Docket No. 50-271 BVY 03-115

/

Attachment 2

Vermont Yankee Nuclear Power Station

Technical Specification Proposed Change No. 257

Calculation VYC-0693A – APRM Neutron Monitoring Trip Loops

[VY CALCULATION TITLE PAGE			
VYC-0693A	2 <u>N/A</u> <u>N/A</u>			
VY Calculation N	lumber Revision Number Vendor Calculation Number Revision Number			
Title: APRM 1	Neutron Monitoring Trip Loops			
QA Status:	SC NNS QQA Operating Cycle Number* <u>N/A</u>			
	erating Cycle Number should only be entered here if the results of the calculation <u>only</u> apply during a specific og cycle otherwise enter "N/A".			
Calculation Supp	orts A Design Change/Specification? 🛛 Yes 🗌 No MM 2003-028			
	/ JG/ 12/403 VYDC/MM/TM/Spec No.			
Implementation F	Required? I Yes AND Culculation Dunc as a Study Only? I Yes No			
Safety Evaluation	Number:N/A			
Superseded Calcu	Blation Number, Title and Revision:_ VYC- 693A Rev. 1 APRM Neutron Monitoring Trip Loops			
For Revisions: Li	st CCNs, IIJs, or SAs incorporated/superseded by this revision;			
Computer Code(s				
	ems in this calculation/revision? 📋 Yes 🖾 No			
	oval: (Print and Sign Name)			
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	r: Jerry Voss Cherry Vor Date: 11/18/2003 cipline Reviewer(s):See Attachment 7.7 Date:			
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	dent Reviewers(s_Kirk Melson Kirk Melson_Date: 11/19/2003 ed: JG R.T. VIBERT R.T.V. hal Date: 12/2/03			
Accepted	U (only for AP 0017 calculations performed by vendors)			
	Date:			
Final Turnover to	DCC (Section 2):			
1)	All open items, if any, have been closed.			
2)	Implementation Confirmation (Section 2.3.4)			
	Calculation accurately reflects existing plant contiguration, (confirmation method indicated helow)			
	Walkdown As-Built input review Discussion with As-Built input review			
	OR N/A, calculation does not reflect existing plant configuration R INT			
3)	All open items, if any, have been closed. Implementation Confirmation (Section 2.3.4) Calculation accurately reflects existing plant contiguration, (confirmation method indicated below) Walkdown As-Built input review OR N/A, calculation does not reflect existing plant configuration Resolution of documents identified in the Design Output Documents Section of VYAPF 0017.07 has been initiated as required (Section 2.3.6, 2.3.7) Printed Name Signature Date			
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	Page 1 of Pages*			

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For calculations performed using AP 0017 this is the number of pages in the body of the calculation.
 For vendor calculations, this is the number of pages of AP 0017 forms added.
 (Title page, review forms, data sheets, 50.59, etc.)

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VYAPF 0017.01 AP 0017 Rev. 8 Page 1 of 1 LPC #2

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VY CALCULATION DATABASE INPUT FORM

Place this form in the calculation package immediately following the Title page or CCN form.

VYC-693A	2	N/A	N/A	
VY Calculation/CCN Number	Revision Number	Vendor Calculation Number	Revision Number	
Vendor Name:	PO N	Jumber:		
Originating Department:				
Critical References Impacted:	UFSAR 🗌 DBD 🗌 R	eload. "Check" the appropriate box if a	ny critical document is identified in the t	ables below.
EMPAC Asset/Equipment ID Nu			•	
EMPAC Asset/System ID Number	er(s):			
Keywords:				
For Revision/CCN only: Are del	etions to General Referen	ces, Design Input Documents or Design	Output Documents required? Yes†	🖾 No

Design Input Documents and General References - The following documents provide design input or supporting information to this calculation. (Refer to Appendix A, sections 3.2.7 and section 4)

* Reference #	** DOC #	REV #	***Document Title (including Date, if applicable)	Significant Difference Review ††	**** Affected Program	Critical Reference (√)
6.15	GE-NE-0000-0012- 0531-01-01	1	May 2003 Project Task Report "Entergy Nuclear Operations Incorporated Vermont Yankee Nuclear Power Station ARTS/MELLLA" Task T0506: NSSS TS Instrument Setpoints.	N/A	N/A •	
6.16	GE-NE-0000-0016- 5688-01	Oj	August 2003 Project Task Report "Entergy Nuclear Operations Incorporated Vermont Yankee Nuclear Power Station Extended Power Uprate" Task T0506: NSSS TS Instrument Setpoints.	N/A	N/A	
6.27	VYC-0690	2	Recirculation Flow Loop Uncertainties to APRM			
6.29	NEDC-33089P		"Vermont Yankee Nuclear Power Station APRM/RBM/Technical Specifications Maximum Extended Load Line Limit Analysis (ARTS/MELLLA)," March 2003			
6.30	NEDC-33090P	0	"Safety Analysis Report for Vermont Yankee Nuclear Power Station Constant Pressure Power Uprate," September 2003			
6.26	OP-2429	14	Recirculation Flow System Baseline Data Collection and Instrument Calibration.			
6.17	GE Performance Specification 25A5903	1	"Flow Control Trip Reference (FCTR) Card".			
6.31	BVY 03-23	0	March 20, 2003, Technical Specification Proposed Change No. 257 Implementation of ARTS/MELLLA at VY.			
6.32	BVY 03-80	0	September 10, 2003, Technical Specification Proposed Change No. 263 Extended Power Uprate.			

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* Reference #	** DOC	C# REV #	Document Title (including Date, if applicable)	**** Affected Program	<pre> †††Critical Reference (✓)</pre>
6.25	OP 4308	21	APRM Monitor Calibration.		
* Reference # ** Doc # - *** Documen		Identifying nun List the specific specific design document (e.g.,	eparer to identify the reference in the body of the calculation. ther on the document, if any (e.g., 5920-0264, G191172, VYC-1286) to documentation in this column. "See attached list" is not acceptable. Design Input/C input document used in the calculation or the specific document affected by the calcu VYDC, MM) that the calculation was written to support. If a DBD is used as a gene change number after the title.	lation and not simpl	y reference the
**** Affecte	d Program -	List the affected	l program or the program that reference is related to or part of.		
† ††				e a check mark	
†††		If the reference	s UFSAR, DBD or Reload (IASD or OPL), check Critical Reference column and check UFSAR, DBD or Reload, his form (above).		

Design Output Documents - This calculation provides output to the following documents. (Refer to Appendix A, section 5)

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	Approval	
Rev. No.	Date	Reason & Description of Change
0		Initial issue, Reflects new methodology described in Instrument Uncertainty and Setpoints Design Guide, Rev.
		This sub-calculation (VYC-693A) only addresses the associated trips, with the analog output uncertainties
		remaining in the parent calculation (VYC-693).
1		Revised to allow the use of N=44 in the RBM flow bias equation (Setpoint $\leq 0.66(W-\Delta W) + N$), and to reflect the
		use of M&TE to set the Flow Bias value in testing the RBM rod blocks. References to any specific operating cycle or COLR report were removed since this calculation is valid for any cycle where the value of N is between 42 and 44.
2		Incorporated VYC-693A CCNs 1, 2, 3 and 4. CCN 2 attachment M and table revisions had no impact on this revision of the calculation since the CCN was based on the flow bias equations used prior to ARTS/MELLLA or EPU. This revision includes the Analytical Limits and calculates Allowable Values (ITS) Trip Setpoints and As-Found Tolerances (CTS) to support ARTS/MELLLA and EPU. The APRM Rod Blocks have been removed from the Technical Specifications. The Rod Block Monitor has been maintained in Technical Specifications; However, the Rod Block Monitor will be treated as an indicated value (without instrument error) for settings.

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1. PURPOSE

1.1 Calculation Objectives

This calculation has been developed in support of the Vermont Yankee Setpoints program and covers the APRM/LPRM (Average Power Range Monitor/Local Power Range Monitor) neutron monitoring loops. This calculation has the following major objectives:

- 1) Document the instrument loop functions and the basis for the setpoints and operator decision points associated with those functions.
- 2) Establish the total loop uncertainty for each increasing¹ Setpoint and verify consistency with the design basis
- 3) Calculate the limiting setpoints and operator decision points.
- 4) Evaluate the adequacy of existing Setpoint Administrative Limits and procedural decision points.
- 5) Provide As-Left and As-Found tolerances for use in instrument calibration and functional test procedures. Verify and document process corrections, instrument scaling, and calibration methods. The errors determined in this calculation are based on the vendor defined operating characteristics.
- 6) This calculation does not include evaluations of the analog indicators or recorder functions. The accuracy of the trip functions determined by this calculation will be used as input for generic evaluations for alarm response, operating procedures, off normal operating procedures and EOP impact.

¹ Low (decreasing) setpoints are not reviewed. They are indicative of a gross failure. Therefore, it is not necessary to determine uncertainty.

1.2 System and Components

This calculation applies to the Power Range Monitoring Instrumentation of the Neutron Monitoring System. The specific components to be addressed are:

	Table 1: System Components						
REF.	TAG NUMBER	RACK/ CABINET	SYS	DESCRIPTION	MFG.	MODEL NO.	CWD
6.18	ND-2-1-104 (80 items)	In-Core	NM	LPRM Detector	GE	N/A	674, 675
6.18	LPRM	9-14	NM	Local Power Range Monitor	GE	135B9824G2	676, 676A, 677, 677A
6.18	APRM A, C, E, B, D, F	9-14	NM	Average Power Range Monitor	GE	920D453G1 920D453G2	678, 679, 680, 688, 692, 693

1.3 Instrument Loop Function

Attachment A has a simplified loop diagram of the instruments and components described below.

1.3.1 Normal Operations

During normal operation the APRMs provide the control room operators with indications of the average reactor power from about two percent to 125 percent via recorders on the operators console. This analog information is also provided to the plant computer. In addition, the APRMs are capable of generating trips when various conditions are exceeded. These trips are:

- Scram on APRM Upscale
- Scram on APRM Downscale (Run Mode)
- Scram on APRM Inoperative
- Scram on APRM Upscale when the RMSS is not in Run (Reduced)
- Rod Block on APRM Upscale
- Rod Block on APRM Downscale
- Rod Block on APRM Upscale when the RMSS is not in Run (Reduced)

During normal operation the RBMs provide the control room operators with indications of the local average power immediately surrounding a control rod that has been selected for withdrawal. The RBM promotes controlled rod withdrawal by issuing rod withdrawal block signals if the reactor operator does not respond correctly to prompts requiring operator action. The RBM issues rod withdrawal block signals on:

- RBM Upscale
- RBM Downscale

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The Rod Blocks associated with APRM and the Rod Block Monitor are not credited for plant protection. The APRM Rod Blocks have been removed from Technical Specifications (and placed in the VY Technical Requirements Manual The Rod Block Monitor is maintained in Technical Specifications; however, the setting for the RBM is treated as an indicated values (without instrument error applied to the setting). Therefore, only the APRM trips will be evaluated in this calculation.

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The purpose of the APRM flow biased rod block function is to avoid a condition that would require Reactor Protection System action if allowed to proceed. The APRM flow biased rod block setting is selected to initiate a rod block before the APRM high neutron flux scram setting is reached. The APRM flow biased rod block setpoint value listed in the TRM is the maximum nominal trip setpoint allowable. Calibration tolerances have been established for this setpoint that will render the setpoint acceptable above or below the nominal value. The uncertainty associated with the difference between the APRM flow biased scram and rod block functions is limited to the uncertainty associated with the trip circuitry. Common equipment (such as detectors, LPRMs, flow input and averaging circuits) will affect both functions equally.

VY has implemented long-term thermal hydraulic stability solution Option I-D. Option I-D is only applicable to plants that can demonstrate that core wide mode instability is the predominant mode and regional mode instability is not expected. Solution application includes demonstrating that the APRM High Flux (Flow Bias) scram line, considered an analytical limit, provides adequate Safety Limit MCPR protection.

1.3.2 Functions During an Accident

The APRMs are assumed to provide the scram initiation signal (120 % power) for the mitigation of the Control Rod Drop Accident, which, according to Reference 6.4, Section 14.6.2, is only of concern when the reactor is operating at less than the RWM Low Power Setpoint (LPSP).

1.3.3 Post-Accident or EOP Functions The APRMs are not required for Post Accident Functions. The APRMs applicability to the EOPs will be addressed outside of this calculation.

2 METHODS AND ASSUMPTIONS

This Calculation has been prepared in accordance with the Governing Procedures and Programs listed in step 2.1. Standard methods employed in this calculation are explained in the "Vermont Yankee Instrument Uncertainty and Setpoints Design Guide" [Ref.6.1]. This calculation is performed using the Class 1 graded approach since one of the functions (reactor scram) performed by the APRM loops is classified as Class 1, Nuclear Safety Related.

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2.1 Governing Procedures and Programs

2.1.1 Vermont Yankee Instrument Uncertainty and Setpoints Design Guide. (Ref. 6.1)

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2.1.2 Vermont Yankee Engineering Procedure, AP-0017, Calculations and Analyses (Ref. 6.9).

2.2 Criteria

2.2.1 Analytical Limits and Technical Specification Limits

The Analytical Limits (AL) for the APRM Scram Flow Bias and Fixed trip are established per the Rod Drop Accident and Core Stability Analysis, and are defined in Ref. 6.15 for ARTS/MELLLA conditions and 6.16 for Extended Power Uprate conditions. This AL value will be used to establish Limiting Setpoints (LSp) and an Allowable Value (AV) for use in the Technical Specifications (TS) as discussed below.

This calculation will use ISA-S-67.04.02 Method 1 for combination of errors to determine a Trip Setpoint and an Allowable Value for Technical Specification values associated with APRM Flow Bias and Scram setpoints. The Limiting Trip Setpoint and the Allowable Value for a process increasing to a limit will be calculated as follows:

- AV = AL-effective uncertainty for all devices and errors not confirmed during surveillance testing.
- LSp = AV effective uncertainty for testing conditions, including devices tested only.
- LSp < $AV (CT_1 + CT_2 + CT_n)$ Confirmation of margin between LSp and AV.

All terms are as currently defined in the VY Setpoint Design Guide.

- 2.2.2 Numerical combinations for the calculations of instrument error, calibration error, loop error, effective error and other associated values have been calculated using Microsoft Excel. Representative calculations in Attachment(s) B were manually verified using a hand calculator, Microsoft Excel stores numbers with at least 15 digits of accuracy, all calculation outputs displayed within this calculation are rounded from the values stored by Excel. Rounding errors induced by Excel are assumed to be negligible within this calculation.
- 2.2.3 No errors were found in the manual verification of the calculations performed with the Software in Attachment B. Physical evidence of the review is provided by check marks or other indications next to each verified calculation. Where multiple calculations are generated by copying cells or formulas selected samples have been verified.
- 2.2.4 Technical Specification Table 4.1.2 requires the performance of a Heat Balance, for calibration of the APRM output signal, once every 7 days. The calibration of the APRMs to Core Thermal Power (CTP) is performed under OP-4400. As a part of this procedure, the individual APRM gains are adjusted such that the individual APRMs read conservatively to the adjusted % rated CTP (+2, -0%).

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The adjustments made to the APRM gains automatically compensate (normalize) the LPRM detector/amplifier output signal. Therefore, since the heat balance is performed every 7 days, the amount of LPRM drift that needs to be considered is only 8 days (7 days + 25% extension). The current LPRM drift value is valid for 700 hours. However, since there is insufficient information to estimate the reduction in this drift value for 8 days, the 700 hour drift value will be used in the calculation.

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2.2.5 Primary Element Accuracy (PEA)

APRM Channel

PEA is a combination of sensor sensitivity and sensor non-linearity uncertainties. The sensitivity of the detectors decreases with neutron fluence. From Reference 6.13, Section 4.5, the average sensitivity loss, and its 2-sigma variation, for all GE LPRM detectors has been determined to be:

Sensor Sensitivity Loss = -0.33% (bias term) $\pm 0.20\%$ (random term)

The detector non-linearity and its 2 sigma variation (in the power range) has been determined to be:

Sensor Non-linearity = -0.49%	(bias term)
±1.0%	(random term)

The first part of these detector errors represent bias type errors which apply to all detectors, whereas the second part are random errors that represent variability amongst sensors. Assuming a worst case scenario where the APRM has the minimum number of operational detectors, the PEA, which on a percent of power basis is simply obtained by adding the bias terms and taking the SRSS of the random terms, is calculated below. In the calculation, the random error is reduced by the square root of the minimum number of operable LPRMs to one APRM channel which is 9 per Reference 6.7, Table 3.1.1, Note 5.

$$PEA = (0.33 + 0.49) \pm \left(\frac{1}{\sqrt{9}}\right) \sqrt{(0.20^2 + 1^2)}$$
$$PEA = -0.82 \pm 0.34\% RP$$

2.2.6 Process Measurement Accuracy (PMA)

<u>APRM</u>

PMA is a combination of APRM tracking error and the uncertainty due to neutron noise. From Reference 6.4, Section 14.5.1.3.1, the most severe event for which the APRMs are assumed to provide the scram signal is the Closure of All Main Steam Line Isolation Valves with failure of the valve position scram. Reference 6.13, Section 4.5 states that for the MSIV closure transient event, the APRM tracking error is 1.11% and the uncertainty due to neutron noise is typically 2.0%. The tracking error is the uncertainty of the maximum deviation of APRM readings with LPRM failures or bypasses during a power transient. The neutron noise is the global neutron flux noise in the reactor core with a typical dominant

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frequency of approximately 0.3 to 0.5 Hertz and typical maximum peak-to-peak amplitude of approximately 5 to 10 percent. $PMA = \sqrt{(2.0^2 + 1.11^2)} = 2.29\% RP$

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2.2.7 The Flow Control Trip Reference Card (FCTR) for the APRM fixed and flow biased scrams is being replaced. The replacement card is designed to operate with a 1% maximum error signal and 0.1% timing accuracy (Ref. 6.17). The 1% error signal includes both device accuracy and drift for a 36-month interval. General Electric has provided additional information (Attachment 7.7) indicating that the reference accuracy (or setting tolerance) for the FCTR is 0.5% of calibrated span.

Control Room (CR) Indication (FI-2-159A, B and FR-2-154) is scaled for a flow rate of 0-41,800 GPM. Rated Recirculation Drive Flow (100%) is defined as the required Drive Flow to achieve 48 MPPH (Reference TS 2.1.A.1.a). Such things as core design, changes in core and piping resistance, jet pump fouling, etc, affect the relationship between Core Flow and Drive Flow. Therefore, since the rated recirculation drive flow value could change, the percentage of rated flow for CR flow indication will vary. OP 2429 normalizes the total recirculation drive flow (output of summers FSUM-2-110A&B) such that the input to the APRM system is 125% of rated flow (as determined by OP 2429). This is consistent with functional testing of the APRM Flow Bias Setpoints and flow indication obtained from the APRM system (chosen via selector switch). Because of this normalization the spans between the drive flow input (VYC-690 errors) and the core flow input are assumed to be equal.

- 2.2.8 Technical Specification Table 4.1.2 requires the performance of a heat balance, for calibration of the APRM output signal, once every 7 days. The calibration of the APRMs to Core Thermal Power (CTP) is performed under OP 4400. The procedure begins by the calculation of CTP by performing an energy balance on the Nuclear Boiler System. Next, % rated CTP is determined (CTP/Rated CTP MWth * 100). Then % rated CTP is divided by the applicable scale factor to find the adjusted % rated CTP. Finally, the individual APRM gains are adjusted such that the individual APRMs read conservatively to the adjusted % rated CTP (+2, -0%). The adjustments made to the APRM gains automatically compensate (normalize) the LPRM detector/amplifier output signal. Therefore, since the heat balance is performed every 7 days, the amount of LPRM drift that needs to be considered is only 8 days (7 days + 25% extension). The uncertainty associated with the heat balance (2% of Reactor Power) is included in the transient analysis (REF. 6.19). Therefore, this uncertainty is not included in this uncertainty calculation.
- 2.2.9 Calibration tolerance for reactor flow biased power settings are + 0.5% CS or (0.625% RP). The tolerances for trips are ±0.4% CS (0.5% RP) per Ref. 6.25 and 6.23.

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2.3 Assumptions

2.3.1 Calibration of instruments is assumed to be at a temperature within the ranges shown in the following table.

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Table 2: Plant Area(s)				
Plant Area	Minimum	Maximum		
Control Room	60 °F	80 °F		

- 2.3.2 The temperature variation within a cabinet is the same as the variation of the room in which it is located. The temperature difference between the room and the cabinet is therefore constant. Calibration data are collected with the equipment at the operating temperature of the cabinet.
- 2.3.3 The vendor does not state a separate value for Humidity Effect (HE). Therefore, it is considered to be included in the accuracy and drift terms.
- 2.3.4 OP4305 does not give a tolerance for setting the value of the flow signal, because the flow signal is adjusted as close as possible using M&TE. This calculation assumes that only M&TE with a total accuracy of better than 0.25% of reading will be used to adjust the flow signal. Therefore, this uncertainty is assumed to be 0.25%. This 0.25% will be combined with the random portion of the VYC-690 flow input. This signal error will then be converted to %RP before being combined for each of the different power to flow lines. However, since the M&TE error affects the overall accuracy and the acceptance criteria for the flow bias setpoints, M&TE with accuracy of 0.05% of span will be used for setting the flow signal value.
- 2.3.5 All of the Power Range Neutron Monitoring System electronic equipment affected by this calculation are located in areas considered to be mild environment (control room). The LPRM detectors are the only components exposed to high radiation and they were designed for this purpose. Therefore, there are no Radiation Effects (RE) applicable to this calculation.
- 2.3.6 The APRM scrams are not assumed to operate for safe shutdown or for other seismic events. For operational basis earthquakes, this calculation assumes that the APRMs, LPRMs and trip functions will be recalibrated prior to continued operation. Therefore, seismic error for Neutron Monitoring is not considered in this calculation.
- 2.3.7 Dead Band (DB) or Readability Uncertainty (RD) are only applicable to that portion of a calculation involving indicators and recorders. Therefore, they do not apply to this calculation.

