO	Two-Loop Operation
TRM	Technical Requirements Manual
TS	Technical Specification
$W_{BSP-Break}$	Flow Breakpoint Setpoint
W_{BSP-RB}	Flow Clamp Rod Block
$W_{BSP-Trip}$	Flow Clamp Scram
URL	Upper Range Limit
VD	Vendor Drift

EXECUTIVE SUMMARY

This document is a supplement analysis data sheet to Reference 1. Included in this document in sequential order are:

- The setpoint functions for the system,
- The setpoint function analyses inputs and the source reference of the inputs,
- The devices in the setpoint function instrument loop,
- The component analysis inputs and input sources,
- The calculated results,
- Input comments and result recommendations,
- References.

System: Average Power Range Monitor
The following Extended Flow Window Stability (EFWS) Average Power Range Monitor (APRM) setpoint functions are included in this document:

- P_{BSP} – Constant Power Line Setpoint 1 at low Recirculation (Recirc) flow rates below the Breakpoint in units of Percent Rated Thermal Power (% RTP) (horizontal line on Power / Recirc Drive flow map):
  - $P_{BSP-Trip}$ – Scram
  - P_{BSP-RB} – Rod Block
- $W_{BSP-Break}$ - Flow Breakpoint Setpoint where Constant Power Line Setpoint intersects the Slope Line Setpoint in units of % Rated Drive Flow (% RDF). (Note that the breakpoint for the Scram and Rod Block are the same, in units of % RDF.)
- Sloped Line Setpoint with Slope (in units of % RTP / % RDF) and Intercept (in units of % RTP) between the Flow Breakpoint Setpoint and the Constant Flow Line Setpoint (sloped line on Power / Recirc Drive Flow map):
  - Scram
  - Rod Block
- W_{BSP} – Constant Flow Line Setpoint (Flow Clamp Setpoint) in units of % RDF (vertical line on Power / Recirc Drive flow map):
  - $W_{BSP-Trip}$ (Flow Clamp Scram)
  - W_{BSP-RB} (Flow Clamp Rod Block)

1. FUNCTION: EFWS APRM SCRAMS AND ROD BLOCKS

Setpoint Characteristics:	Definition		Reference(s)
Event Protection:	Limiting event for the new EFWS APRM setpoints: **Scram:** ▪ The EFWS APRM Scram setpoint functions provide a Scram for stability transients in accordance with the Enhanced Option III Long Term Stability solution **Rod Block:** ▪ The EFWS Rod Blocks serve as a warning of potential EFWS Scrams.		
Function After Earthquake	☐ Required	☒ Not Required	Comment 6

Setpoint Direction
• Constant Power Line Setpoint:
  • $P_{BSP-Trip}$ Scram
  • P_{BSP-RB} Rod Block
• Sloped Line Setpoint:
  • Scram
  • Rod Block
• Constant Flow Line (Flow Clamp) Setpoint:
  • $W_{BSP-Trip}$ (Scram)
  • W_{BSP-RB} (Rod Block)
• $W_{BSP-Break}$ - Flow Breakpoint Setpoint
	
	☒ Increasing
	☒ Increasing
	
	☒ Increasing
	☒ Increasing
	
	☐ Increasing
	☐ Increasing
	
	☒ Increasing
		
		☐ Decreasing
		☐ Decreasing
		
		☐ Decreasing
		☐ Decreasing
		
		☒ Decreasing
		☒ Decreasing
		
		☐ Decreasing	

Single or Multiple Channel	☐ Single	☒ Multiple	Ref. 4.2 (Sections 3.2, 4.2.2, 4.3);
Licensee Event Report (LER) Calculation Basis if Multiple Channel	Standard (Conservative) LER Calculation ☐ or Configuration Specific LER Calculation ☒		Ref. 1, Ref. 2
Trip Logic for Configuration Specific LER Calculation	2-Out-Of-4		Comment 26