2.3.8 Temperature Effect (TE) is not provided as a separate term by the vendor so it is assumed to be included in one of the given accuracy or drift terms.

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- 2.3.9 The Barometric Pressure Effect (PB) is not applicable to this calculation (Section 3.6.9 of Ref. 6.1).
- 2.3.10 None of the Process Static Pressure Effects (SP) are applicable to this calculation (Section 3.6.13 of Ref. 6.1).
- 2.3.11 Power Supply Voltage Effect (VE) is considered to be included in the accuracy and drift terms since the vendor does not give a separate value for VE.
- 2.3.12 VYC-1758 (Reference 6.20) shows DMM's available to support the APRM calibration with total device error of better than ±0.05% CS (10 VDC Range). Therefore, the SRSS of 2 DMM's required for the calibration per Ref. 6.25 result in an M&TE uncertainty of ±0.071% CS.
- 2.3.13 The neutron monitoring system is located in the control room with the exception of the sensing devices, which are located in the reactor. Therefore, unless otherwise stated, this calculation will use the set of specifications related to the Control Room environment in Ref. 6.1.
- 2.3.14 Technical Specification Table 3.1.1 defines the Limit for APRM High Flux Reduced as equal to 15 % RP. This value has been assumed to be the Analytical Limit for this calculation.

3 INPUT DATA

Data used to calculate loop uncertainties, process corrections, setpoints, and decision points are tabulated below with the applicable reference or basis

3.1 Process, Loop Data and Analytical Limits Presented below are the input values required to calculate the Limiting Setpoints (Analytical Limits and those parameters such as calibration frequency that are common to all loop components).

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	Table 3: Process Data and Analytical Lin	nits
Basis	Description	Data
Ref. 6.3	Process Span (PS)	0 to 125 % RP
	Analytical Limits	
ARTS/MELLLA	APRM High Flux Scram (Two Loop Ops)	
Reference 6.15	Core Flow 0 to \leq 31.1 %	< 0.4Wd+64.4%
	Core Flow 31.1 to \leq 54.0 %	<1.28Wd+37.0%
	Core Flow 54.0 to \leq 75 %	< 0.66Wd+70.5%
	Core Flow > 75%	Maximum of 120%
	APRM High Flux Scram (Single Loop Ops)	
	Core Flow 0 to \leq 39.1 %	< 0.4Wd+61.2%
	Core Flow 39.1 to ≤ 61.9 %	<1.28Wd+26.8%
	Core Flow 61.9 to \le 83.0 %	< 0.66Wd+65.2%
	Core Flow >83%	Maximum of 120%
Extended Power	APRM High Flux Scram (Two Loop Ops)	
Uprate (EPU)	Core Flow 0 to \leq 30.9 %	<0.33Wd+53.7%
Reference 6.16.	Core Flow 30.9 to ≤ 66.7 %	<1.07Wd+30.8%
	Core Flow 66.7 to \leq 99 %	< 0.55Wd+65.5%
	Core Flow > 99%	Maximum of 120%
	APRM High Flux Scram (Single Loop Ops)	
	Core Flow 0 to \leq 39.1 %	<0.33Wd+51.1%
	Core Flow 39.1 to ≤ 61.7 %	<1.07Wd+22.2%
	Core Flow 61.7 to \leq 119.4 %	< 0.55Wd+54.3%
	Core Flow >119.4	Maximum of 120%
Assumption 2.3.13	APRM High Flux Scram (Reduced)	≤15 % Power

3.2 Environmental Conditions

The following table identifies the limiting environmental conditions expected for each loop instrument.

	Table 4: Environmental Input Data				
Basis	Description	Data			
Ref. 6.1, Table 2	Normal Drywell Temperature (Below 270 ft) Normal Reactor Building Temperature (Occupied Area)	160°F 106°F			
Ref. 6.5	Normal Radiation	N/A (Assumption 2.2.6)			
Ref. 6.6	Accident Radiation	N/A (Assumption 2.2.6)			

3.3 Primary Elements ND-2-1-104 Data

	Table 5: Primary Element Input Data			
Basis	Description	Data		
Ref. 6.2 Ref. 6.3	Maximum Temperature Nominal Operating Neutron Flux Maximum Operating Gamma Flux Accuracy (PEA)	600°F 1.2×10 ¹² to 2.8×10 ¹⁴ nv 1.2×10 ⁹ R/hr See Text		

3.4 LPRM Data

	Table 6: LPRM Input Data				
Basis	Description	Data			
Ref. 6.2	Accuracy Drift	±0.8% CS ±0.8% CS/700 hrs			

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3.5 APRM A, B, C, D, E, F, Data

Table 7: APRM Input Data					
Basis	Description	Data			
Ref. 6.11	Averaging Circuitry Accuracy Drift	±0.80% CS ±0.5% CS/2 weeks			
Ref. 6.33	Trip Circuits (Reduced Scram) Analyzed Drift	±0.5% CS/3 months (13 weeks)			
Ref. 6.11 25A5903 Rev. 1 (Assumption 2.2.19)	Trip Circuits (Flow Biased) Accuracy and Drift	±1.0% CS (0 to 100% flow) valid for 36 months. Timing error not used.			
Ref. 6.7 Table 4.1.2 & 4.1.1	Calibration Interval: APRM High Flux Scram Trips LPRM Reactor Heat Balance	3 months (13 weeks) 2000MWD/T Weekly			

3.6 Flow Bias Error Data

The following information is copied or extrapolated from VYC-690 Rev. 2. The accuracy associated with the cardinal flow rates for ARTS/MELLLA and EPU are used in the spreadsheet as an additional error associated with calculation of the APRM setpoints. Errors in VYC-0690 (as listed below) have been calculated based on an assumed maximum total recirculation span of 83,600 gpm (41,800 gpm per loop) to ensure maximum accuracy for recirculation flow indication in the control room. However, the calculation of flow bias for the APRMs is based on an ideal flow of 65,000 gpm (32,500gpm per loop). Therefore to compensate for the difference in reference values for the errors associated with the flow bias a multiplier of 1.286 is used. As discussed in Section 2.2.7, the input into the FCTR is then scaled, during the core flow to recirculation flow verification, to 125% of recirculation flow. This multiplication has been performed in the spreadshects that perform the detailed calculations for this document. The error is also multiplied by the specific flow correction value (i.e. if the flow formula is 0.33Wd+53.7 EPU 0-39.1% flow, then the random flow error would be multiplied by 0.33) in this same step.

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% Core Flow	Random Error [% Calibrated Span]	Bias Error [% Calibrated Span		
20	0.7266	0.4501		
30.9	0.5941	0.2937		
31.1	0.5927	0.2919		
39.1	0.5513	0.2327		
54	0.5143	0.1688		
66.7	0.4994	0.1367		
75	0.4934	0.1216		
83	0.4891	0.1099		
99	0.4834	0.0922		
119.4	0.4791	0.0764		

Table 9: Flow Input Errors One Recirculation Pump Running					
% Core Flow	Random Error [% Calibrated Span]	Bias Error [% Calibrated Span]			
20	0.4673	0.1137			
37.5	0.4358	0.0608			
39.1*	0.434776	0.058368			
40	0.4342	0.057			
60	0.4277	0.038			
61.7 *	0.427428	0.03698			
61.9 *	0.427396	0.03686			
62.5	0.4273	0.0365			

* Values linearly interpolated from VYC-0690 Ref. 6.27

4 CALCULATION DETAIL

The detailed calculations of the APRM loop uncertainties, setpoints, testing tolerances, and margins have been performed using Microsoft Excel spreadsheets and are documented as Attachment B.

5 **RESULTS AND CONCLUSIONS**

5.1 Allowable Value

The Allowable Value for each required point has been determined and the results are presented in the table below. Since this is a major revision of the method and calculation of Allowable Values and Setpoints no comparison to existing values has been performed.

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Table 10: Allowable Values	<u></u>		
Output Instrument	% RxP	mV	Curve % RxP
APRM A, B, C, D, E, F Scram Trips		······································	
ARTS/MELLLA Flow Biased			
APRM High Flux Scram (Two Loop Ops)			
Core Flow 0 to \leq 31.1 % (point based on 25% flow)	71.1	5.688	< 0.4Wd+61.10%
Core Flow 31.1 to <54.0 % (point based on 50 % flow)	97.3	7.785	<1.28Wd+33.31%
Core Flow 54.0 to \leq 75 % (point based on 70% flow)	113.5	9.078	< 0.66Wd+67.28%
Core Flow > 75%	117.0	9.357	N/A
APRM High Flux Scram (Single Loop Ops)			
Core Flow 0 to ≤39.1 % (point based on 25% flow)	68.1	5.447	< 0.4Wd+58.09%
Core Flow 39.1 to ≤61.9 % (point based on 50% flow)	87.6	7.005	<1.28Wd+23.56%
Core Flow 61.9 to ≤ 83.0 % (point based on 70% flow)	108.3	8.664	<0.66Wd+62.10%
Core Flow > 83.0%	117.0	9.357	N/A
EPU Flow Biased			
APRM High Flux Scram (Two Loop Ops)			
Core Flow 0 to \leq 30.9 % (point based on 25% flow)	58.7	4.696	<0.33Wd+50.45%
Core Flow 30.9 to ≤ 66.7 % (point based on 50% flow)	80.7	6.458	<1.07Wd+27.23%
Core Flow 66.7 to ≤99.0 % (point based on 75% flow)	103.6	8.287	<0.55Wd+62.34%
Core Flow > 99.0%	117.0	9.357	N/A
APRM High Flux Scram (Single Loop Ops)			
Core Flow 0 to ≤39.1 % (point based on 25% flow)	56.3	4.500	<0.33Wd+48.00%
Core Flow 39.1 to ≤ 61.7 % (point based on 50% flow)	72.5	5.801	<1.07Wd+19.01%
Core Flow 61.7 to \leq 119.4 % (point based on 75% flow)	92.5	7.398	<0.55Wd+51.22%
Core Flow > 119.4%	117.0	9.357	N/A

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Note: % CS is calculated based on multiplying the calculated Vdc terms in attachments 7.2 by 10 (100% Span / 10Vdc).

5.2 Setpoint Evaluation

Results are presented below for the Limiting Setpoint (LSp).

Table 11: APRM Fixed Scram (Reduced) Trip Setpoint Results				
Description				
ITS: Analytical Limit (AL); CTS: Tech. Spec. Limit (TS)	≤ 15.0			
Limiting Setpoint (LSp)	11.72			
ITS: Allowable Value (AV)	12.97			
Margin to LSp (M ₁)	+0.345			
Existing Setpoint	11.375			
New Setpoint	N/A			
Margin to Normal Operations	There is no stable operating point when the reactor is in the "Startup" mode.			

These results are presented graphically in Figure 1.

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Table 12: Limiting Setpoints and Calibration Cardinal Points						
Output Instrument	% RxP	mV	Curve % RxP			
APRM A, B, C, D, E, F Scram Trips						
ARTS/MELLLA Flow Biased	1					
APRM High Flux Scram (Two Loop Ops)						
Core Flow 0 to \leq 31.1 % (point based on 25% flow)	69.9	5.588	< 0.4Wd+59.85%			
Core Flow 31.1 to ≤54.0 % (point based on 50 % flow)	96.1	7.685	<1.28Wd+32.06%			
Core Flow 54.0 to ≤75 % (point based on 70% flow)	112.2	8.978	< 0.66Wd+66.03%			
Core Flow > 75%	115.7	9.257	N/A			
APRM High Flux Scram (Single Loop Ops)						
Core Flow 0 to ≤39.1 % (point based on 25% flow)	66.8	5.347	<0.4Wd+56.84%			
Core Flow 39.1 to ≤ 61.9 % (point based on 50% flow)	86.3	6.905	<1.28Wd+22.31%			
Core Flow 61.9 to ≤83.0 % (point based on 70% flow)	107.1	8.564	< 0.66Wd+60.85%			
Core Flow > 83.0%	115.7	9.257	N/A			
EPU Flow Biased						
APRM High Flux Scram (Two Loop Ops)						
Core Flow 0 to ≤30.9 % (point based on 25% flow)	57.5	4.596	<0.33Wd+49.20%			
Core Flow 30.9 to ≤66.7 % (point based on 50% flow)	79.5	6.358	<1.07Wd+25.98%			
Core Flow 66.7 to ≤99.0 % (point based on 75% flow)	102.3	8.187	< 0.55Wd+61.09%			
Core Flow > 99.0%	115.7	9.257	N/A			
APRM High Flux Scram (Single Loop Ops)						
Core Flow 0 to ≤39.1 % (point based on 25% flow)	55.0	4.400	< 0.33Wd+46.75%			
Core Flow 39.1 to ≤ 61.7 % (point based on 50% flow)	71.3	5.701	<1.07Wd+17.76%			
Core Flow 61.7 to ≤119.4 % (point based on 75% flow)	91.2	7.298	< 0.55Wd+49.97%			
Core Flow > 119.4%	115.7	9.257	N/A			

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Note: Due to the small difference between As-Left and As-Found allowances, rounding of setpoints is not recommended.

5.3 Calibration and Test Results

Test As-Found tolerances (FT) and As-Left tolerances (CT) are for the Fixed Scram (Clamp and Reduced settings) are defined in Tables 13 and 14.

Table 13: Calibratio	on Tolerances			
As Left (CT)				
Description	Limits Vdc	Limits % RP		
APRM Fixed Scram (Reduced) Trip	0.04 Vdc	0.5 % RP		

Table 14: Calib	oration Tolerances	
As Found (FT)		
Description	Limits Vdc	Limits % RP
APRM Fixed Scram (Reduced) Trip	0.1 Vdc	1.25%

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Table 15: Calibration Points, As-Left and As-Found						
Output Instrument				As-Found Min	As-Found Max	
APRM A, B, C, D, E, F Scram Trips						
ARTS/MELLLA Flow Biased	[
APRM High Flux Scram (Two Loop Ops)						
Core Flow 0 to ≤ 31.1 % (point based on 25% flow)	5.588	5.538	5.638	5.488	5.688	
Core Flow 31.1 to ≤54.0 % (point based on 50 % flow)	7.685	7.635	7.735	7.585	7.785	
Core Flow 54.0 to ≤ 75 % (point based on 70% flow)	8.978	8.928	9.028	8.878	9.078	
Core Flow > 75%	9.257	9.207	9.307	9.157	9.357	
APRM High Flux Scram (Single Loop Ops)						
Core Flow 0 to ≤39.1 % (point based on 25% flow)	5.347	5.297	5.397	5.247	5.447	
Core Flow 39.1 to ≤61.9 % (point based on 50% flow)	6.905	6.855	6.955	6.805	7.005	
Core Flow 61.9 to <83.0 % (point based on 70% flow)	8.564	8.514	8.614	8.464	8.664	
Core Flow > 83.0%	9.257	9.207	9.307	9.157	9.357	
EPU Flow Biased						
APRM High Flux Scram (Two Loop Ops)						
ow 0 to ≤30.9 % (point based on 25% flow)	4.596	4.546	4.646	4.496	4.696	
Core Flow 30.9 to ≤66.7 % (point based on 50% flow)	6.358	6.308	6.408	6.258	6.458	
Core Flow 66.7 to ≤99.0 % (point based on 75% flow)	8.187	8.137	8.237	8.087	8.287	
Core Flow > 99.0%	9.257	9.207	9.307	9.157	9.35	
APRM High Flux Scram (Single Loop Ops)						
Core Flow 0 to \leq 39.1 % (point based on 25% flow)	4.400	4.350	4.450	4.300	4.500	
Core Flow 39.1 to ≤ 61.7 % (point based on 50% flow)	5.701	5.651	5.751	5.601	5.801	
Core Flow 61.7 to ≤119.4 % (point based on 75% flow)	7.298	7.248	7.348	7.198	7.398	
Core Flow > 119.4%	9.257	9.207	9.307	9.157	9.35	

Note: Recirculation drive flow input to APRM can be determined by the equation RDF (Vdc) = % flow/125 * 10.

Table 16: Total Loop Uncertainty and Non-Test Error					
Output Instrument	TLU % RxP	Non Test % RxP			
APRM A, B, C, D, E, F Scram Trips		l			
ARTS/MELLLA Flow Biased					
APRM High Flux Scram (Two Loop Ops)					
Core Flow 0 to \leq 31.1 % (point based on 25% flow)	-4.55%	-3.30%			
Core Flow 31.1 to ≤54.0 % (point based on 50 % flow)	-4.94%	-3.69%			
Core Flow 54.0 to ≤75 % (point based on 70% flow)	-4.47%	-3.22%			
Core Flow > 75%	-4.29%	-3.04%			
APRM High Flux Scram (Single Loop Ops)					
Core Flow 0 to ≤39.1 % (point based on 25% flow)	-4.36%	-3.11%			
Core Flow 39.1 to ≤61.9 % (point based on 50% flow)	-4.49%	-3.24%			
Core Flow 61.9 to <83.0 % (point based on 70% flow)	-4.35%	-3.10%			
Core Flow > 83.0%	-4.29%	-3.04%			

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Output Instrument	TI II % ByP	Non Test % RxP
EPU Flow Biased		
APRM High Flux Scram (Two Loop Ops)		
Core Flow 0 to ≤ 30.9 % (point based on 25% flow)	-4.50%	-3.25%
Core Flow 30.9 to ≤66.7 % (point based on 50% flow)	-4.82%	-3.57%
Core Flow 66.7 to ≤99.0 % (point based on 75% flow)	-4.41%	-3.16%
Core Flow > 99.0%	-4.29%	-3.04%
APRM High Flux Scram (Single Loop Ops)		
Core Flow 0 to ≤39.1 % (point based on 25% flow)	-4.35%	-3.10%
Core Flow 39.1 to ≤61.7 % (point based on 50% flow)	-4.44%	-3.19%
Core Flow 61.7 to ≤119.4 % (point based on 75% flow)	-4.33%	-3.08%
Core Flow > 119.4%	-4.29%	-3.04%

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Table 17: Total Loop Uncertainty and	nd Non-Test Erro	Dr
Output Instrument	TLU % CS	Non Test % CS
APRM A, B, C, D, E, F Scram Trips		
ARTS/MELLLA Flow Biased		
High Flux Scram (Two Loop Ops)		
Core Flow 0 to \leq 31.1 % (point based on 25% flow)	-3.64%	-2.64%
Core Flow 31.1 to <54.0 % (point based on 50 % flow)	-3.95%	-2.95%
Core Flow 54.0 to ≤75 % (point based on 70% flow)	-3.58%	-2.58%
Core Flow > 75%	-3.43%	-2.43%
APRM High Flux Scram (Single Loop Ops)		
Core Flow 0 to ≤39.1 % (point based on 25% flow)	-3.49%	-2.49%
Core Flow 39.1 to ≤61.9 % (point based on 50% flow)	-3.59%	-2.59%
Core Flow 61.9 to ≤83.0 % (point based on 70% flow)	-3.48%	-2.48%
Core Flow > 83.0%	-3.43%	-2.43%
EPU Flow Biased		
APRM High Flux Scram (Two Loop Ops)		
Core Flow 0 to ≤30.9 % (point based on 25% flow)	-3.60%	-2.60%
Core Flow 30.9 to ≤ 66.7 % (point based on 50% flow)	-3.85%	-2.85%
Core Flow 66.7 to ≤99.0 % (point based on 75% flow)	-3.53%	-2.53%
Core Flow > 99.0%	-3.43%	-2.43%
APRM High Flux Scram (Single Loop Ops)		
Core Flow 0 to ≤39.1 % (point based on 25% flow)	-3.48%	-2.48%
Core Flow 39.1 to ≤61.7 % (point based on 50% flow)	-3.56%	· · · · · · · · · · · · · · · · · · ·
Core Flow 61.7 to ≤119.4 % (point based on 75% flow)	-3.47%	1
Core Flow > 119.4%	-3.43%	-2.43%

5.4 Calculation Review and Impact Consideration

5.4.1 This calculation evaluates the uncertainty of loop components for design changes including Extended Power Uprate. The uncertainty determined by this calculation

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will be used as input for the Reactor Scram Flow Biased and the APRM Fixed Scram (Reduced) Trip Setpoint and Allowable Value results.

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- 5.4.2 The Design Input Considerations of ARTS/MELLLA and the VY Extended Power Uprate as well as the change in the methodology used to develop Limiting Sctpoints and Allowable Values have been considered in this calculation. The setpoints developed in this calculation are not applicable until the VY licensing amendments BVY 03-80 for Extended Power Uprate and BVY 03-23 ARTS/MELLLA are approved (as applicable).
- 5.4.3 The function of the instruments covered by this calculation is an assumed input in the Reload Licensing Analysis. This analysis does not assess conformance to 10 CFR 50.46, "Acceptance Criteria for ECCS for Light Water Nuclear Power Reactors," and Appendix K, "ECCS Evaluation Models". The results of this calculation do not identify errors or require changes to the Reload Licensing Analysis. Therefore, the reporting requirements of 10 CFR 50.46 are not applicable.
- 5.4.4 A review of the Vermont Yankee Event Report Database was conducted to identify any Event Reports that would impact this calculation. This review identified no event reports, associated with these components.
- 5.4.5 Precursor calculations used for design input to this calculation are not impacted by the results of this calculation. Any applicable interactions due to changes in precursor calculations will be addressed per AP 0017 during the change process for those calculations. Calculation VYC-0690 [Ref. 6.27] provides direct input to the flow errors used for this calculation.
- 5.5 Summary of Requirements
 - 5.5.1 The current calibration procedure, OP 4308, Rev. 21 [Ref 6.25] requires update to accurately reflect the LSp and As-Found and As-Left tolerances. A precaution should be added to Ref. 6.25 to ensure that M&TE with an accuracy better than 0.05% of span is used to set the flow bias input value during calibration.
 - 5.5.2 This calculation is not an implementing document and a 50.59 screen or evaluation is not required. The output of this calculation is implemented through update to applicable plant documents (i.e., OP 4308, FSAR). The downstream process that updates applicable output documents will satisfy the 50.59 evaluation requirements.
- 5.6 Summary of Recommendations
 - 5.6.1 Based on the results of this calculation the following changes should be made to the evaluated trip setpoints:

5.6.1.1 APRM Flow Biased Scram Trip Setpoint.

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5.6.1.1.1 The formula to develop the curve for the APRM Flow Biased Scram Trip setpoints must be changed in accordance with Table 12 for the specific application of ARTS/MELLA or Extended Power Uprate.