Plant Data:	Value	Sigma if not 2	Reference(s)
Flow Primary Element (Venturi) a.) Accuracy (APEA) b.) Drift (DPEA)	a.) ± 1% rated Recirc flow b.) n/a		
Flow Process Measurement Accuracy (PMA) a.) PMA (flow noise) b.) PMA (static head)	a.) ± 1.0% rated Recirc Flow b.) Negligible		

Plant Data:	Value	Sigma if not 2	Reference(s)
Power Primary Element (LPRM Detector) (% Power) a.) $APEA_{Accuracy}$ b.) $APEA_{Power\ Supply\ Effect}$ c.) DPEA	a.) ± 1%; bias 0.49% b.) Negligible c.) ± 0.2% / 7days; bias 0.33 % / 7days		Ref. 2 (Section 4.5.3); Comment 16
Power Process Measurement Accuracy (PMA) (% Power) a.) Tracking (fixed and flow-biased) b.) Noise (neutron flux) c.) Noise (Simulated Thermal Power (STP))	a.) ± 1.11% b.) ± 2.0% c.) ± 0.0%		Comment 13

Components (or Devices) in Setpoint Function Instrument Loop:

- Flow Element
- Local Power Range Monitor (LPRM) Detector
- Flow Transmitter
- Nuclear Measurement Analysis and Control (NUMAC) Chassis:
  - Instrument Loop Flow Electronics (Recirculation Flow Monitor System)
  - Instrument Loop Power Electronics (LPRM, APRM, Trip Circuit)

1.1 EFWS APRM Constant Power Line Setpoint: $P_{BSP-Trip}$ Scram (Comment 23)

Current Function Limits:	**Value/Equation Currently** (% RTP)	**EFWS Value/Equation** (% RTP)	**Applicable W_d Range** (% RDF)	**Reference(s)**
Analytical Limit (AL)	n/a	42.6	$0 \leq W_d \leq 29$	
Technical Specification (TS) Allowable Value (AV)	n/a	Results in Section 3	Results in Section 3	
Nominal Trip Setpoint (NTSP)	n/a	Results in Section 3	Results in Section 3	
Operational Limit (OL)	n/a	28.3	Results in Section 3	Section 3, Comment 17

1.2 EFWS APRM Constant Power Line Setpoint: P_{BSP-RB} Rod Block (Comment 23)

Current Function Limits:	**Value/Equation Currently** (% RTP)	**EFWS Value/Equation** (% RTP)	**Applicable W_d Range** (% RDF)	**Reference(s)**
Design Limit (DL)	n/a	n/a	$0 \leq W_d \leq 29$	Comment 19; Comment 24
TS AV	n/a	Scram AV – 10.3 %	Results in Section 3	Comment 19
NTSP	n/a	Results in Section 3	Results in Section 3	
OL	n/a	n/a	n/a	Comment 3

1.3 EFWS APRM $W_{BSP-Break}$ - Flow Breakpoint Setpoint (Comment 23)

Current Function Limits:	**Value/Equation Currently** (% RTP)	**EFWS Value/Equation** (% RDF)	**Reference(s)**
AL/DL	n/a	29.0	Comment 19; Comment 24
TS AV	n/a	Results in Section 3	
NTSP	n/a	Results in Section 3	
OL	n/a	n/a	Comment 3

1.4 EFWS APRM Sloped Line Setpoint: Scram (Comment 23)

Current Function Limits:	**Value/Equation Currently** (% RTP)	**EFWS Value/Equation** (% RTP)	**Applicable W_d Range** (% RDF)	**Reference(s)**
AL	n/a	2.49 W_d + (-29.61)	$29.0 < W_d \leq 45.5$	
TS AV	n/a	Results in Section 3	Results in Section 3	
NTSP	n/a	Results in Section 3	Results in Section 3	
OL	n/a	2.49 W_d + (-49.6)	Results in Section 3	Section 3, Comment 17