5.6.1.1.2 Revise the As-Left and As-Found tolerances as defined in Table 15 for the new calibration points.

5.6.1.2 APRM Fixed Scram (Reduced).

- 5.6.1.2.1 Trip setpoints must be changed in accordance with Table 12. The values for Allowable Value and Limiting Setpoint do not change for this function for ARTS/MELLLA or EPU.
- 5.6.1.2.2 Revise the As-Left and As-Found tolerances as defined in Table 15 for the new calibration points.

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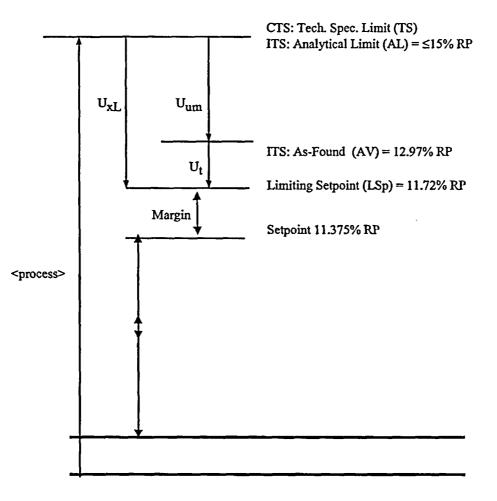
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APRM Fixed Scram (Reduced) Setpoint

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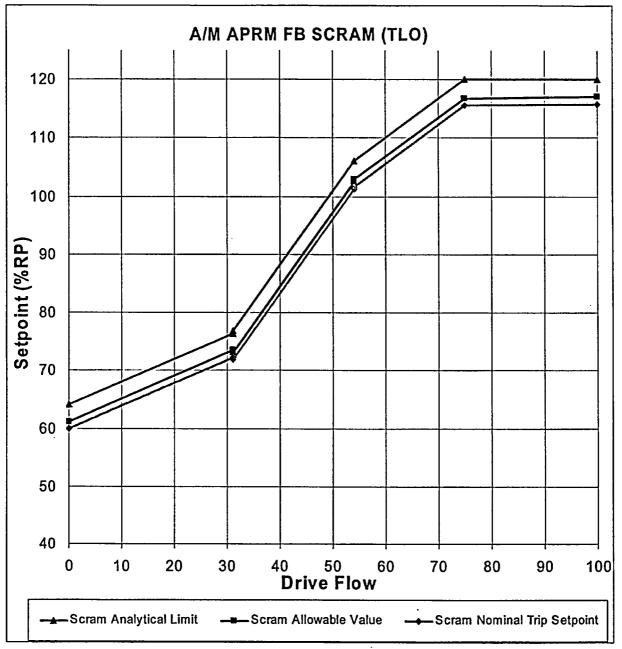


Figure 2

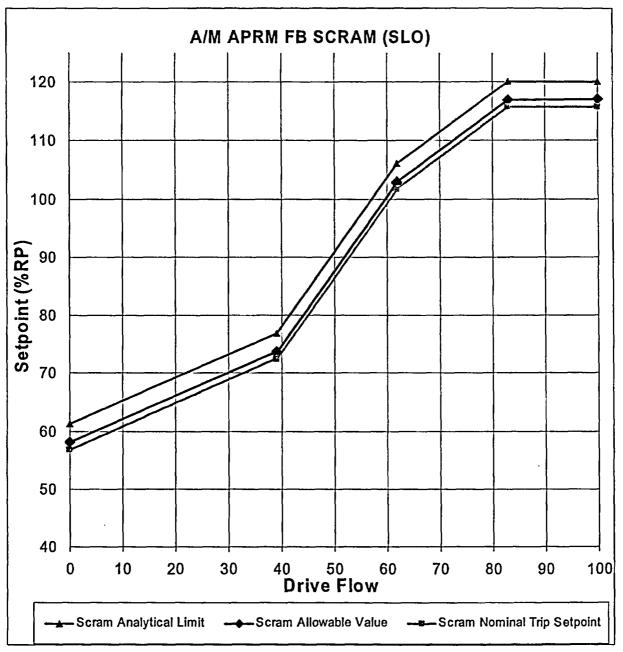
APRM Flow Bias Scram Analytical Limit, Allowable Value, Nominal Trip Setpoint (ARTS/MELLLA) Two Recirculation Loops

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Figure 3

APRM Flow Bias Scram Analytical Limit, Allowable Value, Nominal Trip Setpoint (ARTS/MELLLA) One Recirculation Loop

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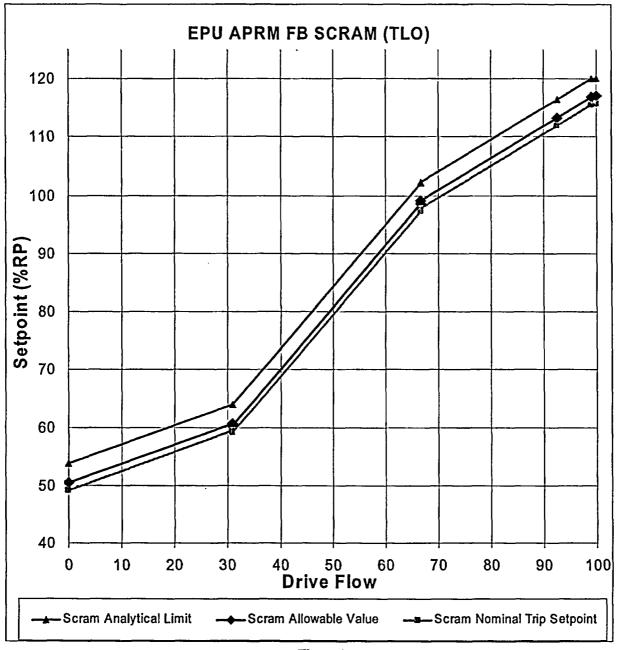


Figure 4

APRM Flow Bias Scram Analytical Limit, Allowable Value, Nominal Trip Setpoint (EPU) Two Recirculation Loops

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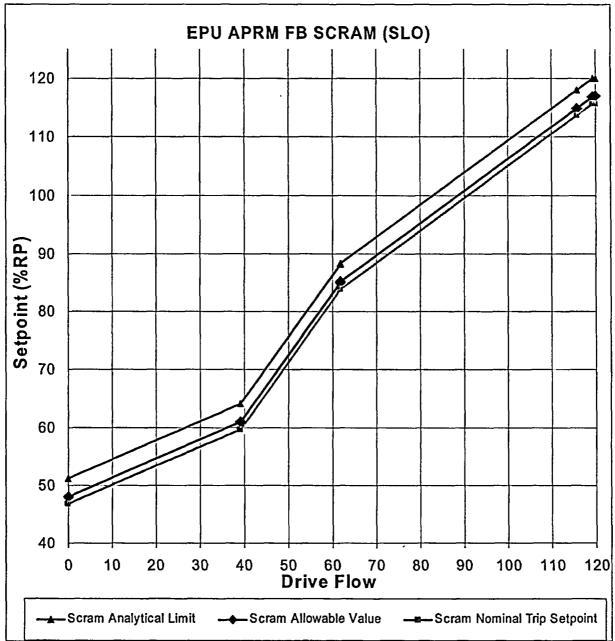
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APRM Flow Bias Scram Analytical Limit, Allowable Value, Nominal Trip Setpoint (EPU) One **Recirculation Loop**

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6 **REFERENCES**

- 6.1 "Instrument Uncertainty and Setpoints Design Guide," Vermont Yankee, Rev. 1.
- 6.2 Design Specification 22A1366, Rev. 3, "Neutron Monitoring System"
- 6.3 Design Specification Data Sheet 22A1366AF, Rev. 1, "Neutron Monitoring System"

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- 6.4 "Vermont Yankee Updated Final Safety Analysis Report, Rev. 17."
- 6.5 "Vermont Yankee Environmental Qualification Program Manual," Rev. 38.
- 6.6 "Vermont Yankee Design Basis Radiation Dose Specification," Yankee Nuclear Services Calculation VYC-193. Rev. 4
- 6.7 Vermont Yankee Technical Specifications through Amendment 212.
- 6.8 Not Used
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- 6.12 Not Used.
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- 6.14 NEDE-24011-P-A-14, June 2000, General Electric Standard Application for Reactor Fuel (GESTAR II).
- 6.15 GE-NE-0000-0012-0531-01-01 Revision 2 November 2003 Project Task Report "Entergy Nuclear Operations Incorporated Vermont Yankee Nuclear Power Station ARTS/MELLLA" Task T0506: NSSS TS Instrument Setpoints.
- 6.16 GE-NE-0000-0016-5688-01 Revision 0 August 2003 Project Task Report "Entergy Nuclear Operations Incorporated Vermont Yankee Nuclear Power Station Extended Power Uprate" Task T0506: NSSS TS Instrument Setpoints.
- 6.17 GE Performance Specification 25A5903 Rev. 1, "Flow Control Trip Reference (FCTR) Card".
- 6.18 EMPAC Database.
- 6.19 Core Operating Limit Report (COLR).
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- 6.27 VYC-690 Rev. 2 "Recirculation Flow Loop Uncertainties to APRM".
- 6.28 NEDE-24011-P-A-14, June 2000, General Electric Standard Application for Reactor Fuel (GESTAR II).
- 6.29 NEDC-33089P, "Vermont Yankee Nuclear Power Station APRM/RBM/Technical Specifications Maximum Extended Load Line Limit Analysis (ARTS/MELLLA)," March 2003.
- 6.30 NEDC-33090P, Rev. 0, "Safety Analysis Report for Vermont Yankee Nuclear Power Station Constant Pressure Power Uprate," September 2003
- 6.31 BVY 03-23 March 20, 2003, Technical Specification Proposed Change No. 257 Implementation of ARTS/MELLLA at VY

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6.32 BVY 03-80 September 10, 2003, Technical Specification Proposed Change No. 263 Extended Power Uprate.

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6.33 VYC-2252, Rev. 0 "Drift Calculation for Average Power Range Monitors."

7 ATTACHMENTS

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- 7.1 Loop Diagram [1 pg]
- 7.2 Calculation Detail (B1 through B4) [8 pgs]
- 7.3 Design Specification 22A1366, Rev. 3, "Neutron Monitoring System" [2 pgs]
- 7.4 Design Specification Data Sheet 22A1366AF, Rev. 1, "Neutron Monitoring System" [1 pg]
- 7.5 Design and Performance Specification 175A1259, Rev. 1, "APRM" [3 pgs]
- 7.6 GE Performance Specification 25A5903 Rev. 1, "Flow Control Trip Reference (FCTR) Card [23 pg]
- 7.7 AP-0017 Forms and Interdepartmental Review Form [7 pgs]

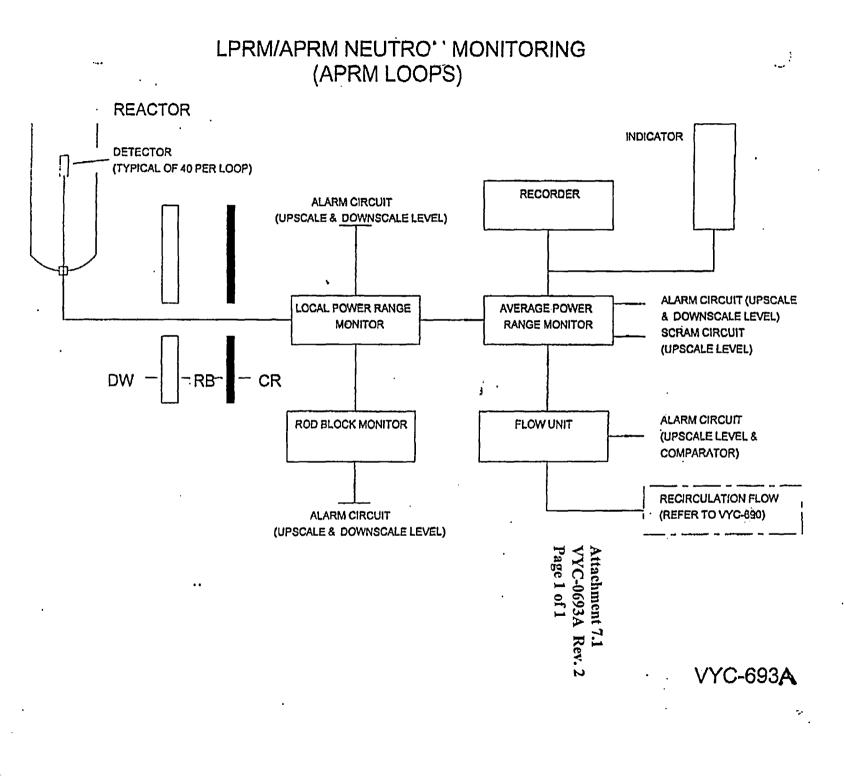
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62 %CS %RP %CS %RP %CS %RP	44 47 FLCA 48 49 50 51 52 53 FLCA 55 55 55 55 55 59 FRX	LUBRATION EFFE %CS 1.0000% -1.0000% -1.0000% -1.0000% -1.0000% -1.0000% -1.0000% -1.0000%	ECT (CE)		CALIBRATION TOLERANCE % RP 0.625 -0.625 -0.625 CALIBRATION TOLERANCE % RP 0.50 -0.50 -0.50 CALIBRATION TOLERANCE	%CS 0.50% -0.50% -0.50% -0.50% -0.50% -0.40%	1.25	-1.00% LOOP TESTING UNCERTAINTY %C3 1.00% -1.00% LOOP TESTING UNCERTAINTY %C3 1.00% -1.00% LOOP TESTING UNCERTAINTY	NON TESTING ERROR % RP 2.2555% -3.2197% NON TESTING ERROR % RP 2.2193%
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ARTS/MELLA Two Loop

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31 Jumba 1 AV LURINO SERVATI Low ALLOWAGE	
37 L395C310100 (TS: (AM) L10 ALLOWARLE LARGEN CTS: ASFCIAD TOLERANCE (TT) COLLEGATION TOLERANCE 33 % C2 \$ESTIM_L23*100 NOS-G38 Viet Viet OSC OSS	
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38 Types AV and Setyon Covet 0.4 Works 85	
33 1 1 1 1 1 1 1 40 Method 1AV LAATNO SETPONT SETPONT ALLOWABLE MAGN CTS ASFOLAD TOLERANCE (FT) CALBRATON TOLERANCE 41 ITS: (AV) L5p VXUE (AC) (CT) CT) CT) CT) 42 KCS % RP % RP % RP % CS VCC % RP % CS VCC % RP 43 13517% 7312 7187 57.5 5.85 NA 594% 553 7022 55.95% 57.0 71.24 44 -29531% 3331 128*Me+3331 128*Me+3206 -	
40 Method 1.AV LANTWS SEPONT SETPONT MARGN CTS ASFOLND TOLERANCE (FT) CLUBRATION TOLERANCE 41 ITS: (AV) LSp VKULE (M2) (CT)	
41 TTS: (AV) LSp VALUE (M2) CT CT 42 % CS % PP % RP Vdc % RP % CS VDC % RP % CS VDC % RP 43 15127% 73 12 71 87 5.5 % A 58 49% 515 73 12 5.99% 560 7249 44 -29531% 33 31 32 05 55 89% 565 70 52 55 99% 570 71 24 46	In the second
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44 2.8511% 33.31 32.06 98.49% 5.65 70.82 55.09% 57.0 71.24 45 1.28*W4-33.31 1.25*W4-32.06 1.28*W4-33.01 1.25*W4-32.06 1.28*W4-33.01 1.25*W4-32.06 1.28*W4-33.01 1.25*W4-32.06 1.28*W4-33.01 1.25*W4-32.06 1.28*W4-33.01 1.25*W4-32.06 1.28*W4-33.01	
46 Marked 1 Marked 1 AV LANTRG SETPONT SETPONT ALLOWABLE MARGN CTS: AS-FOLND TOLERANCE (FT) CALERATION TOLERANCE 47 ITS: (AV) LSp VALUE (M2) CTI CALERATION TOLERANCE 48 ITS: (AV) LSp VALUE (M2) CTI CALERATION TOLERANCE 50 1.8052% 100 52 101.67 8.13 8.23 NA 82.34% 8.23 100.292 81.84% 8.16 102.39 51 -2.5756% 67.28 66.03 - 80.34% 8.03 100.42 80.84% 8.08 101.05 52 0.665Wd+67.28 0.657Wd+66.03 - </td <td></td>	
46 Marked 1 Marked 1 AV LANTRG SETPONT SETPONT ALLOWABLE MARGN CTS: AS-FOLND TOLERANCE (FT) CALERATION TOLERANCE 47 ITS: (AV) LSp VALUE (M2) CTI CALERATION TOLERANCE 48 ITS: (AV) LSp VALUE (M2) CTI CALERATION TOLERANCE 50 1.8052% 100 52 101.67 8.13 8.23 NA 82.34% 8.23 100.292 81.84% 8.16 102.39 51 -2.5756% 67.28 66.03 - 80.34% 8.03 100.42 80.84% 8.08 101.05 52 0.665Wd+67.28 0.657Wd+66.03 - </td <td></td>	
47 Method 1 AV LANTRO SETPORT SETPORT ALLOWABLE MARGN CTS AS FOUND TOLERANCE (FT) CALBRATION TOLERANCE 48 TTS: (AV) LSp VALUE (M2) CT C(T) C(T) C 49 % CS % RP % RP Vdu KKP % CS VDC % RP % CS	
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53 Method 1 AV LIMTNO SETPONT ALLOWABLE MARGN CTS AS-FOUND TOLERANCE (FT) CALBRATION TOLERANCE 55 ITS: (AV) LSP VALUE (M2) (CT) CALBRATION TOLERANCE 56 MCS % RP % RP VALUE (M2) (CT) (CT) 57 11755% 116 96 115.71 9.28 9.38 NA 93.37% 9.36 116.96 \$2.97% 9.30 116.21 58 -2.4315% 116 96 115.71 9.278 9.38 NA 93.37% 9.36 116.96 \$2.97% 9.30 116.21 59	
54 Method 1 AV LMTING SETPOINT SETPOINT ALLOWABLE MARGIN CTS AS-FOUND TOLERANCE (FT) CALBRATION TOLERANCE 55	
58 % RP % RP Vdo Vdc % RP %CS VDC <	
58 % RP % RP Vdo Vdc % RP %CS VDC <	NL
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58 -2 4315% 91.57% 9.16 114 45 92.17% 9.22 115.21 59 Image: Second	
Sg Method 1 AV LIMTING SETPOINT SETPOINT ALLOWABLE MARGIN CTS: AS-FOLIND TOLERANCE (FT) CALBRATION TOLERANCE 60 ITS: (AV) LSp VALUE (M2) (TT) CALBRATION TOLERANCE 61 ITS: (AV) LSp VALUE (M2) (CT) CALBRATION TOLERANCE 62 % CS % RP % RP Vdo % RP % CS VDC % RP 63 1.7755% 12 87 11.72 0 94 1 04 NA 10.38% 1.04 12.97 \$7.78% 0.98 1222	
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ARTSMELLLA Single Loop

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	ADD14 Second Cales	utation for ARTS/MELLLA Single Recirculation Loop Operatio	_			1	Values based on Tables 6 and 7 accuracy and drift	
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쉬	COLDING TIL		SPAN %	Salport Slope	Analytical Lemits	SENSITIVITY	ACCURACY	REPEATABILITY
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10		FLOW BIASED SCRAM (20-39 1%)	125	0 40	69.20		1 0000%	<u> </u>
111		FLOW BIASED SCRAM (39.1 + 61 9%)	125	1.28	78 85		1.0000%	
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		IPMENT UNCERTAINTY (MATE)		0.071%	(2.3 12 IN TEXT)			
		ERTAINTY BAS (FROM VYC-690, REV.2)	····-	0.07176	0.058368	0 03666		
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		ERTAINTY RANDOM (FROM VYC-690, REV.2)	+	0 4673	0 434776	0 427396	CS FOR FLOW SIGNAL IS 128 6%	
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		NTY RANDOM EFFECT Includes 0.25% ST(Sec 2.3 4) (%		0.2726%	0 8258%	0.4203%		
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25	PRIMARY ELEMEN	IT ACCURACY (%RP) (Section 2.2.5)	0 82%	Bies '4/-	0.340000%			
26 0	PROCESS MEASUR	REMENT ACCURACY (%RP) (Section 2.2.6) +	2 29%					
27					·			
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30								{
		accuracy of all components			SRSS of Calibration Terms in % RP	SRSS of Calibration Terms	NON TESTING UNCERTAINTY	
	HASED SCRAM (20		· · · · · · · · · · · · · · · · · · ·	E35/\$C\$10	LOOP TESTING UNCERTAINTY	LOOP TESTING UNCERTAINTY	0 64"SQRT(\$E\$25"2+\$C\$20"2+\$D\$20"2+\$O\$19+\$N\$16)	L35/\$C\$10*100
	BRATION EFFECT		CALIBRATION TOLERANCE	CALIBRATION TOLERANCE				
			SRP		\$C\$10"SORT(A35*2) % RP	SORT(A35*2)	0 84-SORT(\$5525*2+\$C\$20*2+\$D\$20*2+\$O\$19+\$N\$16)-\$C\$25-\$D\$19 % RP	
75	%C3 1.0000%	······································	0 625	%CS	125	<u>%C9</u> 100%	2 2311%	<u>% C3</u> 1 785%
36	-1 0000%		-0 625	0 50%		-1 00%		-2 458%
씕			-0 623	-0.5076	•1.23	•100%	-3 1096%	-2 43076
37 38	G10	·						
38	-A35						······································	Typical AV and Selpoint Curves
39			<u>}</u>					•
	ASED SCRAM (39 1		<u> </u>					
<u>41</u>	BRATION EFFECT (
42	%CS		CALIBRATION TOLERANCE	CALIBRATION TOLERANCE	LOOP TESTING UNCERTAINTY	LOOP TESTING UNCERTAINTY	NON TESTING ERROR	
43			% RP	%C3	% RP	%CS	% RP	% CS
41	1.0000%		% RP 0 625	%CS 0 50%	<u>% RP</u> 1.25	%CS 1.00%	2.3251%	1 6601%
	1.0000%		% RP	%C3	% RP	%CS	% RP	
45			% RP 0 625	%CS 0 50%	<u>% RP</u> 1.25	%CS 1.00%	2.3251%	1 6601%
45 48			% RP 0 625 -0 623	%CS 0 50%	<u>% RP</u> 1.25	%CS 1.00%	2.3251%	1 6601%
47 6	ASER SCRAUMAN		% RP 0 625 -0 625 	%CS 0 50%	% RP 1.25 -1 25	%CS 1.00% -1.00%	% RP 2.3251% -3 2412%	1 6601%
47 6	ASER SCRAUMAN		% RP 0 625 -0 625 	%C\$ 0 50% -0 30%	% RP 1.25 -1.25 -1.25 LOOP TESTING UNCERTAINTY	%CS 1.00% -1.00%	% RP 2.3251% -3 2412% NON TESTING ERROR	1 8601% -2 5930%
47 6	ASER SCRAUMAN		% RP 0 625 	%C\$ 0 50% -0 50%	% RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP	%C3 1.00% -1.00% -1.00% LOOP TESTING UNCERTAINTY %C3	% RP 2 2251% -3 2412% NON TESTING ERROR % RP	1 8601% -2 5930%
47 6	ASER SCRAUMAN		% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 623	%C\$ 0.50% -0.30% 	% RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25	%CS 1.00% -1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00%	% RP 2.3251% -3 2412% NON TESTING ERROR % RP 2.2412%	1 8601% -2 5930%
47 A 48 E 50 51	ASER SCRAUMAN		% RP 0 625 	%C\$ 0 50% -0 50%	% RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP	%C3 1.00% -1.00% -1.00% LOOP TESTING UNCERTAINTY %C3	% RP 2 2251% -3 2412% NON TESTING ERROR % RP	1 8601% -2 5930%
47 A 48 E 50 51	1.0000% -1.000% ASED SCRAW (01.9 BRATION EFFECT (%CS 1.000% -1.000%		% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 623	%C\$ 0.50% -0.30% 	% RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25	%CS 1.00% -1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412%	1 8601% -2 5930%
47 4 48 4 50 51 51 52 53	ASED SCRAM (61 9 BRATION EFFECT (%CS 1 0000% -1.0000%	- 83 0%) (CE)	% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 623	%C\$ 0.50% -0.30% 	% RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25	%CS 1.00% -1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412%	1 8601% -2 5930%
47 4 48 50 51 52 53	ASED SCRAM (61 9 BRATION EFFECT (%CS 1 0000% -1.0000%	- 83 0%) (CE)	% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 625 -0 625	%C\$ 0.50% -0.30% 	% RP 1.25 -1.25 LOOP TESTING UNCERTIANTY % RP 1.25 -1.25	%CS 1.00% -1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412%	1 8601% -2 5930%
47 4 48 4 50 51 51 51 51 55 55 55 55 55 55 55 55 55	ASED SCRAM (61 9 BRATION EFFECT (%CS 10000% -1.0000% BIASED SCRAM (20	- 63 0%) (CE) - 20 0%)	% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 623	%C\$ 0.50% -0.30% 	% RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25	%CS 1.00% -1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412%	1 8601% -2 5930%
47 4 48 4 50 51 51 51 51 55 55 55 55 55 55 55 55 55	ASED SCRAM (01 9 BRATION EFFECT (%CS 10000% -1.0000% BIASED SCRAM (20 BRASED SCRAM (20 BRASED SCRAM (20 BRATION EFFECT (- 63 0%) (CE) - 20 0%)	% RP 0 625 -0 623 CALERATION TOLERANCE % RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 625 -0 625 CALERATION TOLERANCE	%C\$ 0 50% -0 30% -0 50% 	% RP 1.25 -1.25 LOOP TESTING UNCERTIANTY % RP 1.25 -1.25	%C3 1.00% -1.00% LOOP TESTING UNCERTAINTY %C3 1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412% -3.0085%	1 8601% -2 5930%
47 4 48 4 50 51 51 51 51 51 55 55 55 55 55 55 55 55	ASED SCRAM (61 9 BRATION EFFECT (%CS 10000% -1.0000% BIASED SCRAM (P6 BRATION EFFECT (%CS	- 63 0%) (CE) - 20 0%)	% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 623 -0 625 -0 br>-0 -0 -0 -0 -0 -0 -0 -0 -0 -0 -0 -0	%CS 0 50% -0 30% 	% RP 1.25 -1 25 LOOP TESTING UNCERTAINTY % RP 1.25 -1 25 -1 25 LOOP TESTING UNCERTAINTY % RP	%CS 1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00% -1.00% LOOP TESTING UNCERTAINTY %CS	% RP 2.3251% -3 2412% NON TESTING ERROR % RP 2.2412% -3 0085% NON TESTING ERROR % RP	1 8601% -2 5930%
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47 4 48 4 50 51 51 52 53 55 55 55 55 55 55 55 55 55 55 55 55	ASED SCRAM (61 9 BRATION EFFECT (%CS 10000% -1.0000% BIASED SCRAM (P6 BRATION EFFECT (%CS	- 63 0%) (CE) - 20 0%)	% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 623 -0 625 -0 br>-0 -0 -0 -0 -0 -0 -0 -0 -0 -0 -0 -0	%CS 0 50% -0 30% 	% RP 1.25 -1 25 LOOP TESTING UNCERTAINTY % RP 1.25 -1 25 -1 25 LOOP TESTING UNCERTAINTY % RP	%CS 1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00% -1.00% LOOP TESTING UNCERTAINTY %CS	% RP 2.3251% -3 2412% NON TESTING ERROR % RP 2.2412% -3 0085% NON TESTING ERROR % RP	1 8601% -2 5930%
47 449 449 449 449 449 449 449 449 449 4	ASED SCRAM (61 9 BRATION EFFECT (%CS 1000% -1.0000% BUASED SCRAM (50 BRATION EFFECT (%CS 10000% -10000%	- 83 0%) (CE) - 81 0%) (CE) 	% RP 0 625 -0 623 TOLERANCE % RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 625 -0 625 -0 625 -0 50 -0 50	%CS 0 50% -0 30% 	% RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25 -1.25	%CS 1.00% -1.00% LOOP TESTING LINCERTAINTY %CS 1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00%	% RP 2.3251% -3 2412% NON TESTING ERROR % RP 2.2472% -3 0985% NON TESTING ERROR % RP 2.2472% -3 0985% 2.3095%	1 8601% -2 5930%
47 48 49 50 51 55 55 55 55 55 55 55 55 55 55 55 55	ASED SCRAM (01 9 BRATION EFFECT %C3 10000% -1.0000% BUASED SCRAM (05 BRATION EFFECT %C5 10000% -10000% -0 SCRAM (REOUC	- 83 0%) (CE) 83 0%) (CE) (CE) (CE) (CE) (CE) (CE) (CE) (CE	% RP 0 625 -0 625 CALERATION TOLERANCE % RP 0 623 -0 623 -0 623 -0 625 -0 625 -0 625 -0 50 -0 50 -0 50 -0 50 -0 50	%CS 0 50% -0 30% 	% RP 1.25 -1.25 LOOP TESTING UNCERTIANTY % RP 1.25 -1.25 LOOP TESTING UNCERTIANTY % RP 1.25 -1.25 -1.25 -1.25 -1.25	%CS 1.00% -1.00% LOOP TESTING LINCERTAINTY %CS 1.00% -1.00% -1.00% -1.00%	% RP 2.3231% -3 2412% NON TESTING ERROR % RP 2.2412% -3 0985%	1 8601% -2 5930%
47 44 44 50 51 52 53 54 55 55 55 55 55 55 55 55 55 55 55 55	ASED SCRAM (01 0 BRATION EFFECT (%CS 10000% -10000% BUASED SCRAM (25 BRATION EFFECT (%CS 10000% -10000% -10000% -10000% -10000%	- 83 0%) (CE) 83 0%) (CE) (CE) (CE) (CE) (CE) (CE) (CE) (CE	% RP 0 625 -0 623 CALERATON TOLERANCE % RP 0 623 -0 623 -0 623 -0 625 -0 625 -0 625 -0 625 -0 625 -0 50 -0 50 -0 50 CALERATION TOLERANCE % RP 0 50 -0 50 CALERATION TOLERANCE	%CS 0 50% -0 30% -0 30% 	% RP 1.25 -1 25 LOOP TESTING UNCERTAINTY % RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25 -1.25 LOOP TESTING UNCERTAINTY LOOP TESTING UNCERTAINTY	%CS 1.00% -1.00% 1.00% 1.00% 1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412% -3.085% NON TESTING ERROR % RP 2.2412% -3.085% -3.085% NON TESTING ERROR % RP 2.2193% -3.0393%	1 8601% -2 5930%
48 44 50 51 52 53 53 54 55 55 55 55 55 55 55 55 60 61 62	ASED SCRAM (61 9 BRATION EFFECT (%C3 1000% -1000% -1000% BRATION EFFECT %C3 1000% -1000% -1000% -1000% -1000% -1000% -1000% -1000%	- 83 0%) (CE) 83 0%) (CE) (CE) (CE) (CE) (CE) (CE) (CE) (CE	% RP 0 625 -0 623 CALERATION TOLERANCE % RP 0 623 -0 623 -0 623 -0 623 -0 623 -0 623 -0 625 -0 625 -0 625 -0 625 -0 625 -0 625 -0 625 -0 625 -0 625 -0 625 -0 625 -0 625 -0 50 -0 50 -0 50 -0 50 -0 50 -0 50 -0 50 -0 50 -0 50 -0 50 -0 50 -0 50	%CS 0 50% -0 30% -0 30% 	% RP 1.25 -1.25 LOOP TESTING LACERTAINTY % RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP	%CS 1.00% -1.00% LOOP TESTING LINCERTAINTY %CS 1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00% -1.00% LOOP TESTING UNCERTAINTY %CS 1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412% -3.0085% NON TESTING ERROR % RP 2.2193% -3.0393% -3.0393%	1 8601% -2 5930%
47 44 44 50 51 52 53 54 55 55 55 55 55 55 55 55 55 55 55 55	ASED SCRAM (01 0 BRATION EFFECT (%CS 10000% -10000% BUASED SCRAM (25 BRATION EFFECT (%CS 10000% -10000% -10000% -10000% -10000%	- 83 0%) (CE) 83 0%) (CE) (CE) (CE) (CE) (CE) (CE) (CE) (CE	% RP 0 625 -0 623 CALERATON TOLERANCE % RP 0 623 -0 623 -0 623 -0 625 -0 625 -0 625 -0 625 -0 625 -0 50 -0 50 -0 50 CALERATION TOLERANCE % RP 0 50 -0 50 CALERATION TOLERANCE	%CS 0 50% -0 30% -0 30% 	% RP 1.25 -1 25 LOOP TESTING UNCERTAINTY % RP 1.25 -1.25 LOOP TESTING UNCERTAINTY % RP 1.25 -1.25 LOOP TESTING UNCERTAINTY LOOP TESTING UNCERTAINTY	%CS 1.00% -1.00% 1.00% 1.00% 1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00% -1.00%	% RP 2.3251% -3.2412% NON TESTING ERROR % RP 2.2412% -3.085% NON TESTING ERROR % RP 2.2412% -3.085% -3.085% NON TESTING ERROR % RP 2.2193% -3.0393%	1 8601% -2 5930% -2 5930%

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1.	ncludes bias and randoms more.					INSTRU		AV = AL . SQR	T(\$E\$25^2+\$C\$	26*2+\$D\$20	2+\$0\$19+\$0\$1	0]-\$C\$25-\$D\$19
2	DRIFT	LINEARITY	HYSTERESIS	ENVIRON EFF.	SEISMIC	SUMS SOU						
4	*CS	%CS	*CS	%CS	%CS	ACCURACIES			Non Testing Error :			
4		I	İ			((G5/100"\$C\$11)"2)	(('5/100°C8)*2)				iom Error as a percent	
5 6 7 8 9 10 11						0.00000000	0 0000000 0				y Random Errer as a p	
1		·				0 00000000	0 00000000					as a parcant of Rx POWER
1	0 2667%					0 00001111	0 00001111					PRM and APRN Converted to percent of RP
1	0 5000%		1		0 00	0 00010000	0 00003906					APRM averaging circuits Converted to percent of RP.
						0.0000000	8 00000000		C25 : Primary Elame	nt Accuracy Bia	Error as a percent of	Power
10	0 0000%					0 00015625	0 00000000		D19: Flow Uncertain	ty Blas Effect as	a percent of Rx POWE	R
	0 0000%					0 00015625	0 00000000					
12	0.0000%					0.00015625	00000000	LSp = AV - \$C\$	10"SQRT(A35*2	2)		
13	0 0000%	<u>†</u>	<u>├</u>			0 00015625	0 00000000		1	//		
14	0 0000%	·				0.00015625	0 0000000	·	A35: Accuracy of the	FCTR Card		
14		i	·			SLAA(N5 N9)	SUM(05:09)	<u> </u>	1			<u>}</u>
Hiid -			{			0 00011111	0 00005017	Sum of the squares of	1 No. ADD148 DD14 minute	l A data hara di data data data data data data data	SI BUOL DIM	
		<u> </u>	┟╼────			00001111	0 00000079	CALIBRATION EQUIP				<u> </u>
		Į	{			<u>├───</u>		UNLIBRATION EQUIP	T	U 76 KP AND SQ	UNICUEIER	<u>}</u>
())-		<u> </u>				<u> </u>	(D16/100*C10)*2		<u> </u>		L	<u> </u>
				├───		 	0.00005096	Sum of the calibration	error and the drift and o	ther circuit errors.		{
20							SUM(016 017)	I	h			<u> </u>
21		<u> </u>	·				ļ	I	<u> </u>			ļ
14 15 16 17 18 20 21 22 23 24 24 25 26		I	L	ļ				L				
23			l			Total Loop Uncertainty						
24			FLOW BIASED SCRAM			-4 3596%	-3.1096%					
25			FLOW BIASED SCRAM			-4.4912%	-3.2412%					
26			FLOW BIASED SCRAM	56.7 - 99 0%)		-4 3485%	-3.0985%	[[
27			FLOW BIASED SCRAM			-4 2893%	-3 0393%					
28			FIXED SCRAN (REDUCE			-3 2752%	-3.0393%					
20				·				t				
27 28 29 30				1		1		 -				
31 32 33	Method 1 AV	LMITING SETPOINT						<u> </u>				······
177	ITS: (AV)	LSp	SETPOINT	ALLOWABLE	MARGIN	AS-FOUND TOLERANC	E AETN		LIBRATION TOLERAN	r=		
33	% RP	% RP	(035/125)*10	VALUE	(M2)	035/C10+J35	S35"10	035+635	035/\$C\$10+F35	V35°10	035+E35	
34	\$E\$10+(L38*100)	N35+G38	Vde	Vde	% RP	%C9	VDC	% RP	*CS	VDC	% RP	
35	65.09	64 84	5.19	529	N/A	52 87%	5.29	65 09	52.37%	5 24	65.47	
34 35 36 37	N35-(SD\$10"5D\$22)	035-(50510'50522)				50 87%	5 09	63 59	51 37%	5.14	64 22	
371-	58 09	50 84		·								
38	0 4"Wd+58 09	0 4"Wd+ 58 84										
39												<u> </u>
	Method 1 AV	LIMITING SETPOINT	SETPOINT	ALLOWABLE	MARGIN	AS-FOUND TOLERANC	- 6 T)		LIBRATION TOLERAN	~~		
40 41	ITS; (AV)		SELFORNI	VALUE	(N/2)	IS-FOUND TOLERAM	<u>eerij</u>			<u>. </u>		
		LSp % RP	· Vde	VALUE Vác	(MZ) % RP	%CS	VDC	% RP	(CT) %CS	VDC	% RP	
	7361	72.36	5.79	589	N/A	58 69%	5 89	7361	58.39%	5 84	72.98	
47 43 44 45	23.58	22 31	3.17	<u> </u>		56 29%	5 69	71.11	57.39%	574	71.73	
	1.28"Wd+23.58	1 25 Wd+22 31		!─────────────────		30 89 76	200	<u> </u>	31.33.0	- 314	11.13	
4	1.40 110 20 00	120 0000 22 31		<u> </u>								
46 47 48 49 50 51		LIMITING SETPOINT	SETPOINT		MARGIN	AS-FOUND TOLERANC		h	LIBRATION TOLERAN			f
	Method 1 AV		SEIPONI	ALLOWABLE		PORTOUND TULERANC	<u> </u>	<u>``</u>				
	IT8: (AV)	1.5p % RP			(M2) % RP	%C9	VDC	% RP	<u>(CT)</u> %CS	VDC	% RP	
49	% RP	101 71	Vde	Vde		82 36%	8 24	102 90	81 85%	8 19	102 33	
	102.96	<u> </u>	8 14	8 24	N/A	87.30%	8.04	102 98	81 85%	8 09	102 33	{=
52	62.10 0.66*Wd+62.10	0 10"Wd+00.85		}}		00.30%	p.04	100 40		U	101 08	<u> </u>
53	0 00 100 02.10	0.00 10 00.03										¶=
23												
54 55 58 57 58 59	Methed 1 AV	LIMITING SETPOINT	SETPOINT	ALLOWABLE	MARGN	AS FOUND TOLERANC	E(FT)	сл	LIBRATION TOLERAN	CE	<u>_</u>	
55	(TS: (AV)	LSp		VALUE	(M2)				(T3)			
50	% RP	% RP	Vd¢	Vdc	% RP	%CS	VDC	% RP	%CS	VDC	% RP	
5/1-	116 96		\$ 26	936	NA	93.57%	9 36	116 96	92 97%	8 30	116.21	
58				<u> </u>		91.57%	9 10	114.45	92.17%	9 22	115 21	
59												
60	Method 1 AV	LIMITING SETPOINT	SETPOINT	ALLOWABLE	MARGIN	AS-FOUND TOLERANC	E (FT)	0	LIBRATION TOLERAN	CE		
61	ITS; (AV)	LSp		VALUE	(M2)				(CT)			
62	% RP	% RP	Vdc	Vde	% RP	%C3	VDC	% RP	*C3	VDC	% RP	
60 61 62 63 64	12.97	11.72	0 94	104	N/A	10 38%	104	12 97	\$ 78%	0 98	12.22	
64						8 38%	0 84	10.47	8 95%	0.90	11 22	
04												