1.5 EFWS APRM Sloped Line Setpoint: Rod Block (Comment 23)

Current Function Limits:	**Value/Equation Currently** (% RTP)	**EFWS Value/Equation** (% RTP)	**Applicable W_d Range** (% RDF)	**Reference(s)**
DL	n/a	n/a	n/a	Comment 19; Comment 24
TS AV	n/a	Scram AV – 10.3 %	Results in Section 3	Comment 19
NTSP	n/a	Results in Section 3	Results in Section 3	
OL	n/a	n/a	n/a	Comment 3

1.6 EFWS APRM Constant Flow Line (Flow Clamp) Setpoint: $W_{BSP-Trip}$ (Scram) (Comment 23)

Current Function Limits:	Value/Equation Currently	EWFS Value/Equation (% RDF)	Reference(s)
AL	n/a	45.5	
TS AV	n/a	Results in Section 3	
NTSP	n/a	Results in Section 3	
OL	n/a	53.9 %RDF	Section 3, Comment 17

1.7 EFWS APRM Constant Flow Line (Flow Clamp) Setpoint: W_{BSP-RB} (Rod Block) (Comment 23)

Current Function Limits:	Value/Equation Currently	EWFS Value/Equation (% RDF)	Reference(s)
DL	n/a	n/a	Comment 19; Comment 25
TS AV	n/a	Scram AV + 6%	Comment 19
NTSP	n/a	Results in Section 3	
OL	n/a	n/a	Comment 3

2. COMPONENTS

2.1 Flow Transmitter

Component Information:	Value/Equation	Reference(s)
Plant Instrument ID No.	FT-2-110 A, B, C, D (existing) FT-2-110 E, F, G, H (additional)	Ref. 4.1 (Section 3.1.4)
Instrument Vendor	Rosemount	
Model ID No. (including Range Code)	1152DP5N92PB Range 5	
Plant Location(s)	Reactor Building, el. 935'	
Process Element	Venturi (FE-2-109 A, B)	

Inputs:

Vendor Specifications	Value / Equation	Sigma if not 2	Reference(s)
Top of Scale	366.31 InWC (20mA)		
Bottom of Scale	-6.05 InWC (4mA)		
Upper Range Limit (URL)	750 InWC		
Accuracy	± 0.25% Span	3	Ref. 4.6 (Section 6)
Temperature Effect	± (0.5% URL + 0.5% Span) per 100ºF	3	Ref. 4.6 (Section 6)
Seismic Effect	± 0.25% URL during and after 3g over range of 5-100 Hz in 3 major axes		Ref. 4.6 (Section 6)
Radiation Effect	± 8% URL during and after 5 x 10^6 RADs TID		Ref. 4.6 (Section 6)
Humidity Effect	Included in accuracy		Ref. 4.6 (Section 6)
Power Supply Effect	± 0.005% of output span per volt		Ref. 4.6 (Section 6)
Radio Frequency Interference / Electromagnetic Interference (RFI/EMI)	negligible		Comment 4
Insulation Resistance Effect	negligible		Comment 4
Over-pressure Effect	± 1% URL after 2000 psig		Ref. 4.6 (Section 6)
Static Pressure Effect a.) Random zero effect b.) Random span effect (Correction uncertainty) c.) Bias span effect	a.) ± 0.25% URL per 2000 psi b.) ± 0.25% input reading per 1000 psi c.) n/a (calibrated out)	3	Ref. 4.6 (Section 6)
Mounting Position Effect a.) Zero Shift b.) Span Effect	a.) Up to 1 InH_20 (calibrated out) b.) None		Ref. 4.6 (Section 6);

2.1 Flow Transmitter (cont'd)

Plant Data:	Value	Reference(s)
Calib Temperature Range	65 to 90 ºF	
Normal Temperature Range	60 to 104 ºF	
Trip Temperature range	60 to 104 ºF	Comment 18
Plant seismic value	n/a	Comment 6
Plant Radiation value	negligible	
Plant Humidity value	20 to 90%	
Power Supply Variation value	negligible	
RFI/EMI value	0	
Over-pressure value	1332 psig	
Static Pressure value	1010 psig	