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<u>}-</u> }		L	<u></u>	E	·	6	·
1 APPH Room	m Calculation for Extended Power Uprate Two Recirculation Law	on Contation			}	Values based on Tables 6 and 7 accuracy and drift	
A PARA DEL	In Calculation for Extended Power Opener The Neck Columbia	SPAN	Setpont Stope	Analytical Limits	SENSITIVITY	ACCURACY	REPEATABLITY
3 EQUIPMEN	IT LD. INSTRUMENT TYPE		Serpore Stope	First Break Point % RP	SENSITVIT	%CS	%CS
J EQUIPMEN	NSTRUMENT TIPE		↓	0 33*D22+51.7		0 &/SQRT(C24)/100	
5 ND-2-1-1	104 LPRM DETECTOR			833 022+321	<u> </u>	08308110240100	
							+
6	ICPS		J				
2	LPRM	+	ļ			0.2667%	- <u> </u>
•	APRM					0.8000%	
9	<type \$=""></type>						. <u> </u>
10	FLOW BIASED SCRAM (20-30 9%)	125	033	60.30		10%	
11	FLOW BIASED SCRAW (30.9 - 66.7%)	125	107	63 86		10%	1
12	FLOW BASED SCRAM (66.7 + 99.0%)	125	0.55	102.19		10%	
171	FLOW BASED SCRAM (>99 0%)	125	Maxmum Value	120.00		10%	·
14	FDED SCRAM (REDUCED)	125	N/a	15 00		10%	- ┦ ─┘───────────────────────────────────
15		123	·····	<u> </u>			
						ļ <u></u>	. <u>+</u>
	N EQUIPMENT UNCERTAINTY (M&TE)		0071%	(2.3.12 N TEXT)			
	TUNCERTAINTY BIAS (FROM VYC-890, REV.2)	-l	0 4501	0 2937	0.1367		· /
	T UNCERTAINTY RANDOM (FROM VYC-690, REV.2)	- <u> </u>	0 7296	0 5941	0 4994	CS FOR FLOW SKINAL IS 128 6%	.+
19 FLOW UNCE	RTANTY BIAS EFFECT (% Rx POWER)	1	6 1910%	0 4041%	0 0967%	CS FOR POWER IS 125%	<u>+</u>
	RTAINTY RANDOM EFFECT Includes 0.25% ST(Sec 2.3.4)] (%)		0 3261%	0 8869%	0 3950%		-{
21 FLOW SETTI		025		(SORT(E18*2+\$C\$21*29100)*1.286*D11			. <u> </u>
	OW VALUES TO BE EVALUATED (% FLOW)	1	20	30.9	667	I	. <u> </u>
	ES TO BE EVALUATED (% FLOW)		20-30 9%	30 9-66 7	66.7-99 0		·
	MBER OF LPRMs PER APRM						
	EMENT ACCURACY (%RP) (Section 2.2.5)	0 82%	Bias 44	0.343000%			
26 PROCESS M	EASUREMENT ACCURACY (%RP) (Section 2.2.6) +	2.29%					
27							1
28 TECH SPEC	LIMT REQUIRED FOR CTS	120.00	% RP				
29 ANALYTICLE	MIT REQUIRED FOR ITS	120.00	% RP				1
30				1		1	
1 31 Calculated an	e calibration tulerance if gosts or accuracy of all components.	1		ISRSS of Calibration Terms in % RP	SRSS of Calibration Terms	NON TESTING UNCERTAINTY	
31 Calculated at 32 FLOW BIASE	e calibration tolerance if exists or accuracy of all components. D SCRAM (20-30 P%)		E35/3C310	SRSS of Celibration Terms in % RP LOOP TESTING UNCERTAINTY	SRSS of Calibration Terms LOOP TESTING UNCERTAINTY		L35/5C\$10-100
32 FLOW BIASE	D SCRAM (20-30 P%)	CALIBRATION TOLERANCE	E35/3C310 CALIBRATION TOLERANCE	LOOP TESTING UNCERTAINTY	LOOP TESTING UNCERTAINTY	0 84"SORT(\$E\$25"2+\$C\$20"2+\$D\$20"2+\$O\$19+\$N\$16)	L 35/\$C\$10*100
32 FLOW BIASE 33 CALIBRATION	D SCRAM (20-30 0%) N EFFECT (CE)		E35/3C310 CALERATION TOLERANCE %C3				(355C\$10°100 % C3
32 FLOW BIASE 33 CALIBRATION	D SCRAW (20-30 0%) N EFFECT (CE)	CALIBRATION TOLERANCE % RP 0.625	CALIBRATION TOLERANCE	LOOP TESTING UNCERTAINTY \$C\$ 10"SORT(A)5"2)	LOOP TESTING UNCERTAINTY SQRT(A35'2)	0 84"SQRT(\$E\$25"2*\$C\$20"2*\$D\$20"2*\$Q\$19*\$N\$18) 0 84"-SQRT(\$E\$25"2*\$C\$20"2*\$D\$20"2*\$O\$19*\$N\$16) \$C\$25 \$D\$19	
32 FLOW BIASE 33 CALIBRATION 34 %CS	D SCRAM (20-30 0%) N EFFECT (CE)	% RP	CALIBRATION TOLERANCE %CS	LOOP TESTING UNCERTAINTY \$C\$10"SORT(A35"2) % RP	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3	0 84"SQRT(5E325"2* 8C320"2* 8Q520"2* 8Q519* \$4%516) 0 84"-SQRT(5E325"2* 8C320"2* 8Q520"2* 8Q519* \$4%516) \$C525- \$Q519 % RP	%03
32 FLOW BIASE 33 CALIBRATIO 34 %CS 35 10000 36 -10000 37 G10	D SCRAM (20-30 0%) N EFFECT (CE)	% RP 0.625	CALIBRATION TOLERANCE %CS 0.50%	LOOP TESTING UNCERTAINTY \$C\$10"SORT(A15"2) % RP 1 25	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100%	8 &FSGRT(15125*2*85128*2*80528*2*10519*54518) 0 &FSGRT(15125*2*85128*2*10520*2*10519*54516) 5 & RP 1 2352*6	* C3 1 789% -2 598%
32 FLOW BASE 33 CALIBRATION 34 %CS 35 10000 36 -10000	D SCRAM (20-30 0%) N EFFECT (CE)	% RP 0.625	CALIBRATION TOLERANCE %CS 0.50%	LOOP TESTING UNCERTAINTY \$C\$10"SORT(A15"2) % RP 1 25	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100%	8 &FSGRT(15125*2*85128*2*80528*2*10519*54518) 0 &FSGRT(15125*2*85128*2*10520*2*10519*54516) 5 & RP 1 2352*6	% CS 1789%
32 FLOW BIASE 33 CALIBRATIO 34 %CS 35 10000 36 -10000 37 G10	D SCRAM (20-30 0%) N EFFECT (CE)	% RP 0.625	CALIBRATION TOLERANCE %CS 0.50%	LOOP TESTING UNCERTAINTY \$C\$10"SORT(A15"2) % RP 1 25	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100%	8 &FSGRT(15125*2*85128*2*80528*2*10519*54518) 0 &FSGRT(15125*2*85128*2*10520*2*10519*54516) 5 & RP 1 2352*6	% C3 1 789% -2 598%
32 FLOW BIASE 33 CALIBRATION 34 %CS 35 10000 30 -1 0000 37 G10 38 A35 39	D SCRAM (20-30 0%) N EFFECT (CE)	% RP 0.625	CALIBRATION TOLERANCE %CS 0.50%	LOOP TESTING UNCERTAINTY \$C\$10"SORT(A15"2) % RP 1 25	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100%	8 &FSGRT(15125*2*85128*2*80528*2*10519*54518) 0 &FSGRT(15125*2*85128*2*10520*2*10519*54516) 5 & RP 1 2352*6	* C3 1 789% -2 598%
32 FLOW BIASE 33 CALIBRATION 34 %CS 35 10000 30 -1 0000 37 G10 38 A35 39	D SCRAM (20 30 0%) N EFFECI (CE) % % D SCRAM (30 9 - 60.7%)	% RP 0.625	CALIBRATION TOLERANCE %CS 0.50%	LOOP TESTING UNCERTAINTY \$C\$10"SORT(A15"2) % RP 1 25	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100%	8 64'SORT(15129'2+\$C529'2+\$D520'2+10819+\$H516) 8 64'SORT(15129'2+\$C529'2+\$D520'2+\$D519+\$H516) \$C525 \$D519	% C3 1785% -2 598% Typical AV and Selport Curves
32 FLOW BIASE 33 CALIBRATION 34 %CS 35 10000* 36 -1 D000* 37 G10 38 A35 39 40 FLOW BIASE 41 CALIBRATION 42 %CS	D SCRAM (20-30 0%) N EFFECT (CE) % % D SCRAM (20 0 - 68.7%) N EFFECT (CE)	% RP 0.625 -0.675	CALERATION TOLERANCE %C3 0 50% -0 50% -0 50% 	LOOP TESTING LINCERTANTY \$C\$107508T(JA15 ⁴ 2) % RP 125 -125 LOOP TESTING LINCERTANTY % RP	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100% 	8 44'SORT(15125'2*\$C129'2*\$0520'2*10519*\$H516) 8 44'SORT(15125'2*\$C129'2*\$0320'2*10519*\$H516)\$C125 \$0519 % RP 2 2352'4 -3 2472'4 NON TESTING ERROR % RP	% C3 1759% -2 598% Typical AV and Setport Curves % C3
32 FLOW BASE 33 CALERATIO 34 %CS 35 10000 36 -10000 37 G10 38 A35 39 40 FLOW BIASE 41 CALERATIO 42 %CS 43 10000	D SCRAM (20 30 0%)	% RP 0.625 -0.625 	CALERATION TOLERANCE 0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50%	LOOP TESTING UNCERTANTY \$C110"SORT(AT\$'2) % RP 125 -125 LOOP TESTING UNCERTAINTY % RP 125	LOOP TESTNO UNCERTAINTY SORT(A35'2) %C3 100% 	8 64*SORT(15252*2*\$C529*2*\$D520*2*30519*\$4516) 0 64*SORT(1522*2*5C520*2*5D520*2*30519*\$4516) \$C525 5D519	% CS 1789% -2 598% Typical AV and Serport Curves % CS 1 8728%
32 FLOW BASE 33 CALERATION 34 %CS 35 10000* 36 -10000* 37 G10 38 A35 39 -40 40 FLOW BASE 41 CALIBRATION 43 10000* 44 -10000*	D SCRAM (20 30 0%)	% RP 0.625 0.625 CALERATION TOLERANCE % RP	CALERATION TOLERANCE %C3 0 50% -0 50% -0 50% 	LOOP TESTING LINCERTANTY \$C\$107508T(JA15 ⁴ 2) % RP 125 -125 LOOP TESTING LINCERTANTY % RP	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100% 	8 44'SORT(15125'2*\$C129'2*\$0520'2*10519*\$H516) 8 44'SORT(15125'2*\$C129'2*\$0320'2*10519*\$H516)\$C125 \$0519 % RP 2 2352'4 -3 2472'4 NON TESTING ERROR % RP	% C3 1 789% -2 598% Typical AV and Sepore Curves % C3
32 FLOW BASE 33 CALERATION 34 %52 35 10000* 36 ~10000* 37 G10 38 A35 39 40 FLOW BASE 41 CALERATION 42 %C3 43 10000* 44 -10000* 45	D SCRAM (20 30 0%)	% RP 0.625 -0.625 	CALERATION TOLERANCE 0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50%	LOOP TESTING UNCERTANTY \$C110"SORT(AT\$'2) % RP 125 -125 LOOP TESTING UNCERTAINTY % RP 125	LOOP TESTNO UNCERTAINTY SORT(A35'2) %C3 100% 	8 64*SORT(15252*2*\$C529*2*\$D520*2*30519*\$4516) 0 64*SORT(1522*2*5C520*2*5D520*2*30519*\$4516) \$C525 5D519	% C3 178% -2 598% Typical AV and Satport Curves % C3 1 8728%
32 FLOW BASE 33 CALERATION 34 4CS 35 10000° 36 -1000° 37 G10 38 A35 39	D SCRAM (20 30 0%) N EFFECT (CE) % % D SCRAM (20 9 - 60.7%) D SCRAM (20 9 - 60.7%) N EFFECT (CE) %	% RP 0.625 -0.625 	CALERATION TOLERANCE 0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50%	LOOP TESTING UNCERTANTY \$C110"SORT(AT\$'2) % RP 125 -125 LOOP TESTING UNCERTAINTY % RP 125	LOOP TESTNO UNCERTAINTY SORT(A35'2) %C3 100% 	8 64*SORT(15252*2*\$C529*2*\$D520*2*30519*\$4516) 0 64*SORT(1522*2*5C520*2*5D520*2*30519*\$4516) \$C525 5D519	% C3 178% -2 598% Typical AV and Satport Curves % C3 1 8728%
32 FLOW BASE 33 CALERATION 34 4CS 35 10000° 36 -1000° 37 G10 38 A35 39	D SCRAM (20 30 0%)	% RP 0.625 -0.625 	CALERATION TOLERANCE 0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50% -0 50%	LOOP TESTING LINCERTAINTY \$C\$10750RT(AT9'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -125 -125	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% -1.00% LOOP TESTING UNCERTAINTY %C3 100% -100%	6 64'SORT(1525'2+\$C529'2+\$0520'2+\$0519-\$4516) 0 64'SORT(1522'2+\$C529'2+\$0520'2+\$0519-\$4516) \$ RP 2 23574 -3 24774 NON TESTING ERROR \$ RP 2.3410% -3 56574	% C3 178% -2 598% Typical AV and Satport Curves % C3 1 8728%
22 FLOW BASE 33 CALERATOL 34 %CS 35 10000 35 10000 36 A35 38 A35 39 40 FLOW BASE 43 10000 41 CALERATION 42 %CS 43 10000 44 -10000 45 46 46 47 FLOW BASE 46 47 FLOW BASE 48 FLOW BASE 49 FLOW BASE 40 FLOW FLOW FLOW FLOW FLOW FLOW FLOW FLOW	D SCRAM (20 30 0%) N EFFECT (CE) % % D SCRAM (00 0 - 60.7%) N EFFECT (CE) % % % D SCRAM (05 7 - 59 0%)	% RP 0.625 -0.625 -0.625 	CALERATION TOLERANCE %C3 0 50% 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50%	LOOP TESTING UNCERTANTY \$C110"SORT(AT\$'2) % RP 125 -125 LOOP TESTING UNCERTAINTY % RP 125	LOOP TESTNO UNCERTAINTY SORT(A35'2) %C3 100% 	8 64'SORT(\$E129'2+\$C529'2+\$05120'2+10519+\$H516) 8 64'SORT(\$E129'2+\$C529'7+\$D520'2+\$0519+\$H516) \$C525 \$D519	% C3 178% -2 598% Typical AV and Setport Curves % C3 18726% -2 8521%
32 FLOW BASE 33 CALERATO 34 4CS 35 10000 36 -10000 36 -1000 37 010 38 A35 39	D SCRAM (20 30 0%) N EFFECT (CE) D SCRAM (20 9 - 00 7%) N EFFECT (CE) X D SCRAM (50 7 - 09 0%) N EFFECT (CE)	% RP 0.625 -0.625 	CALERATION TOLERANCE %C3 0 50% -0 50% -0 50% -0 50% 	LOOP TESTING LINCERTAINTY \$C\$10750RT(AT9'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -125 -125	LOOP TESTING LINCERTAINTY SORT(A35'2) %C3 100% -1.00% LOOP TESTING LINCERTAINTY %C3 100% -100% -100% -100% -100%	6 64*SORT(15252*2*50529*2*50529*2*0519*24516) 0 64*SORT(1522*2*50529*2*50529*2*0519*54516) 50225 50319	% C3 1 789% -2 598% Typical AV and Selport Curves % C3 1 8778% -2 8521%
32 FLOW BASE 33 CALERATO 34 4CS 35 10000 36 -10000 36 -1000 37 010 38 A35 39	D SCRAM (26 30 0%)	% RP 0.625 -0.675 	CALERATION TOLERANCE %C3 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50% 0 50% 0 50% 0 50% 0 50%	LOOP TESTING LINCERTANTY \$C\$10750RT(AT\$'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -123 LOOP TESTING LINCERTAINTY % RP 125 -123	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% 	6 64'SORT(1525'2+\$C529'2+\$0520'2+\$0519-\$4516) 0 64'SORT(1522'2+\$C529'2+\$0520'2+\$0519-\$4516) \$C525 \$0519	% C3 1 785% -2 598% -2 598% Typical AV and Serport Curves
32 FLOW BASE 33 CALERATION 34 4CS 35 10000° 36 -10000° 36 -10000° 36 -10000° 37 G10 38 A35 39 40 41 CALBRATION 42 %CS 43 10000° 44 -10000° 45 CALBRATION 46 CALBRATION 47 FLOW BASE 48 CALBRATION 49 %CS 50 1<0000°	D SCRAM (20 30 0%) N EFFECT (CE) % % D SCRAM (20 0 - 60.7%) N EFFECT (CE) % % D SCRAM (55 7 - 50 0%) N EFFECT (CE) %	% RP 0.625 -0.625 -0.625 	CALERATION TOLERANCE %C3 0 50% -0 50% -0 50% -0 50% 	LOOP TESTING LINCERTANTY \$1210'SORT(AR3'2) \$% RP 125 -125 LOOP TESTING LINCERTANTY % RP 125 -123 LOOP TESTING LINCERTANTY % RP	LOOP TESTING LINCERTAINTY SORT(A35'2) %C3 100% -1.00% LOOP TESTING LINCERTAINTY %C3 100% -100% -100% -100% -100%	6 64*SORT(15252*2*50529*2*50529*2*0519*24516) 0 64*SORT(1522*2*50529*2*50529*2*0519*54516) 50225 50319	% C3 1 789% -2 598% Typical AV and Selport Curves % C3 1 8778% -2 8521%
32 FLOW BASE 33 CALERATO 34 4CS 35 10000 36 -10000 36 -1000 37 G10 38 A35 39	D SCRAM (20 30 0%) N EFFECT (CE) % % D SCRAM (20 0 - 60.7%) N EFFECT (CE) % % D SCRAM (55 7 - 50 0%) N EFFECT (CE) %	% RP 0.625 -0.675 	CALERATION TOLERANCE %C3 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50% 0 50% 0 50% 0 50% 0 50%	LOOP TESTING LINCERTANTY \$C\$10750RT(AT\$'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -123 LOOP TESTING LINCERTAINTY % RP 125 -123	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% 	6 64'SORT(1525'2+\$C529'2+\$0520'2+\$0519-\$4516) 0 64'SORT(1522'2+\$C529'2+\$0520'2+\$0519-\$4516) \$C525 \$0519	% C3 1 785% -2 598% -2 598% Typical AV and Serport Curves
32 FLOW BASE 33 CALERATO 34 4CS 35 10000 36 -10000 36 -1000 37 G10 38 A35 39	D SCRAM (20 30 0%) N EFFECT (CE) % % D SCRAM (20 0 - 60.7%) N EFFECT (CE) % % D SCRAM (55 7 - 50 0%) N EFFECT (CE) %	% RP 0.625 -0.675 	CALERATION TOLERANCE %C3 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50% 0 50% 0 50% 0 50% 0 50%	LOOP TESTING LINCERTANTY \$C\$10750RT(AT\$'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -123 LOOP TESTING LINCERTAINTY % RP 125 -123	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% 	6 64'SORT(1525'2+\$C529'2+\$0520'2+\$0519-\$4516) 0 64'SORT(1522'2+\$C529'2+\$0520'2+\$0519-\$4516) \$C525 \$0519	% C3 1 785% -2 598% -2 598% Typical AV and Serport Curves
32 FLOW BASE 33 CALERATO 34 %CS 35 10000 36 -10007 37 010 38 A35 39 -10007 41 CALERATO 42 %CS 43 100007 44 -100007 45	D SCRAM (20 30 0%) N EFFECT (CE) % % D SCRAM (30 9 - 60.7%) N EFFECT (CE) % % D SCRAM (08 7 - 99 0%) N EFFECT (CE) %	% RP 0.625 -0.675 	CALERATION TOLERANCE %C3 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50% 0 50% 0 50% 0 50% 0 50%	LOOP TESTING LINCERTANTY \$C\$10750RT(AT\$'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -123 LOOP TESTING LINCERTAINTY % RP 125 -123	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% 	6 64'SORT(1525'2+\$C529'2+\$0520'2+\$0519-\$4516) 0 64'SORT(1522'2+\$C529'2+\$0520'2+\$0519-\$4516) \$C525 \$0519	% C3 1 785% -2 598% -2 598% Typical AV and Serport Curves
32 FLOW BASE 33 CALERATO 34 %CS 35 10000 36 -10007 37 010 38 A35 39 -10007 41 CALERATO 42 %CS 43 100007 44 -100007 45	D SCRAM (26 30 0%)	% RP 0.625 -0.675 -0.675 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625	CALERATION TOLERANCE %C3 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50% 0 50% 0 50% 0 50% 0 50%	LOOP TESTING LINCERTANTY \$C\$10750RT(AT\$'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -123 LOOP TESTING LINCERTAINTY % RP 125 -123	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% 	6 64*SORT(4525*2*45329*2*50520*2*30519*54516) 0 64*SORT(4525*2*45320*2*50520*2*30519*54516) 50225 50319	% CS 1 785% -2 598% -2 598% Typical AV and Salport Curves
32 FLOW BASE 33 CALERATO 34 4CS 35 10000* 36 -1000* 37 G10 38 A35 39 -400* 41 CALERATO 42 %CS 43 1000* 44 -1000* 45 -1000* 46 -1000* 47 FLOW BASE 49 %CS 51 -1000* 51 -1000* 52 -1000* 54 FLOW BASE	D SCRAM (08 7 - 99 0%) N EFFECT (CE) % % D SCRAM (08 7 - 99 0%) N EFFECT (CE) % % D SCRAM (08 7 - 99 0%) N EFFECT (CE) % % %	% RP 0.625 -0.625 -0.625 CALERATION TOLERANCE % RP 0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625	CALERATION TOLERANCE %C3 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50% 0 50% 0 50% 0 50% 0 50%	LOOP TESTING LINCERTANTY \$C\$10750RT(AT\$'2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -125 -125 -125 -125 -125 -125 -125 -125 -125 -125 -125	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% -1.00% -1.00% 	8 64'SORT(\$E129'2+\$C529'2+\$05120'2+\$0519-\$4516) 8 64'SORT(\$E129'2+\$C529'2+\$0520'2+\$0519-\$4516) 9 8 RP 2 2352'4 -3 2472'4 NON TESTING ERROR 8 8 RP 2.3410'6 -3 5652'4 NON YESTING ERROR 8 8 RP 2.3410'6 -3 5652'4 -3 1607'6 -3 1607'6	% C3 1 785% -2 598% -2 598% Typical AV and Serport Curves