Drift:	Value	Sigma if not 2	Reference(s)
Current Calib. Interval	24 months ☐ Includes extra 25%	n/a	Ref. 3.1 (Table 3.3.1.1-1, SR 3.3.1.1.11)
Desired Calib. Interval	24 months ☐ Includes extra 25%	n/a	Ref. 3.1 (Table 3.3.1.1-1, SR 3.3.1.1.11)
Drift Source	☒Vendor ☐Calculated	n/a	Ref. 4.6 (Section 6)
Drift Value	± 0.2% URL / 30 months		Ref. 4.6 (Section 6); Ref. 1; Ref. 2; Comment 7

2.1 Flow Transmitter (cont'd)

Calibration:	Value / equation	Sigma if not 3	Reference(s)
As Left Tolerance (ALT)	± 0.3125% Span (± 0.05 mA)		
Leave Alone Tolerance (LAT)	= ALT		

Input Calibration Tool:	Ashcroft Model 2089	n/a	
Accuracy	± 0.1% of full scale (FS = 277.3 InWC)		
Resolution / Readability	0.0005		
Minor Division	n/a		
Upper Range	n/a		
Temperature Effect	Included in accuracy		
Input Calibration Standard:	Deadweight tester	n/a	
Accuracy	= Input Calibration tool accuracy		Comment 8
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			
Output Calibration Tool:	Fluke Model 189	n/a	
Accuracy	± 0.04 mA		
Resolution / Readability	0.005		
Minor Division	n/a		
Upper Range	n/a		
Temperature Effect	Included in accuracy		

2.1 Flow Transmitter (cont'd)

Calibration:	Value / equation	Sigma if not 3	Reference(s)
Output Calibration Standard:	Fluke Calibrator	n/a	
Accuracy	= Output Calibration Tool accuracy		Comment 8
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			

Application Specific Input:	Value	Sigma if not 2	Reference(s)
n/a			

2.2 Flow Electronics (Recirculation Flow Monitor System)

Component Information:	Value/Equation	Reference(s)
Plant Instrument ID No.	Undefined	Comment 2
Instrument vendor	GEH	Ref. 4.2
Model ID No. (including Range Code)	NUMAC	Ref. 4.2
Plant Location(s)	Admin Bldg, El 951'	
Process Element	n/a	

Inputs:

Vendor Specifications	Value / Equation	Sigma if not 2	Reference(s)
Top of Scale	FS = 125% loop flow	n/a	Ref. 4.2 (Sections 4.3.5.3, 4.3.5.4, 4.6.2); Ref. 4.3 Table 1
Bottom of Scale	0% loop flow	n/a	Ref. 4.2 (Sections 4.3.5.3, 4.3.5.4, 4.6.2); Ref. 4.3 (Table 1)
URL	n/a	n/a	Ref. 4.2 (Sections 4.3.5.3, 4.3.5.4, 4.6.2)
Accuracy	± 0.122 mAdc (where 16 mAdc input span from FT corresponds to 125% flow)		Comment 9
Temperature Effect	included in accuracy		
Seismic Effect	negligible		Ref. 4.5 (Sections 4.1.1, 4.2.6); Comment 4
Radiation Effect	negligible		Ref. 4.5 Sections 4.2 & 4.2.4); Comment 4, Comment 10
Humidity Effect	included in accuracy		Comment 4
Power Supply Effect	included in accuracy		Comment 4
RFI/EMI Effect	negligible		Ref. 4.5 (Sections 4.1.1, 4.2.5), Comment 4
Insulation Resistance Effect	negligible		Comment 4
Over-pressure Effect	n/a		Comment 5
Static Pressure Effect	n/a		Comment 5

2.2 Flow Electronics (cont'd)

Plant Data:	Value	Reference(s)
Calib Temperature Range	72 to 78 ºF	
Normal Temperature Range	72 to 78 ºF	
Trip Temperature range	72 to 78 ºF	
Plant seismic value	n/a	
Plant Radiation value	negligible	
Plant Humidity value	20 to 90%	
Power Supply Variation value	negligible	
RFI/EMI value	negligible	
Over-pressure value	n/a	Comment 5
Static Pressure value	n/a	Comment 5

Drift:	Value	Sigma if not 2	Reference(s)
Current Calib. Interval	24 months ☐ Includes extra 25%	n/a	
Desired Calib. Interval	24 months ☐ Includes extra 25%	n/a	
Drift Source	☐ Vendor ☒ Calculated	n/a	Ref. 1; Ref. 2
Drift Value • (% rated drive flow)	Not specified; [[ ]] = ± 0.122 mAdc / 6 months		Ref. 1; Ref. 2

2.2 Flow Electronics (cont'd)

Calibration:	Value / equation	Sigma if not 3	Reference(s)
ALT	n/a		
LAT	n/a		
Input Calibration Tool:	Internal to NUMAC	n/a	
Accuracy	± (1.1)*0.192% units on 125% scale		Comment 14
Resolution / Readability	included in accuracy		
Minor Division	included in accuracy		
Upper Range	125%	n/a	
Temperature Effect	included in accuracy		
Input Calibration Standard:	included in calibration tool		
Accuracy	n/a		
Resolution / Readability	n/a		
Minor Division	n/a		
Upper Range	n/a		
Temperature Effect	n/a		
Output Calibration Tool:	n/a		
Accuracy			
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			
Output Calibration Standard:	n/a		
Accuracy			
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			

Application Specific Input:	Value	Sigma if not 2	Reference(s)
n/a			

2.3 Power Electronics (LPRM, APRM, Trip Circuit)

Component Information:	Value/Equation	Reference(s)
Plant Instrument ID No.	Undefined	Comment 2
Instrument vendor	GEH/ Reuter-Stokes	Ref. 4.2
Model ID No. (including Range Code)	NUMAC	Ref. 4.2
Plant Location(s)	Power electronics: Admin Bldg, El 951'	
Process Element	Local Power Range Monitor (LPRM) Neutron detector	Ref. 4.2 (Sections 3.2, 4.3.2, 4.4.3)

Inputs:

Vendor Specifications	Value / Equation	Sigma if not 2	Reference(s)
Top of Scale	FS = 125%	n/a	Ref. 4.2 (Section 4.3.2)
Bottom of Scale	0%	n/a	Ref. 4.2 (Section 4.3.2)
URL	n/a	n/a	Ref. 4.2 (Section 4.3.2)
Accuracy • LPRM Detector • LPRM Electronics	$A_{LPRM\ Detector}$ = APRM PEA ± 0.943% (% local power)		Ref. 1; Ref. 2;
Temperature Effect	included in accuracy		
Seismic Effect	included in accuracy		Ref. 4.5 (Sections 4.1.1 & 4.2.6); Comment 4
Radiation Effect	negligible		Ref. 4.5 (Sections 4.2 & 4.2.4); Comment 4, Comment 10
Humidity Effect	included in accuracy		Comment 4
Power Supply Effect (Detector)	See APRM PEA		
RFI/EMI Effect	negligible		Ref. 4.5 (Sections 4.1.1 & 4.2.5); Comment 4
Insulation Resistance Effect	negligible		Comment 4
Over-pressure Effect	n/a		Comment 5
Static Pressure Effect	n/a		Comment 5

2.3 Power Electronics (cont'd)

Plant Data:	Value	Reference(s)
Calib Temperature Range	72 to 78 ºF	
Normal Temperature Range	72 to 78 ºF	
Trip Temperature range	72 to 78 ºF	
Plant seismic value	n/a	Comment 6
Plant Radiation value	negligible	
Plant Humidity value	20 to 90%	
Power Supply Variation value	negligible	
RFI/EMI value	negligible	
Over-pressure value	n/a	Comment 5
Static Pressure value	n/a	Comment 5