32 FLOW BASE 33 CALERATO 34 %CS 35 10000 36 -10001 37 G10 38 A35 39 -10001 38 A35 39 -10001 41 CALBRATICH 42 %CS 43 100001 44 -100001 45	D SCRAM (26 30 0%) N EFFECT (CE) % % D SCRAM (30 9 - 60.7%) N EFFECT (CE) % % % D SCRAM (68 7 - 99 0%) N EFFECT (CE) % % % D SCRAM (>99 0%) N EFFECT (CE) % %	% RP 0.625 -0.625 -0.625 CALERATION TOLERANCE % RP 0.625 -0.625 CALERATION TOLERANCE % RP 0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625 -0.625	CALERATION TOLERANCE %C3 0 30% -0 50% CALERATION TOLERANCE %CS 0 50% -0 50% -0 50% -0 50%	LOOP TESTING LINCERTAINTY \$12107507(A15/2) \$% RP 125 -125 LOOP TESTING LINCERTAINTY % RP 125 -123 LOOP TESTING LINCERTAINTY % RP 125 -123 LOOP TESTING LINCERTAINTY % RP	LOOP TESTING UNCERTAINTY SORT(A35'2) %C3 100% -1.00% 	6 64*SORT(4525*2*45329*2*50520*2*30519*54516) 0 64*SORT(4525*2*45320*2*50520*2*30519*54516) 50225 50319	% CS 1 785% -2 598% -2 598% Typical AV and Salport Curves
32 FLOW BASE 33 CALERATO 34 %CS 35 10000 36 -10001 37 G10 38 A35 39 -10001 38 A35 39 -10001 41 CALBRATICH 42 %CS 43 100001 44 -100001 45	D SCRAM (20 30 0%) N EFFECT (CE) % % D SCRAM (20 0 - 60.7%) N EFFECT (CE) % % D SCRAM (58.7 - 90.0%) N EFFECT (CE) % % D SCRAM (20 0 - 60.7%) N EFFECT (CE) %	% RP 0.625 -0.675 -0.675 -0.675 -0.625	CALERATION TOLERANCE %C3 0 50% 0 50% CALERATION TOLERANCE %CS 0 50% 0 50	LOOP TESTING LINCERTAINTY \$C\$107507(LATY2) % RP 125 -125 -125 LOOP TESTING LINCERTAINTY % RP 125 -1	LOOP TESTING UNCERTAINTY SORT(ASY2) %C3 100% 	6 64*SORT(4525*2*4532*2*5052*2*50519*54516) 0 64*SORT(4525*2*4532*2*50512*50519*54516) 0 64*SORT(4525*2*5052*50519*54516) 0 54*SORT(4525*50519 0 54*SO	% C3 1 785% -2 598% - Typical AV and Selport Curves - - % C3 - 1 8728% -2 5521% - - % C3 - 1 752% -2 5235% - 2 % C3 - 2 525%
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53 SETPORT ALLOWARLE MARGIN CTS ASFOLND TOLERANCE (F) CALERATION TOLERANCE 54 Method 1 AV LAMTING SETPORIT SETPORIT ALLOWARLE MARGIN CTS ASFOLND TOLERANCE (F) CALERATION TOLERANCE 55 TT3: (AV) LSp VALUE (A2)	42 43	% RP 60.30 27.23 1 07Wd+27.23 Method 1 AV (T\$: (AV) % RP 90 02	LBp 9% RP 39 45 25 90 1.07Wd+25 92 LIMITING SETPONT LBp % RP 91.77	Vde 472 SETPOINT Vde	VALUE Vde 4 82 ALLOWABLE VALUE Vde	(M2) % RP N/A MARGIN (M2) % RP	%C3 48.24% 40.24% CT9: AS %C3 79.27%	Vds 4 82 4 82 FOUND TOLERAND Vds 7 82	% RP 00.30 57 80 ≥ (FT) % RP 99 02	(CT %C3 47.14% 48.74% CAL (CT %C5 78.12%) 4.17 4.67 IBRATION TOLERA) Vdc 7.87	% RP 59 67 59 42 NCE % RP 98 40	
53 SETPORT ALLOWARLE MARGIN CTS ASFOLND TOLERANCE (F) CALERATION TOLERANCE 54 Method 1 AV LAMTING SETPORIT SETPORIT ALLOWARLE MARGIN CTS ASFOLND TOLERANCE (F) CALERATION TOLERANCE 55 TT3: (AV) LSp VALUE (A2)	42 43	% RP 60.30 27.23 1 07Wd+27.23 Method 1 AV (13: (AV) % RP 90 62 62.34	18p 56 RP 59 85 25 98 1.07Wd+75	Vde 472 SETPOINT Vde	VALUE Vde 4 82 ALLOWABLE VALUE Vde	(M2) % RP N/A MARGIN (M2) % RP	%C3 48.24% 40.24% CT9: AS %C3 79.27%	Vds 4 82 4 82 FOUND TOLERAND Vds 7 82	% RP 00.30 57 80 ≥ (FT) % RP 99 02	(CT %C3 47.14% 48.74% CAL (CT %C5 78.12%) 4.17 4.67 IBRATION TOLERA) Vdc 7.87	% RP 59 67 59 42 NCE % RP 98 40	
S4 Mathed 1 AV LIAITING SETPOINT SETPOINT ALLOWARLE MARGIN CTS: AS-FOLING TOLERANCE (FT) CALIBRATION TOLERANCE 55 TIS: (AV) LSP VALUE (AZ) (CT) (CT) 56 MRP % RP Vdc Vde % RP % CS Vde % RP 57 116 56 115.71 9.78 9.39 N/A 93.27% 9.30 116.21 58 91.57% 9.16 114.46 92.97% 9.30 116.21 59 91.57% 9.16 114.46 92.97% 9.30 116.21	45 48 48 50 51 52	% RP 60.30 27.23 1 07Wd+27.23 Method 1 AV (13: (AV) % RP 90 62 62.34	18p 56 RP 59 85 25 98 1.07Wd+75	Vde 472 SETPOINT Vde	VALUE Vde 4 82 ALLOWABLE VALUE Vde	(M2) % RP N/A MARGIN (M2) % RP	%C3 48.24% 40.24% CT9: AS %C3 79.27%	Vds 4 82 4 82 FOUND TOLERAND Vds 7 82	% RP 00.30 57 80 ≥ (FT) % RP 99 02	(CT %C3 47.14% 48.74% CAL (CT %C5 78.12%) 4.17 4.67 IBRATION TOLERA) Vdc 7.87	% RP 59 67 59 42 NCE % RP 98 40	
55 ITS: (AV) LSP VALUE (AZ) (CT) 56 % RP % RP % CS Vde % RP 57 116 96 92 97% 9 30 116 21 58 91 57% 9 35 116 96 92 97% 9 30 116 21 58 91 57% 8.16 114 45 92 87% 9 30 116 21	42 43	% RP 60.30 27.23 1 07Wd+27.23 Method 1 AV (13: (AV) % RP 90 62 62.34	18p 56 RP 59 85 25 88 1.87Wd+75 98 1.87Wd+75 98 1.87Wd+75 98 1.87P 57 RP 97.77 61 C9	Vde 472 SETPOINT Vde	VALUE Vde 4 82 ALLOWABLE VALUE Vde	(M2) % RP N/A MARGIN (M2) % RP	%C3 48.24% 40.24% C13: A5 %C3 78.27% 71.27%	Vde 482 482 FOUND TOLERANG Vde 792 7.72	% RP 60.30 57.80 ∞E (FT) % RP 90.02 90.52	(CT %C3 47.14% 46.74% CAL (CT %C3 78.12% 78.12%)	% RP 59 67 58 42 NCE % RP 98 40 97.15	
50	45 48 47 48 50 51 52 53	94 RP 60.30 27.23 107Wd+2723 Method 1 AV (TS: (AV) % RP 99 02 02.34 0.55'Wd+62.34	18p % RP 39 15 23 95 1,07W0+25 92 1.007W0+25 92 1.007W0+25 92 1.007W0+25 92 1.007W0+25 92 3.07 61 0.9 9 557W0+61 93	Vde 472 SEIPOINT Vde 7 82	VALUE Vde 482 ALLOWABLE VALUE Vde 7 92	(M2) % RP N/A MARCIN (M2) % RP N/A	%C3 48.24% 40.24% C13: A5 %C3 78.27% 71.27%	Vde 482 482 FOUND TOLERANG Vde 792 7.72	% RP 60.30 57.80 ∞E (FT) % RP 90.02 90.52	(CT %C3 47.14% 46.74% CAL (CT %C3 78.12% 78.12%)	% RP 59 67 58 42 NCE % RP 98 40 97.15	
50	45 48 47 48 50 51 52 53	% RP 60.30 27.23 1 07Wd+27.23 Method 1 AV (T3: (AV) % RP 99 62 62.34 0.55*Wd+62.34 Method 1 AV	18p % RP 39 t5 25 99 1.07Wd+25 98 1.08TMG SETPONT 1.8p % RP 97.77 61 09 0 55Wd+61 93 1.07Wd+61 93	Vde 472 SEIPOINT Vde 7 82	VALUE Vde 482 ALLOWABLE VdLUE VdLUE Vde 782 ALLOWABLE	(M2) % RP NA MARCIN (M2) % RP NA NA	%C3 48.24% 40.24% C13: A5 %C3 78.27% 71.27%	Vde 482 482 FOUND TOLERANG Vde 792 7.72	% RP 60.30 57.80 ∞E (FT) % RP 90.02 90.52	(CT %C3 47.14% 48.74% CAL (CT %C5 78.72% 77.72% CAL (CAL)	% RP 59 67 58 42 NCE % RP 98 40 97.15	
50	45 48 47 48 50 51 52 53	% RP 60.30 27.23 1 07Wd+27.23 Method 1 AV (113: (AV) % RP 90 62 02.24 0.55*Wd+62.34 Mathod 1 AV (13: (AV)	18p % RP 39 15 23 98 1,87 Wd+25 93 LBATING SETPONT 18p % RP 91,17 61 09 9 55 Wd+61 89 LBATING SETPONT LSp	Vde 4.72 SETPOINT Vde 7.82 SETPOINT	VALUE Vde 482 ALCOWABLE VALUE Vde 7 82 ALCOWABLE VALUE	(N2) % RP NA MARGN (V2) % RP NA NA MARGN (V2)	%C3 48 24% 46 24% CT3: A3 %C3 79 27% 77 22% CT3: A3	Vde 4 82 4 82 FOUND TOLERANC Vde 7 92 7.72 FOUND TOLERANC	% RP 60.30 57.80 € (FT) % R0 99.02 98.52 € (FT) ℃	(CT %C3 47.74% 46.74% CA CA CA 70.72% 70.72% CA CA CA) Voe 477 487 UBRATION TOLERA) Voe 7.87 7.77 UBRATION TOLERA)	% RP 59 87 59 82 NCE % RP 99 40 97.15 NCE	
50	45 48 47 48 50 51 52 53	94 RP 60.30 27.23 107Wd+2723 Method 1 AV (T3: (AV) 90 62 02.34 0.55Wd+62.34 Mothed 1 AV T3: (AV) % RP	180 % RP 39 85 23 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 5 RP 9,777 6 1 09 9 55'W0+61 93 1,07 1,07 6 1 09 9 55'W0+61 93 1,07 1,07 1,07 1,07 1,07 1,07 1,07 1,07	Vde 472 SETPOINT Vde 7 82 SETPOINT Vde	VALUE Vde 482 ALLOWABLE VALUE Vde 782 ALLOWABLE VALUE Vde Vde	(M2) % RP NA MARGN (M2) % RP NA NA MARGN (M2) % RP	%C3 48.24% 40.24% C13: A5 %C3 70.27% 71.22% C15: A5 %C3	Vde 4 82 4 82 FOUND TOLERANC Vde 7 82 7.12 FOUND TOLERANC Vde	% RP 60.30 57.80 ∞ (FT) % RP 96.02 96.52 ∞ (FT) % RP	(CT %C3 47.74% 46.74% CAL (CT %C3 78.12% 78.12% 78.12% CAL (CAL (CAL) (C) Vee 4.17 4.67 BRATION TOLERA) Vee 7.87 7.77 7.77 1.77 BRATION TOLERA D Vee	% RP 59 67 58 42 NCE % RP 68 40 97.15 NCE % RP	
50	45 48 47 48 50 51 52 53	94 RP 60.30 27.23 107Wd+2723 Method 1 AV (T3: (AV) 90 62 02.34 0.55Wd+62.34 Mothed 1 AV T3: (AV) % RP	180 % RP 39 85 23 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 5 RP 9,777 6 1 09 9 55'W0+61 93 1,07 1,07 6 1 09 9 55'W0+61 93 1,07 1,07 1,07 1,07 1,07 1,07 1,07 1,07	Vde 472 SETPOINT Vde 7 82 SETPOINT Vde	VALUE Vde 482 ALLOWABLE VALUE Vde 782 ALLOWABLE VALUE Vde Vde	(M2) % RP NA MARGN (M2) % RP NA NA MARGN (M2) % RP	%C3 48.24% 40.24% CTS: A5 %C3 79.27% 77.22% CTS: A5 %C3 91.57%	Vde 4 82 4 62 FOUND TOLERANC Vde 7 92 7.12 FOUND TOLERANC Vde 8 33	% RP 60.39 57 80 ≤ (FT) % RP 99 02 98 52 ⇒ (FT) % RP 116 96	(CT %C3 47.74% 48.74% CAL (CT %C3 78.72% 77.72% CAL (CT (CAL (CT) %C3 29.87%	Vee 477 467 BRATION TOLERA Vde 7.87 7.77 ERATION TOLERA D Vde 9.30	% RP 59 67 59 67 58 42 % RP 68 40 97.15 NCE % RP 116 21	
80 Methed 1 AV LIMTING SETPONT SETPONT ALLOWABLE MAGIN CTS: AS-FOLMO TOLERANCE (FT) CALIBRATION TOLERANCE 61 115: (AV) LSp VALUE (A/2) (CT) (CT) 62 % RP % RP Vdc Vdc % RP %CS Vdc % RP 63 17.27 0.94 104 N/A 10.35% 0.64 10.47 8.95% 0.90 11.22	45 48 47 48 49 50 51 52 53 54 53 54 57 58	94 RP 60.30 27.23 107Wd+2723 Method 1 AV (T3: (AV) 90 62 02.34 0.55Wd+62.34 Mothed 1 AV T3: (AV) % RP	180 % RP 39 85 23 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 5 RP 9,777 6 1 09 9 55'W0+61 93 1,07 1,07 6 1 09 9 55'W0+61 93 1,07 1,07 1,07 1,07 1,07 1,07 1,07 1,07	Vde 472 SETPOINT Vde 7 82 SETPOINT Vde	VALUE Vde 482 ALLOWABLE VALUE Vde 782 ALLOWABLE VALUE Vde Vde	(M2) % RP NA MARGN (M2) % RP NA NA MARGN (M2) % RP	%C3 48.24% 40.24% CTS: A5 %C3 79.27% 77.22% CTS: A5 %C3 91.57%	Vde 4 82 4 62 FOUND TOLERANC Vde 7 92 7.12 FOUND TOLERANC Vde 8 33	% RP 60.39 57 80 ≤ (FT) % RP 99 02 98 52 ⇒ (FT) % RP 116 96	(CT %C3 47.74% 48.74% CAL (CT %C3 78.72% 77.72% CAL (CT (CAL (CT) %C3 29.87%	Vee 477 467 BRATION TOLERA Vde 7.87 7.77 ERATION TOLERA D Vde 9.30	% RP 59 67 59 67 58 42 % RP 68 40 97.15 NCE % RP 116 21	
61 115: (AV) L8p VALLE (A2) (CT) 62 % RP % RP % CS Vdc % RP 63 172 97 11.72 0.94 1.04 NVA 10,35% 1.04 12.97 9.18% 0.98 12.22 64 8.33% 0.64 10.47 8.95% 0.90 11.22	45 48 47 48 49 50 51 52 53 54 53 54 57 58	94 RP 60.30 27.23 107Wd+2723 Method 1 AV (T3: (AV) 90 62 02.34 0.55Wd+62.34 Mothed 1 AV T3: (AV) % RP	180 % RP 39 85 23 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 1,07W0+25 98 5 RP 9,777 6 1 09 9 55'W0+61 93 1,07 1,07 6 1 09 9 55'W0+61 93 1,07 1,07 1,07 1,07 1,07 1,07 1,07 1,07	Vde 472 SETPOINT Vde 7 82 SETPOINT Vde	VALUE Vde 482 ALLOWABLE VALUE Vde 782 ALLOWABLE VALUE Vde Vde	(M2) % RP NA MARGN (M2) % RP NA NA MARGN (M2) % RP	%C3 48.24% 40.24% C13: A3 %C3 70.22% 71.22% C15: A5 %C3 90.57% 91.57%	Vde 4 82 4 82 4 82 4 82 4 82 4 82 7 82 7 82 7 82 7 172 7 17	% RP 60.30 57.80 57.80 % RP 99.02 99.52 52 % RP 116.96 114.46 114.46	(CT %C3 47.14% 46.74% CAL (CT %C5 78.12% 77.12% CAL (CT %C5 78.12% 77.12% CAL (CT %C5 92.97% 92.97%) V69 4.17 4.67 BRATION TOLERA) V60 7.87 7.87 7.77 7.77 ERATION TOLERA 0 9.30 9.30 9.30	% RP 59 67 59 42 % RP 98 40 97.15 NCE % RP 116 21 116 21	
VI V/I	45 48 47 48 50 51 52 53 54 55 55 56 57 58 59	% RP 60.30 27.23 107Wd+2723 Method 1 AV (T3: (AY) % RP 90 62 62.34 9.55'Wd+62.34 Method 1 AV T13: (AY) % RP 19.55'Wd+62.34 Method 1 AV T15: (AY) % RP 116 96	18p % RP 39 85 23 98 1,07W6425 98 LBMTING SETPONT LSp % RP 97,17 6109 957Wd+61 89 LMTING SETPONT LSp MRD % RP 913.71	Vde 4 72 SETPOINT Vde 7 82 SETPOINT Vde 9 28	VALUE Vde 482 ALOWABLE VALUE Vde 782 ALOWABLE VALUE Vde 8.35	(M2) % RP NA MARCIN (M2) % RP NA MARGIN (M2) % RP NA	%C3 48.24% 40.24% C13: A3 %C3 70.22% 71.22% C15: A5 %C3 90.57% 91.57%	Vde 4 82 4 82 4 82 4 82 4 82 4 82 7 82 7 82 7 82 7 172 7 17	% RP 60.30 57.80 57.80 % RP 99.02 99.52 52 % RP 116.96 114.46 114.46	(CT %C3 47.14% 46.74% CAL (CT %C5 78.12% 77.12% CAL (CT %C5 78.12% 77.12% CAL (CT %C5 92.97% 92.97%) V69 4.17 4.67 BRATION TOLERA) V60 7.87 7.87 7.77 7.77 ERATION TOLERA 0 9.30 9.30 9.30	% RP 59 67 59 42 % RP 98 40 97.15 NCE % RP 116 21 116 21	
VS VV VV<	45 48 47 48 50 51 52 53 54 55 55 56 57 58 59	% RP 60.30 27.23 107Wd+27.23 Method 1 AV (13: (AV) % RP 90 82 62.34 8.55*Wd+62.34 Method 1 AV 113: (AV) % RP 16 98 116 98 Method 1 AV	18p % RP 39 85 23 98 1,07Wd+23 98	Vde 4 72 SETPOINT Vde 7 82 SETPOINT Vde 9 28	VALUE Vde 482 ALLOWABLE VALUE Vde 782 ALLOWABLE VALUE Vde 8.33 ALLOWABLE	(M2) % RP NA MARGIN (M2) % RP NA MARGIN MARGIN MARGIN	%C3 48.24% 40.24% C13: A3 %C3 70.22% 71.22% C15: A5 %C3 90.57% 91.57%	Vde 4 82 4 82 4 82 4 82 4 82 4 82 7 82 7 82 7 82 7 172 7 17	% RP 60.30 57.80 57.80 % RP 99.02 99.52 52 % RP 116.96 114.46 114.46	(CT %C3 47.14% 48.74% CAL (CT %C3 78.12% 77.12% CAL (CT %C3 (CT %C3 (CT %C3 (CT %C3 (CT %C3 (CT %C3) (Vce 4.17 4.67 4.67 BRATION TOLERA 0 Vde 7.87 7.77 7.77 BRATION TOLERA 0 Vde 9.30 9.30 9.30 LERATION TOLERA 0	% RP 59 67 59 42 % RP 98 40 97.15 NCE % RP 116 21 116 21	
01 14.77 14.76 0.99 1.09 1.09 1.09 1.09 1.09 1.09 1.09	45 48 47 48 50 51 52 53 54 55 55 56 57 58 59	% RP 60.30 27:23 1 07:Wd+27:23 Method 1 AV (15: (AV) % RP 98 62 62:34 0:55:Wd+62:34 Method 1 AV 115: (AV) % RP 98 62 62:34 95:StWd+62:34 0:55:Wd+62:34 0:56:Wd+72:34 0:56:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72:34 0:57:Wd+72	180 % RP 39 15 23 98 1,07Wd+23 98 1,07Wd+109 1,0	Vde 4.72 SETPONT Vde 7.82 SETPONT Vde 9.78 SETPONT	VALUE Vde 482 482 VALUE Vde 782 VALUE Vde 782 VALUE Vde 782 VALUE Vde 410WABLE VALUE Vde Vde 782 VALUE Vde Vde 782 Vde V V V V V V V V V V V V V V V V V V	(M2) % RP NA MARGN (M2) % RP NA MARGN (M2) % RP NA MARGN (M2) % RP NA	%C3 48 24% 40 24% CT8: AS %C3 70 22% CT8: AS %C3 93 37% 91 51% CT8: AS	Vde 4 82 4 82 FOUND TOLERANC Vde 7 82 7.72 7.72 FOUND TOLERANC Vde 9 33 8.10 FOUND TOLFRAME	% RP 60.30 \$7.80 \$7.80 \$6.57.80	(CT %C3 47.74% 4674% CAL %C5 7872% 7872% 7872% CAL (CT %C5 2872% 2873% 92.97% 92.97% CAL (CT	V69 4.17 4.87 4.67 UBRATION TOLERA 9 Y66 7.87 Y77 777 V66 9.30 9.30 9.30 0.30 9.30 0.30 9.30	% RP 59 67 59 67 59 67 59 67 59 67 59 67 59 67 59 67 98 60 97.15 NCE % RP 116 21 116 21 NCE	
04 1 1 1 2 337% 0 00% 1 104/ 8 V5% 0 V90 1 1122	45 48 47 48 50 51 52 53 54 55 55 56 57 58 59	% RP 60.30 27.23 1 #7Wd+2723 Method 1 AV IT3: (AY) % RP 99 #2 82.34 #.55*Wd+62.34 Method 1 AV IT3: (AY) % RP 116: 98 Method 1 AV 115: (AY) % RP	18p % RP 39 85 23 98 1,07W6425 98 LBMTING SETPONT LSp % RP 97,17 6109 957Wd+61 89 UMTING SETPONT LSp % RP 115,71 LSP % RP 115,71 LANTING SETPONT LSp % RP 115,71 LBp % RP % RP	Vde 472 SETPOINT Vde 7 82 SETPOINT Vde 9 28 SETPOINT SETPOINT Vde	VALUE Vde 482 ALOWABLE VALUE Vde 782 ALOWABLE VALUE Vde 8.35 ALOWABLE VALUE Vde Vde Vde Vde Vde Vde Vde Vde Vde Vde	(M2) % RP NA MARGN (M2) % RP NA MARGN (M2) % RP NA MARGN (M2) % RP	%C3 48.24% 40.24% C13: A5 %C3 70.22% 71.22% C15: A5 %C3 91.57% 01.57% C13: A5 %C3	Vde 4 82 4 82 4 62 FOUND TOLERANC Vde 7 82 7.12 FOUND TOLERANC Vde 9 33 9.18 FOUND TOLERANC Vde 9 35 9.18	% RP 60.30 \$7.60 \$7.60 % RP 99.02 99.52 2€ (FT) % RP 116.96 114.46 \$4.8P \$4.8P	(CT %C3 47.74% 46.74% CAL (CT %C5 78.12% 77.12% 77.12% CAL (CT %C3 92.97% 92.97% 92.97% CAL (CAL (CAL) (CT %C3) Vee 4.17 4.67	% RP 59 67 59 67 58 42 NCE % RP 98 40 97.15 NCE % RP 118 21 116 21 NCE % RP	
	45 48 47 48 49 50 51 52 53 54 53 54 57 58	% RP 60.30 27.23 1 #7Wd+2723 Method 1 AV IT3: (AY) % RP 99 #2 82.34 #.55*Wd+62.34 Method 1 AV IT3: (AY) % RP 116: 98 Method 1 AV 115: (AY) % RP	18p % RP 39 85 23 98 1,07W6425 98 LBMTING SETPONT LSp % RP 97,17 6109 957Wd+61 89 UMTING SETPONT LSp % RP 115,71 LSP % RP 115,71 LANTING SETPONT LSp % RP 115,71 LBp % RP % RP	Vde 472 SETPOINT Vde 7 82 SETPOINT Vde 9 28 SETPOINT SETPOINT Vde	VALUE Vde 482 ALOWABLE VALUE Vde 782 ALOWABLE VALUE Vde 8.35 ALOWABLE VALUE Vde Vde Vde Vde Vde Vde Vde Vde Vde Vde	(M2) % RP NA MARGN (M2) % RP NA MARGN (M2) % RP NA MARGN (M2) % RP	%C3 48.24% 40.24% CT3: AS %C3 70.27% 71.22% CT5: AS %C3 90.57% 91.57% CT3: AS %C3 91.57% 01.57% %C3 91.57% 91.57% 10.28%	Vde 4 82 4 82 FOUND TOLERANG Vde 7 92 7 172 FOUND TOLERANG Vde 9 33 8 18 FOUND TOLERANG Vde 104	% RP 60.30 \$7 80 \$7 80 % RP 96 52 \$6 (FT) % RP 116 96 116 96 116 46 \$2 (FT) % RP 116 96 116 45 \$2 (FT)	(CT %CS 47.14% 48.74% (CAL (CT %CS 92.97% 92.97% 92.97% (CT %CS 97.9% (CT %CS 97.9%	Vde 417 4 67 467 BRATION TOLERA 7 Vde 7 7.87 7 7.77 7 BRATION TOLERA 9 0 9.30 9.30 9.30 BRATION TOLERA 9 0 Vde 0 9.9	% RP 59 67 59 67 58 42 NCE % RP 98 40 97.15 NCE % RP 118 21 118 21 NCE % RP 118 21 118 21 1222	