Drift:	Value	Sigma if not 2	Reference(s)
Current Calib. Interval	7 days ☐ Includes extra 25%	n/a	Ref. 3.1 (Table 3.3.1.1-1, SR 3.3.1.1.2)
Desired Calib. Interval	7 days ☐ Includes extra 25%	n/a	Ref. 3.1 (Table 3.3.1.1-1, SR 3.3.1.1.2)
Drift Source	☒Vendor ☐Calculated	n/a	Ref. 1; Ref. 2
Drift Value ▪ (% power)	± 0.5% FS / 700 hours		Ref. 4.4 (Section 4.3.3.3)

2.3 Power Electronics (cont'd)

Calibration:	Value / equation	Sigma if not 3	Reference(s)
	Included in APRM calibration		
ALT	APRM Gain Adjustment Factor (AGAF)		Comment 11
LAT	= ALT		Comment 11
Input Calibration Tool:	n/a		Comment 11
Accuracy			
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			
Input Calibration Standard:	n/a		Comment 11
Accuracy			
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			
Output Calibration Tool:	n/a		Comment 11
Accuracy			
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			
Output Calibration Standard:	n/a		Comment 11
Accuracy			
Resolution / Readability			
Minor Division			
Upper Range			
Temperature Effect			

Application Specific Input:	Value	Sigma if not 2	Reference(s)
Minimum No. of LPRMs per APRM Channel	14 of 24	n/a	Ref. 4.1 (Sections 3.1.2, 4.1.5); Ref. 4.3 (Table 1)
AGAF	± 2% RTP	3	

3. SUMMARY RESULTS

Calculated Values

Setpoint Function	EFWS Value / Equation † (% RTP or % RDF)	Applicable Recirc Drive Flow (W_d) Range (% RDF)	Meets LER Avoidance Criteria ††	Meets STA Criteria †††
Constant Power Line Setpoint **$P_{BSP-Trip}$ Scram**	AL: 42.6 % RTP AV: 40.6 NTSP: 38.6	$0 \le W_d \le 29.0$ $0 \le W_d \le 30.3$ $0 \le W_d \le 31.3$	Yes	Yes
Constant Power Line Setpoint **P_{BSP-RB} Rod Block**	DL: n/a AV: 30.3 % RTP NTSP: 28.3	$0 \le W_d \le 30.3$ $0 \le W_d \le 31.3$	Yes	n/a
$W_{BSP-Break}$ - Flow Breakpoint Setpoint	AL: 29.0 % RDF AV: 30.3 NTSP 31.3	See previous column	n/a	n/a
Sloped Line Setpoint Scram	AL 2.49 W_d + (-29.61) % RTP AV: 2.49 W_d + (-34.8) NTSP: 2.49 W_d + (-39.3)	$29.0 < W_d \le 45.5$ $30.3 < W_d \le 46.9$ $31.3 < W_d \le 47.9$	Yes	Yes
Sloped Line Setpoint Rod Block	DL: n/a AV: 2.49 W_d + (-45.1) % RTP NTSP: 2.49 W_d + (-49.6)	$30.3 < W_d \le 52.9$ $31.3 < W_d \le 53.9$	Yes	n/a
Constant Flow Line (Flow Clamp) Setpoint **$W_{BSP-Trip}$ (Scram)**	AL: 45.5 % RDF AV: 46.9 NTSP: 47.9	See previous column	Yes	Yes
Constant Flow Line (Flow Clamp) Setpoint **W_{BSP-RB} (Rod Block)**	DL: n/a AV: 52.9 % RDF NTSP: 53.9	See previous column	Yes	n/a

† See Comment 19 and Comment 20. †† See Comment 26. ††† See Comment 15 and Comment 19.

4. COMMENTS AND RECOMMENDATIONS

1. Unless specifically identified as "bias" errors in this document, all instrument uncertainty errors will be considered to be random in nature, even when the "±" symbol is not shown.
2. Some plant specific information has not been provided or is not currently available in the current MNGP setpoint document, but is considered unnecessary because the effects of this information are included within the instrument accuracy values or are not necessary for setpoint evaluation.
3. Spurious trip avoidance (STA) evaluations are not performed for Rod Blocks or permissives per GEH setpoint methodology (References 1 and 2), such as the EFWS APRM Rod Blocks. Therefore, the OLs are not applicable.
4. Seismic effect, radiation effect, humidity effect, power supply effect, RFI/EMI effect, and insulation resistance effect errors are marked "negligible" or "included in accuracy" and are considered to have negligible impact on the manufacturer's accuracy terms if they are not identified separately.
5. Per References 1 and 2, overpressure effects are applicable only to pressure measurement devices (e.g., differential pressure transmitters), and static pressure effects are applicable only to differential pressure measurement devices. These effects are marked "n/a" for other devices or not considered.
6. In general, the EFWS APRM Scram and Rod Block functions are only required during normal operating conditions. Therefore, the Seismic Effect for the flow transmitters and associated electronics is not considered in this evaluation.
7. The current approach in GEH setpoint calculation methodology treats the Flow Transmitter Drift for this instrument to be a 2-sigma value.
8. The error of the calibration standard used to calibrate a calibration tool is conservatively assumed to be equal to the error of the calibration tool.
9. The accuracy of the flow electronics is not given in the NUMAC specifications, and [[

   ]] The combined error for the loop flow electronics is ± 0.122 mA at 2σ.
10. The NUMAC electronics are typically located in the Control Building at BWR plants, where the radiation dose is expected to be negligible. At MNGP, the electronics will be located in the Administration Building, which is also expected to have negligible radiation dose.
11. The APRM subsystem is calibrated on-line weekly (Reference 3.1) using the AGAF process, where the gain of the APRMs is adjusted to read the Core Thermal Power (CTP) determined by the Process Computer (P/C), within a specified As Left Tolerance (ALT). [[

    ]]

Thus, the only calibration error to consider for the APRM electronics sub-loop is the ALT specified by the AGAF process.

12. [[

]] Because the EFWS setpoints are calculated as TLO setpoints, and no separate SLO setpoints are calculated, (see Comment 23), there is no need to adjust them if the plant is placed into SLO. Therefore the TLO to SLO Setting Adjustment for the Sloped line Setpoint functions and the constant Flow Line (Flow Clamp) setpoint functions is zero.

13. Each of the EFWS APRM setpoint functions is based on the STP signal. The neutron noise value is applied to the EFWS APRM Constant Power Line Setpoints (P_{BSP}), the Sloped Line Setpoint functions, and the Constant Flow Line (Flow Clamp) Setpoints (W_{BSP}).

14. Complete inputs are unavailable for the Flow Electronic calibration errors for all Maintenance and Testing Equipment (M&TE) to be used at MNGP. Therefore, the Flow Electronics calibration errors are based on using errors that are 10% higher than the errors for assumed calibration tools. Moreover, the error of the calibration standard used to calibrate a calibration tool is conservatively assumed to be equal to the error of the calibration tool.

15. Per GEH setpoint methodology (Reference 1 and Reference 2), [[
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16. [[

]] (Reference 2 Section 4.5.3)

17. For the EFWS APRM Scrams, the OLs were set equal to the associated EFWS Rod Block NTSPs from Section 3. During a power or flow transient, the Rod Block would be reached first, with some margin to the Scram, consistent with GEH setpoint methodology.

18. The Neutron Monitoring System performs its trip functions before accident temperatures are reached, so temperatures for trip and normal conditions are assumed to be the same.

19. For the EFWS APRM Rod Block setpoint functions, the proper terminology is "Design Limit" (DL) instead of "Analytical Limit," because there are no accident or transient analyses based on these Rod Blocks. The EFWS APRM Rod Block AVs were selected based on engineering judgment with a minimum specified margin (i.e., 6%) away from the EFWS APRM Scram AVs. This margin was increased for the Constant Power Setpoint and the Sloped Line Setpoint functions to 10.3% to ensure the STA evaluation for these Scram setpoint functions met the STA Criteria, and to ensure that the W_{BSP} - Flow Breakpoint Setpoint between the Constant Power and Sloped Line for the Rod Block and Scram functions are the same, a PRNM equipment requirement.