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	A	6	C	0	E	F	G
11			APRM Scram Catculation for Exte	inded Power Uprate Single Recirculation	Loon Operation.	1	Values based on Tables 6 and 7 accuracy and drift
1			SPAN	Setpoint Slope	Analytical Limits	SENSITIMTY	ACCURACY
13	EQUIPMENTID.	INSTRUMENT TYPE		Serbour Stope	First Break Point % RP	SENSITVIT	
H	ECO-WENTLD.	ENGINOMENT TIPE	·	ļ		l	%CS
14				I	0 33°D22+53.7		ļ
5		LPRM DETECTOR					
14		CPS	l	l			
Щ				l			0.2667%
7 -		APRM	· _ · _ · _ · _ ·				0 8000%
2		<type 5=""></type>					
10 11		FLOW BIASED SCRAM (20-39.1%)	125	033	57.70		1.0000%
ाग		FLOW BASED SCRAM (39.1 - 61.7%)	125	1.07	64.04		1.0000%
12						<u> </u>	
		FLOW BIASED SCRAM (61.7 + 119 4%)	125	0 55	88 24		1.0000%
11		FLOW BIASED SCRAM (>119.4%)	125	Maximum Value	120 00		1 0000%
H		FIXED SCRAN (REDUCED)	125		15.00		1 0000%
15				%CS			
18	CALIBRATION EQUIP	MENT UNCERTAINTY (MATE)		0 071%	(2 3 12 IN TEXT)		
		TAINTY BIAS (FROM VYC-690, REV.2)		0.1137	0 058368	0 03698	
		TAINTY RANDOM (FROM VYC 690, REV.2)	<u>}</u>	0.4673	0 434776	0 427428	CS FOR FLOW SIGNAL IS 128 8%
		Y BIAS EFFECT (% Rx POWER)	<u> </u>	0.483%			
1	LOW INCOMING	Y RANDOM EFFECT (Includes 0 25% ST(Sec 2.3.4)) (% Rx	00460		0 0803%	0 0262%	CS FOR POWER IS 125%
				0.2249%	0 6901%	0.3502%	<u> </u>
	LOW SETTING TOL		0.25	(SORT(D18*2+C21*2)100)*1 286*D10		(SORT/F18*2+\$C\$21*2910091.200*D12	I
		UES TO BE EVALUATED (% FLOW)	l	20	39.1	61.7	
		E EVALUATED (% FLOW)		20-39.1%	39.1 - 81 7%	617-1194	
24	WINNUM NUMBER	OF LPRMI PER APRM	9			·	
25	RIMARY ELEMENT	ACCURACY (%RP) (Section 2.2.5) EMENT ACCURACY (%RP) (Section 2.2.6) ±	0 82%	Bias '++	0.340000%		······································
28	ROCESS MEASUR	EMENT ACCURACY (% RP) (Section 2.2.6) +	2 29%				<u>}</u>
21							
	ECH SPEC LIMIT R		400.00			· · · · · · · · · · · · · · · · · · ·	<u> </u>
			120 00	% RP			l
	WALYTIC LIMIT REC	URED FOR IIS	120 00	% RP		<u> </u>	
30							
		n tolerance if exists or accuracy of all components.				SRSS of Calibration Terms	NON TESTING UNCERTAINTY
32 9	LOW BIASED SCRA	M (20-39.1%)		E35/\$C\$10	LOOP TESTING UNCERTAINTY	LOOP TESTING UNCERTAINTY	0 84"SORT(\$E\$25*2+\$C\$26*2+\$D\$20*2+\$0\$19+\$N\$16)
33	CALIBRATION EFFEC %CS 1 0000% -1.0000% G10	CT (CE)	CALIBRATION TOLERANCE	CALIBRATION TOLERANCE	\$C\$10"SORT(A35*2)	SORT(A3542)	0 84*-SORT(\$E\$25*2+\$C\$26*2+\$D\$20*2+\$O\$19+\$N\$16)-\$C\$25-\$D\$19
34	%CS		% RP	%CS	% RP	%CS	% RP
35	1 0000%		0.625	0.50%	125	1.00%	2 2273%
30	-1.0000%		-0 625	-0 50%	-1 25	-1 00%	-3 0950%
37	G10						
38	-A35						
39							
	LOW BIASED SCRA						
	ALIBRATION EFFEC						
41		31 (CE)	CALIBRATION TOLERANCE	CALIBRATION TOLERANCE	LOOP TESTING UNCERTAINTY		NON TESTING ERROR
2244	%C3		% RP	%CS	% RP	%CS	% RP
凹	1 0000%		0.625	0 50%	1.25	1.00%	2 2938%
141	-1 D000%		-0 625	-0.50%	-1.25	-1.00%	-3.1941%
45							
46							
47	LOW BIASED SCRA	M (61.7 + 119 4%)	CALIBRATION				
	ALIBRATION EFFEC		TOLERANCE		LOOP TESTING UNCERTAINTY	LOOP TESTING UNCERTAINTY	NON TESTING ERROR
40	%CS		% RP	%CS	%RP	%CS	% RP
50	1.0000%		0.625	0 50%	1.25	1.00%	2 2387%
51	-1 0000%		-0.625	+0 50%	-125	-1.00%	-3 0849%
52			•0.02.5	*0.3076	-149	*3.0070	*3 104970
53	┉┉┉┉┉						
	LOW BIASED SCRA		CALIBRATION				
55 K	ALIBRATION EFFEC	CT (CE)	TOLERANCE		LOOP TESTING UNCERTAINTY	LOOP TESTING UNCERTAINTY	NON TESTING ERROR
68	%C9		% RP	%CS	% RP	%C3	%RP
57	1.0000%		0 50	0 40%	1.25	1.00%	2.2193%
58	-1.0000%		-0.58	-0 40%	-1.25	-1.00%	-3 0393%
50					ويتبار والمتحاك بمترون والمتحاد والمتحاد والمتحاد والمتحاد والمتحاد والمتحاد والمتحاد والمتحاد والمتح		
	KED SCRAM (RED	ICED)	CALIBRATION				
	ALIBRATION EFFEC		TOLERANCE		LOOP TESTING UNCERTAINTY	LOOP TESTING UNCERTAINTY	NON TESTING ERROR
		(10c)					
62	%CS		% RP	<u>%C9</u>	% RP	%C9	% RP
6	1 0000%		0.50	0.40%	125	1.00%	2.2193%
64	-1.0000%		-0.50	-0 40%	-1.25	-1.00%	-3 0393%