20. Scram AVs and NTSPs and Rod Block NTSPs were calculated using the methodology of Ref. 1 and Ref. 2. However, for consistency and for conservatism, the Rod Block NTSPs were selected with a specified margin (i.e., same as discussed in Comment 19) further away from the EFWS APRM Scram NTSPs, also moving them slightly further away from the AVs.

21. The Allowed Value may be retained in the Technical Specifications or a supporting document such as the Technical Requirements Manual or the Core Operating Limits Report (COLR).
22. The APRM FB Clamp AVs at high Recirc flows do not change for MELLLA+ (Ref. 5.11 (and inputs file with markups)). Therefore, the associated NTSPs also do not change for MELLLA+.
23. Per guidance from MNGP, the EFWS setpoint functions are to be calculated using the TLO instrument errors, rather than the SLO instrument errors. The setpoints above the Flow Clamp are separate for TLO and SLO. There will be only one set of EFWS setpoints in the instability region. Two sets of flow biased setpoints remain for TLO and SLO above the Flow Clamp.
24. Per Ref. 4.4, the flow intersection (i.e., the W_{BSP} - Flow Breakpoint Setpoint) between EFWS APRM Constant Power and Sloped Line setpoint functions must be the same for Scram and Rod Block.
25. Per Ref. 4.4, the Flow Clamp may have different values for Scram and Rod Block, and each can vary up to 70% Drive flow.
26. The Licensee Event Report (LER) Avoidance tests used Z = 0.81, as is the standard practice for GEH setpoint calculations for multiple channel setpoint functions. For the PRNM APRM channel logic to the Reactor Protection System, this results in a LER Avoidance probability of approx. 80.5 percent.
27. Transfer functions used in this calculation:

Flow Transmitter:	Output (mA) is linearly converted from input (InWC).
Flow Electronics:	Output is proportional to the square root of the two inputs, which are then summed.
Power Electronics:	Output is proportional to the average of the inputs and a comparison of the APRM signal with the flow biased reference is made.

5. REFERENCES

1. GE Nuclear Energy, "General Electric Methodology for Instrumentation Technical Specification and Setpoint Analysis," NEDC-32889P, Revision 3, November 2002.

2. GE Nuclear Energy, "General Electric Instrument Setpoint Methodology," NEDC-31336P-A, September 1996.

3. Monticello Nuclear Generating Plant Licensing and related documents:

   3.1. Monticello Nuclear Generating Plant Technical Specifications, as revised through April 15, 2014.

   3.2. Monticello Nuclear Generating Plant Technical Requirements Manual (TRM), as revised through April 15, 2014.

4. Vendor Specifications

   4.1. GE 24A5221NF, Rev. 2, "PRNM Requirements Specification," Data Sheet, NMS (Monticello), February 13, 2008.

   4.2. GE 24A5221, Rev. 17, "NUMAC Power Range Neutron Monitor System," Requirements Specification, NUMAC, July 21, 2008.

   4.3. GE 26A7534NF, Rev. 2, "NUMAC Average Power Range Neutron Monitor with DSS-CD," Data Sheet, Power Range NMS (MNGP), May 29, 2008.

   4.4. GE 26A7534, Rev. 0, "NUMAC Power Range Neutron Monitor with DSS-CD," Design Specification, NUMAC PRNM, February 19, 2008.

   4.5. GE 23A5082, Rev. 1, "NUMAC Requirements Specification," Design Spec, August 9, 1995.

   4.6. Rosemount Nuclear specification sheet 00809-0100-4235, Rev. AA, "Model 1152 Alphaline® Nuclear Pressure Transmitter," June 1999, provided in Monticello Plant Technical Manual NX-17137.