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┣- ┣ -		incluces bias and random	<u>├</u>	<u></u>		<u> </u>	·····	·	<u> </u>		<u> </u>	·	
		errors.	1	t	((INSTRUM	ENTS	AV = AL - SORT	r/\$E\$25^2+\$	C\$26^2+\$D\$20	0^2+\$0\$19+\$	O\$10)-\$C\$25-\$D\$19
- 1	REPEATABILITY	DRIFT	LINEARITY	HYSTERESIS	ENMRON EFF.	SEISMIC	SUMS SOUA			1	1		
3-	%CS	wcs	%CS	%CS	%CS	%CS	ACCURACIES	ALLOTHERS	f	Non Testing Erro	<u>.</u>	<u> </u>	
1-		<u></u>					((G5/100*SC\$11)*2)	([:5/100°C8)*2)			ment Accuracy Ran	dom Frank no a pa	I
51-				<u> </u>			0 00000000	0.00000000	·····		Hoursmant Accurse		
5-						[0 00000000	00000000					ST] IS a percent of Rx POWER
1		0.2667%					0 00001111	0 00001111					for LPRM and APRIA Converted to parcent of RP
8		0 5000%				0.00	0 00010000	0 00003906					and APRM averaging circuits Converted to percent of RP.
9	_			1			0 00000000	0 00000000	[ment Accuracy Bian		
10		0 0000%					0.00015625	0 00000000		D19: Flow Uncer	ainty Blas Effect as	a percent of Rx P	OWER
11		0 0000%					0 00015825	0 00000000					
12		0.0000%					0.00015625	0 00000000	LSp = AV - \$C\$	10"SORT(A3	54211		
13		0 0000%		<u> </u>	·		0.00015625	8 00000000		Testing Error:		<u> </u>	
14		0 0000%		<u> </u>			0 00015625	00000000		A35: Accuracy of	the FCTR Card	t~	
15						i	SUM(N5 N9)	SUM(05 09)		//-	1		
16				<u> </u>			0 00011111	0 00005017	Sum of the squares of th	APRM/ PRM rie	rue doft and other erro	OR SUM/P6 P101	<u> </u>
17			<u> </u>		1			0 00000079	CALIBRATION EQUIP	MENT CONVERTE	D TO S RP AND S	QUARED E 1842	<u> </u>
10			<u> </u>	<u> </u> -			<u> </u>	(D16/100°C10)*2		1	1	1	
		·		<u> </u>	t			0 00005098	Sum of the catibration er	nor and the drift and	other circuit errore	<u> </u>	
20			1	h		i		SUM(016:017)			[1	
19 20 21 22 23 23 24	·····									t	1	i	<u> </u>
22							/ =·			1	<u>├ ─ ─ ─</u>	·	
23			<u>-</u>	1		·	Total Loop Uncertainty	Applied Non-Testing	Uncertainties	;	<u> </u>	<u> </u>	
24			i	FLOW BIASED SCRAM (20-3	30 9%)		-4 3456%			l	1	1	
25				FLOW BIASED SCRAM (30.			-4 4441%	-3.1941%			[
28				FLOW BLASED SCRAM (66.)			-4 3349%	-3 0849%	·				
27				FLOW BIASED SCRAM 1>99			-4.2893%	-1.0393%					
28				FIXED SCRAM (REDUCED)	· · · · · ·		-3 2752%	-3 0393%		·	t		
29					[j	
30										r	1		
31	_	Method 1 AV	LIMITING SETPOINT										
25 26 27 28 79 30 31 32 33	£35/\$C\$10*100	IT\$: (AV)	LSp	SETPOINT	ALLOWABLE_	MARGIN	CTS: AS	FOUND TOLERANC	£ (FT)	CAL	BRATION TOLERA	NCE	
		% RP	% RP	(035/125)*10	VALUE	(M2)		S35*10	035+G35	035/5C\$10+F35	V35*10	O35+E35	
34 % (\$E\$10+(L30*100)	N35+G36	Vớc	Vdc	% RP	%CS	VDC	% RP	%CS	VDC	% RP	
35	1.782%	54.60	63 35	4 27	4.37	N/A	43.68%	4 37	54 60	43,18%	4 32	53 98	
30	-2 476%	N35-(50510'50522)	_035-(\$D\$10*\$D\$22)				41 08%	4.17	52.10	42 18%	4.22	52.73	
37		48 00	40.75										
	xeal AV and Selpoint Curves	0.33"Wd+ 48 00	0 33 Wd+ 46 75									ļ	¶
39											ليستر بسيبار	1	
40		Method 1 AV	LIMITING SETPOINT	SETPOINT	ALLOWABLE	MARGIN	CIS: AS	FOUND TOLERANC	E (F1)		BRATION TOLERA	NCE	
41		ITS: (AV)	LSp		VALUE	(1/2)					CT)		
42 % (% RP	% RP	Vdc	Vdc	% RP	%CS	VDC	% RP	%C3	VDC	% RP	
43	1.8350%	60 84	50 59	411	487	N/A	48 67%	4 87	60 84	48.17%	482	60.22	
44	-2 5553%	19 01 1 07*Wd+ 19.01	17.76 1.07*Wd+ 17.76				40 07%	467	58 34	47,1796	4.72	58.97	
긢-		10/300+19.01	1.0/140+11.70										¥
46				00000								L	·····
47		Method 1 AV	LIMITING SETPOINT	SETPOINT	ALLOWABLE	MARGIN	CIS: AS	FOUND TOLERANC	e (r 1)		BRATION TOLERA	NCE	
	~~~~~~	<u>ПВ: (AV)</u> % RP	LSp % RP		VALUE	(M2) % RP		1000					[
49 % (	1.7910%	85.15	8190	8 71	V <del>dc</del>	N/A		0 81	% RP 85 15	%CS67.62%	0C 6 76	% RP 84.53	
51	-2 4879%	51 22	49 87		<del>  ""-</del>		68.12%	661	82 85	60 62%	6 66	83 28	
52	-240/878	0 55 Wd+ 51 22	0 55"Wd+ 49 97				00.1270		02.03	00 02 70			l
52 53												;	┦━━━━━━━━━━━━━━━━
::		Method 1 AV	LIMITING SETPONT	SETPOINT	ALLOWABLE	MARGN	CTE AP	FOUND TOLERANC	6.61)	C.11	BRATION TOLERA	NICE	
54 55		ITS: (AV)	LSP	DE IPONI	VALUE	(M2)	UI3.MS	TOURD TOLE TONIC	<u></u>		CTI	~ <b>~</b>	
58 % (	18	% RP	% RP	Vde	Vde	% RP	%CS	VDC	% RP	%CS	VDC	% RP	┣ <u>┈───</u> ─────
57	1.7755%	116 96	115.71	9.20	9.36	N/A	93 57%	9 36	116 98	92.97%	930	118 21	· · · · · · · · · · · · · · · · · · ·
54	-2 4315%						91 57%	9 10	114 48	92.17%	922	115 21	
57 50 50 80													<u></u>
80		Method 1 AV	LIMITING SETPOINT	SETPOINT	ALLOWABLE	MARGIN	24 913	FOUND TOLERANC	É (E I)	CA	BRATION TOLERA	NCE	
61		ITS: (AV)	LSp		VALUE	(1/2)	013:75	TO THE TOLETONIC	- ¥ ·/		CT)		·
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62 % (		% RP 12 97	%RP 11.72	0 94	Vdc	% RP	%CS 10.38%	VDC	% RP 12 97	96CS	0.98	% RP 12 22	·
	<u> </u>	<u>% RP</u> 12 97	11.72	0 94	1 04	N/A	10.38%	1.04 0.84	12 97 10 47	978% 978%	0 98 0 90	12 22 11 22	

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GENERAL 🚱 ELECTRIC	
ATOMIC POWER EQUIPHENT DEPARTMENT	
DESIGN SPECIFICATION	SHEC. HO. 22A1366 REV. NO. 3 SH NO. 12 CONT ON INCERIS

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4.4.2.1. The detector sensitivity shall be such that the output of the signal conditioner corresponds to the required parcent power reading associated with the neutron flux level in the vicinity of the detector.

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4.4.2.2. The range of neutron flux (operating) shall be as specified on the data sheets.

4.4.2.3. The range of neutron flux at 100 percent reactor power shall be as specified on the data sheets.

4.4.2.4. The range of gamma dose rate at 100 percent reactor power shall be as specified on the data sheets.

4.4.2.5. The detector shall be designed such that the saturation characteristics of the detector do not cause an error in the signal due to power supply variations of greater than +1 percent of the 100 percent reactor power value over the operating neutron flux range specified in the data sheets.

4.4.2.6. The detector shall be so designed that the true output shall not deviate from the ideal output by more than <u>+1</u> percent of the 100 percent reactor power value over the top decade of the operating flux range specified in the data sheets.

4.4.2.7. The detector shall have a minimum lifetime of 2.0 years in the lifetime neutron flux specified in the data sheets. End-of-life is defined as having occurred when the ratio of the output signal resulting from neutrons, to the output signal resulting from gammas, reaches 5 to 1.

4.4.2.8. The detector/cable leakage current shall not exceed ±1.6 percent of the full scale output during the life of the detector. Leakage current is defined as that current presented to the signal conditioning equipment when the detector is at operating conditions but with no neutron or gamma flux present.

4.4.2.9. The detector and detector assembly environment shall be as follows:

a. Neutron and Gamma Flux at Detector as spacified on the date sheets.

b. Dose Rates at Detector Assembly Connector: Gamma: 2.4 R/hr Neutroup: 10 ren/hr

c. Reactor Pressure:

Operation:	1025 psig #t	546°F
Design:	1250 paig at	600°F
Maximum Emergency	Pressure: 1375	peig at \$83°F

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Attachment 7.3 VYC-0693A Rev. 2 Page 2 of 2

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ATCHIC POWER EQUIPMENT DEPARTMENT

DESIGN SPECIFICATION

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4.4.5.2. The true output of the signal conditioning equipment shall not deviate from the ideal output by more than 40.8 percent of full scale at control room design center environmental conditions over the range of flux (operating) specified in the data sheets.

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4.4.5.3. At the control room design center environmental conditions specified in the data sheets, the equipment shall not have a long term drift (700 hours) greater than <u>40.8</u> percent of full scale.

4.4.5.4. The signal conditioning equipment shall be designed to that the gain can be set at a desired value within  $\frac{4}{10}$ , 1 percent of the full scale value over its range of adjustment. The gain shall be adjustable in three steps and each step shall be continuously adjustable by at least a factor of 5.

4.4.5.5. The signal conditioning equipment shall provide a 0 to 160 mV for zero to full scale output for the computer.

4.4.5.6. The signal conditioning squipment shall provide a D to 10 volt signal to the Average Power Range Monitoring system. Assignment of the various signal conditioning outputs to the APRN's is made on the Instrument Engineering Diagram (IED) listed in Paragraph 2 of the data sheets. The signal conditioner shall be designed such that two APRN's may be driven from each LPRM signal conditioner output.

4.4.5.7. The signal conditioning equipment shall provide a 0 to 10 volt signal to the Rod Block Monitor (EBM) System specified in Paragraph 4.8.8. The required "A" core level and "C" core level conditioned detector signals shall be connected through a switching matrix to the RBM associated with Reactor Protection System Trip System A. The required "B" core level and "D" core level conditioned detector signals shall be connected through the switching matrix to the RBM associated with Reactor Protection System Trip System B. The appropriate inputs shall be automatically switched upon selection of a rod. Selection details are found on the Instrument Engineering Disgram (IED) listed in Paragraph 2 of the data sheets.

4.4.5.8. Signal Output to LPRM Meter Group Display - The equipment shall be designed such that a group of conditioned outputs are provided to the LPRM Group Display upon selection of a control rod. Particular selection and routing details are as specified on the Instrument Engineering Diagram (IED) listed in Paragraph 2 of the data sheets.

4.4.6. Trip and Alarm Functions. The following trip and alarms are required:

a. Upscale Level Alarm

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b. Downscale Level Alarm

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Attachment 7.4

VYC-0693A Rev. 2 Page 1 of 1 Yankee Nuclear Services GENERAL 🚳 ELECTRIC ATCHIC POPER EQUIPMENT DEPARTMENT wee no. 2211366AF .... DESIGN SPECIFICATION - DATA SHEET 2 CONT ON SHEET S ()4.4.1. (continued) These sources are placed scially in the core as shown on Figure 1. and radially as shown on the instrument angineering diagram listed and realisity as shown on the instrument supporting disgram insted in Paragraph 2 of these data sheets. The sources shall be irradiated in a summer described on the irradiation specification listed on the Seutron Source Drawing listed in Paragraph 2 of these data sheets. b. Penetrations shall be designed and installed such that special -. coardal cables can be used for connection of detectors to signal conditioning equipment. 4,4.2. Intermediate Range Monitoring System. Penetrations - seme as Paragraph 4.4.1 above. 4.4.3. Fower Range Monitoring Systems . . - -Detector and Detector Assembly shall be placed within the core in the manner shown in Figure 2 of these data sheets. b. Range of Operating Neutron Flux shall be from 1.2 x 10¹² nv to 2.8 x 10¹⁴ nv. c. The Seutron Flux at 100 percent Reactor Fover in the vicinity of the detector shall be within the range of  $9.4 \times 10^{-1}$  mv to  $2.8 \times 10^{16}$  mv. The peak neutron flux at 120 percent of rated power will be  $3.4 \times 10^{14}$  m. The detector signal resulting from this flux shall not deviate from the ideal output by more distribution of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percent of the 100 percen than (later) percent of the 100 percent rated power value. d. The Gauna Flux at 100 percent Reactor Power in the vicinity of
 the dategoor shall be within the range of 4.2 x 10³ R/hr to
 1.2 x 10⁹ K/hr. e. Detector Lifetime Seutron Flux shall be 1.84 x 1012 my maximum at the maximum gamma flux specified. : 4.4.4. Local Power Range Monitoring. When the reactor power is distributed with octant symmetry, the equivalent positions shall be as shown in Table I of these O data sheets. 4.4.5. <u>Average Fouer Eange Hositoring</u>. The number of LPRM outputs used as input to an ARM that may be bypassed at any cas time shall not exceed one" for ARD's that have ten LPRM inputs (not counting LPRMs powered from another bus) and seven ł for an APRI that has twenty unshared LODI inputs. į Under conditions where all LFRM signals from and associated • **( )** with the companion LPRH are missing. TUC 3 6 1903

ADDM/DRM Noutron Monitoring Trin Loope

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Attachment 7.5 VYC-0693A Rev. 2 Page 1 of 3

Yankee Nuclear Services

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	-1		TITLE DESIGN & PERFORMA	NCE SPEC.	CONT \$4 SHEET 2	exec. ]
		175A1259	APRK			
00HT 6H	BHCET	2 MM 1	FIRST MADE FOR "DESIGN	STANDARD	5 212.7.3	
1.0	TEM	PERATURE AND HUN	IDITY			REVISIO
		Restricted	•	17549680	parz. 1.1	<b>S</b>
	1.2	Pull		17549680	pers. 1.2	R. 4
2.0	POKE	ER	۰.			3 44
		-45 wolts DC #15 wolts DC		175A9683		1
				17589698		Build
3.0	INPL					
	3.1	LPRH				1 Led.
		3.1.1 Polarity 3.1.2 Maximum	number to operate	0 to +10 · 24	volte DC	- ú
		3.1.3 Minimum	number to operate in ape			
- • '			number to operate	6		
		LPRH Sypass LPRH Count		l for ead	h lprm	
		3.3.1 Number		1		
		3.3.2 Folarity	-	-0.5 ma p	er lprh	
	3.4	Calibrator Fove	r			
		3.4.1 Number 3.4.2 Value		l for each -14 volts	DC nominal	
	3.5	Flow		2 to 10 v	lts DC nominal	ł
4.0	OUTP	VTS				
	4.1	Recorder		0 to -1 v	olt	
		Output Impedance	e	1.2K ohms		
•	4.2	Couputer Output Impedance	t	0 to -160 215 obse	MA.	
		Keter		0 to -10		
			igual (Isolated)	0 to -10 -	rolts DC	
5.0		ROLS AND INDICAT	ORS			
	5.1	Mode Switch				
•		5.1.1 Operate 5.1.2 Standby.	Seme as 5,1.1 except			: [
		inoperat	ive trip is tripped.		:	47
			PRH's disconnected, DC a djusted to zero.	ada -		
		5.1.4 Power Te	st. Operator may apply	and		
		while at	le simulated power signs ill connected to the act	ual		
		flov sig	nel.			
		apply ad	d Flow Test. Operator m justable simulated signs	uy le		
-0. 41		far_barb	Power and Flow			PRINTS
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1	75A1259	APRH					
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						R	EVISION
5.2	Heter Function	Switches			•	, F	8 K
		Average output of	lprm" =			• F	
	5.2.2 More	utput from Flow Com	verter 10			1	
	percent	-					MAD.
	5.2.3 Count.	Number of LPRM's be	ing Averaged.		-	ſ	
		ending is 5 times the				•	Buch
	5.2.4 AI-A6, 1	u-B6, Cl-C6, D1-D6. stput of each LPRK.	Selects			1	
		or power from obser				1	A La
5.3	Heter Reverse,	Expand Switch				ŀ	- Jul
	5.3.1 Reverse		· 1 vc	olt f.s.		L	
	5.3.2 Rozal		10 1	olts f.s.		}	
	5.3.3 X10 exp	und	·1 vo	lt f.s.			
5.4		mtioneter. Adjusta				· 1	
		signal; Range-zero	to				
5.5	greater than fo	ul scele. itiometer. Adjustabl	le	•			
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5 £		than 1001 Flow. ust Potentiometer.	Controle				
2.0		ision resistors of					
		ter then -10 volts 1			• :	I	
5.7		ultor Svitch. Allovi viewed aa meter.	B CELIDIACOL			ł	
5.8	LFRH Bypessed 1	ight. Indicates who				1	
		is in the .Calibrat	e or Bypassed			]	
5.9	condition. Meter Expand Li	ght. Indicates when	a the peter				
,		Switch is in a post					•
5 10	than Mormal.	ch Basses all las	aliza estas				
2.10		ch. Resets all late associated LPRM's.	entug ettiko				
			•				ł
5.0 PERF							ł
6.1	Averaging Circo					.	
		(includes Linearit	ty and			•	×7
	Stebilit Lestric	ed Conditions	*0.E	BI		:	~ 1
	Full Con		*2.4	17			
	6.1.2 Drift 6.1.3 Response		40.5 <5 •	51/2 veeks			<u> </u>
	6.1.4 Cain			-40X			<u> </u>
6.2	Trip Circuits	NOD-Flow Bissed)					
	Spece. apply w	en using Quad Trip I					<u> </u>
	13611322 and Th	ip Reference Unit 1	3681321.				PRINTS
MADE BY IAM	Teppen idill.7	- Armonus	NID	bry ex	17541259		
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Attachment 7.5 VYC-0693A Rev. 2 Page 3 of 3

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		A1259.			APRN	•	•••••	• • • • •				
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		- <u>I</u>			11101190211							REV
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### DOCUMENT DESCRIPTION

#### 1.1 DOCUMENT PURPOSE AND USE

This Design Specification describes in quantitative terms the characteristics of the FLOW CONTROL TRIP REFERENCE CARD.

These characteristics are grouped as follows:

- Inputs to the card their information content and electrical characteristics ٠
- Outputs from the card their information content and electrical characteristics
- The functions of the card its information processing, transfer functions, and the interrelationships between the inputs and the outputs
- The physical environment under which the card will function properly
- The card's physical parameters size, shape, type and placement of connectors
- Application information potential safety hazards

#### 1.2 DOCUMENT SCOPE

document describes the performance of the FLOW CONTROL TRIP This REFERENCE CARD with respect to its use as a component part.

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#### 2. RELATED DOCUMENTS

#### 2.1 REQUIREMENTS

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a) BWROG Hardware-Related Task Authorization for Stability LTS Enhanced Option 1-A: 94.159.0, .5, 95.159.0, .5, .7, 96.159.0

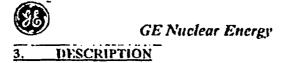
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- b) NUMAC Requirements Specification: 23A5082
- NUMAC Software Configuration Management Plan 23A5161 (meets requirements of ANSI/IEEE 7-4.3.2-1982)
- d) NEDO-32339-A Class I, December 1996 Licensing Topical Report, Reactor Stability Long-Term Solution Enhanced Option I-A
- e) NEDO-32339-P Supplement 2, Enhanced Option I-A Solution Design, April 1995, with errata 8/1/95, 9/15/95, 1/31/96, 3/27/96, and 11/27/96
- NEDO-32339 Supplement 5, Enhanced Option I-A Solution Closure, September 1996

#### 2.2 APPLICABLE STANDARDS

- a. MIL HDBK-217F Reliability Prediction of Electronic Equipment
- b. GE 265A1148 Specification for Printed Circuit Boards
- c. IEEE 323-1974 Qualifying Class IE Equipment for Nuclear Power
- d. IEEE 344-1975 Seisnic Qualification of Class IE Equipment for Nuclear Power
- e. GE 100 Series Electromagnetic, Interference and Susceptibility

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# 3.1 GENERAL

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The FLOW CONTROL TRIP REFERENCE CARD is a Class 1E component. This card provides all of the functions required by the original equipment and section 2.2, and will not deter from the current mechanical parameters or electrical connections in order to implement new features, unless otherwise requested. Logic common, if not present at the connector, will be connected to present unused pins. In addition, this card provides input flow signal validation to ensure fail safe operation. This card may be inserted and removed under power without danger and will automatically reinitiate after completion of an internal self-test (approx. 5 sec.). This card provides for the following interface between the input flow and the output references:

- Provides flow signal output following noise & EMI filtering.
- Provides a Scram Trip Reference based on a derived core flow function residing in memory for the recirculation Two Loop Operation, Two Loop Setup Operation, Single Loop Operation and Single Loop Setup Operation settings.
- Provides a control rod block Trip Reference based on a derived core flow function residing in memory for the recirculation Two Loop Operation (TLO), TLO Setup, Single Loop Operation (SLO), and SLO Setup settings with slope and offset adjustment.
- DIP switches provide selection of alignment constants for the Recirculation Drive/Core Flow transfer function.
- DIP switches provide selection of an alternate set of trip reference function tables.
- DIP switches provide constants for the Power Based Adjustment transfer function.
- Provides a recorder output of the control rod block Trip Reference with offset adjustment.
- Provides validation of incoming flow signal (out-of-range high or low).
- Provides an INOP output contact that is actuated if the card is not operable or fails self test.
- Status LED provides visual latched confirmation of status (INOP).
- Status pushbutton provides reset of status (INOP).
- Setup LED provides visual latched confirmation of setpoint Setup condition.
- Setup pushbutton alternately changes between SETUP and NORMAL setpoint arrays.
- Provides for automatic reset of trip reference setpoints to normal based on a preset control rod block trip reference value.
- Provides a factory test output.

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#### 3.2 PHYSICAL

The FLOW CONTROL TRIP REFERENCE CARD is designed in two different size configurations. The FLOW CONTROL TRIP REFERENCE CARD is designed as a pincompatible replacement for the existing FCTR Card in the APRM page. See Section 7, Specified Mechanical Characteristics, for details.

#### 3.3 FIRMWARE

This card contains firmware for providing recirculation drive flow based setpoints associated with the input-output interface.

#### 4. OPERATIONAL PERFORMANCE

#### 4.1 ACCURACY

The FLOW CONTROL TRIP REFERENCE CARD will be designed to operate with an accuracy of  $\pm 1.0$  % over 36 months due to environmental, initial calibration and accuracy drift.

#### 4.2 SERVICE LIFE

The target service life for the FLOW CONTROL TRIP REFERENCE CARD is to operate continuously (within the specified environmental limits, and allowing for replacement of failed components) for at least 40 years.

#### 4.3 POWER REQUIREMENTS

This card will require +15 VDC, -15 VDC. Analog Common & Digital Common for normal operation. Digital Common will be required for EMI grounding purposes even though +5 VDC is not being used. The +5 VDC will be generated on board from the +1 5 VDC. The card connections will be compatible with the present pin-out configuration in the APRM page connector with the Digital Common if connected, taken from the present logic common pin-out. If not connected, then the logic common will be connected to present unused pins. The power requirements of this card will not adversely affect the APRM page's power supply capability. Application and tolerances are listed below.

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4.3.1 POSITIVE LOGIC CIRCUIT SUPPLY VOLTAGE (Generated on board from the +15 VDC & Analog Common)

Application: +5 Volt DC power used for internal logic.

PARAMETER	SYMBOL	MIN LIMIT	OPERATING MAX	OPERATING MAX	MAX LIMIT	UNITS
Logic Supply Voltage	Vnc	0	4.5	5.5	5,5	VDC
Logic Supply Ripple Voltage	Vocr	0	0.00	0.05	0.10	VRMS

#### 4.3.2 POSITIVE ANALOG CIRCUIT SUPPLY VOLTAGE

Application +15 Volt DC power used for internal ADC's, DAC's, amplifiers, etc.

PÄRAMETER	SYMBOL	MIN LIMIT	OPERATING MAX	OPERATING MAX	MAX LIMIT	UNITS
Positive Analog Supply Voltage	Vdd	0	- 14	16	16	VDC
Analog Supply Kipple Voltage	Vddr	0	0.00	0.01	0.10	VRMS

#### 4.3.3 NEGATIVE ANALOG CIRCUIT SUPPLY VOLTAGE

Application: -15 Volt DC power used for internal ADC's, DAC's, amplifiers, etc.,

PARAMETER	SYMBOL	MIN LIMIT	OPERATING MAX	OPERATING MAX	MAX LIMIT	UNITS
Negative Analog Supply Voltage	Vss	0	-14	-16	-16	VDC
Analog Supply Ripple Voltage	Vssr	0	0,00	0.01	0,10	VRMS

#### 4.4 SAMPLE TIME

The minimum time for sampling the flow input is 4 msec. The interval for updating the trip references is 28 msec.

#### 4.5 ANTI-ALIASING FILTER

The flow input anti-aliasing filter is set at <20 11z.

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### 4.6 RESPONSE TIME

The maximum response time from input to output is 250 msec,

#### 4.7 AUTOMATIC TRIP REFERENCE SELECTION

Trip reference functions are identified as setup and non-setup. When the control rod block setpoint exceeds a specified Automatic Setdown Setpoint, the trip reference functions are taken from the non-setup tables, even if the setup selection has been made with the pushbutton selector switch provided.

#### 4.8 RECIRCULATION DRIVE CORE FLOW TRANSFER FUNCTION

The Recirculation Drive/Core Flow transfer function will be adjustable to accommodate variations in this relationship. Two four-position DIP switches, operating in binary, are used to select the appropriate alignment constants used in the transfer function. There will be a maximum of sixteen choices for each of two alignment constants.

#### 4.9 POWER BASED ADJUSTMENT ADDER

The Power Based Adjustment Adder provides an adjustment to the output trip reference setpoints. The same adjustment adder is applied to both output trip references. Three of four switches are used to provide eight choices for the adjustment adder. Selection of an adjustment adder of zero results in no adjustment to the output trip references.

#### 4.10 ALTERNATE TRIP REFERENCE SELECTION

Two complete sets of trip reference arrays are stored in memory. One switch of a four DIP switch is used to select between SET1 (primary) and SET2 (alternate).

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#### 5.1 TRIP REFERENCE ARRAYS

At least 512 points (9-bit resolution) composing an array of each specified function (plant specific) will be held in memory. There will be up to a maximum of two sets, each consisting of eight (8) transfer functions. These functions are programmed into the memory component (installed on a EPROM) and can only be changed by component replacement.

#### 5.2 TRIP REFERENCE FUNCTION SPECIFICATIONS

The 512 point, (9-bit resolution) tables for each plant-specific trip reference function are specifies as:

- 1. Single Loop Operation (SLO) NORMAL
- a. Scram

1

- b. Control rod block
- 2. Two Loop Operation (TLO) NORMAL
- a. Scram
- b. Control rod block
- 3. SLO Setup
  - a. Scram
- b. Control rod block
- 4. TLO Setup
  - a. Scram
- b. Control rod block

These functions are programmed into the memory component (installed on a socket) and can only be changed by component replacement.

#### 5.3 SIGNAL VALIDATION

The input recirculation drive flow will be validated to confirm that it is not out-of-range (high >130 or low < -15%).

#### 5.4 AUTOMATIC SETDOW'N SETPOINT

The Automatic Setdown Setpoint is provided for each pair of TLO (NORMAL/SETUP) and SLO (NORMAL/SETUP) trip references. The setpoint is programmed into EPROM.

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#### 6. SPECIFIED I/O CHARACTERISTICS

6.1 INPUTS

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#### 6.1.1 ELECTRICAL INPUTS

 Input Flow: 0 to 10 volts DC (relates to 0 to 125 % flow) Input impedance, Z_{in}, is 100 KΩ.

#### 6.1.2 LOCAL OPERATOR'S INPUTS

- 1. Recirc TLO/SLO (switch allows choice)
  - 2. INOP Reset (pushbutton)
  - 3. Recorder offset adjustment
  - 4. SETUP (pushbutton alternate action)
  - 5. DIP switches for drive flow alignment constants, power-based adjustment constant, and Alternate trip reference selection
- a) Manual Reset:
  - 1. Pushbutton
  - 2. Change in switch status (TLO/SLO)

b) Automatic Reset:

- From SETUP to NORMAL of a specified rod block setpoint corresponding to 5% recirculation drive flow above A'nom¹
- 2. Power failure
- 3. Exiting INOP

Upon reset of SETUP, current recirculation TLO/SLO switch setting will determine the applicable arrays applied

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#### 6.2.1 ELECTRICAL OUTPUTS

- 1. Output Recirc Drive Flow: 0 to +10 volts DC
- 2. Scram Trip Reference: 0 to -10 volts DC
- 3. Control rod block Trip Reference: 0 to -10 volts DC
- 4. Control rod block Recorder, 0 to -1 volt DC with an offset of ± 100 mV
- 5. INOP: normally open (N.O.) contact, non-latched. Open, non-energized, on INOP.

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A'nom - the highest flow in operating domain associated with Restricted Region of recirculation drive flow transfer function (plant specific),

² A critical Self-test fault zeroes the Scram and Rod Block trip references (forces APRM scram and rod block)

#### 6.2.1.1 FACTORY TEST OUTPUT

Single digital fiber-optic communication output, transmitter only, at a data rate of 19.2 kHz. Hewlett-Packard IIFBR-1414T fiber-optic transmitter.

#### 6.2.2 LOCAL OPERATOR'S INDICATION

1. A non-latched two color LED to indicate trip reference setup condition. LED color indications are:

•	GREEN:	Normal boundaries
•	YELLOW:	Setup boundaries
	YELLOW (slow blink):	Flow validation inhibit (normal boundaries)
•	YELLOW (double blink):	Flow validation inhibit (setup boundaries)

#### 2. A latched two color LED to indicate card INOP Status. LED color indications are:

GREEN:	Operating Normal
• RED (steady):	Current INOP (self-test fault)
• RED (slow blink):	Previous INOP, cleared, but not reset (Initial power-up or previous self-test fault) *
• RED (fast blink):	Flow validation fault
	Previous Flow validation fault *
• OFF:	No power to card

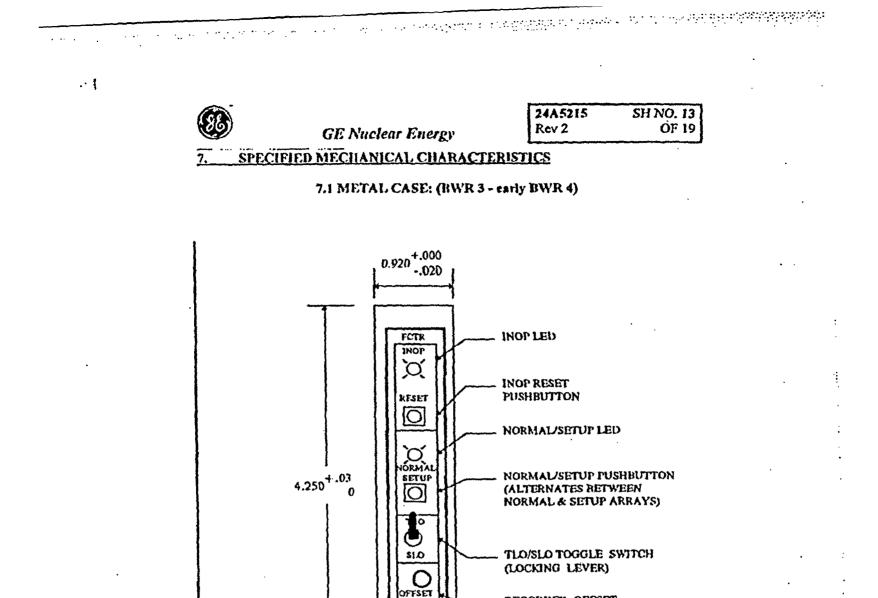
Previous INOP or flow validation fault is reported and reset in the order of occurrence.

Non-latched

² If an INOP occurs (RED) and then clears automatically, this indication will be latched REDblinking) which indicates normal operation but with a past INOP. This can be reset by the INOP Reset pushbutton.

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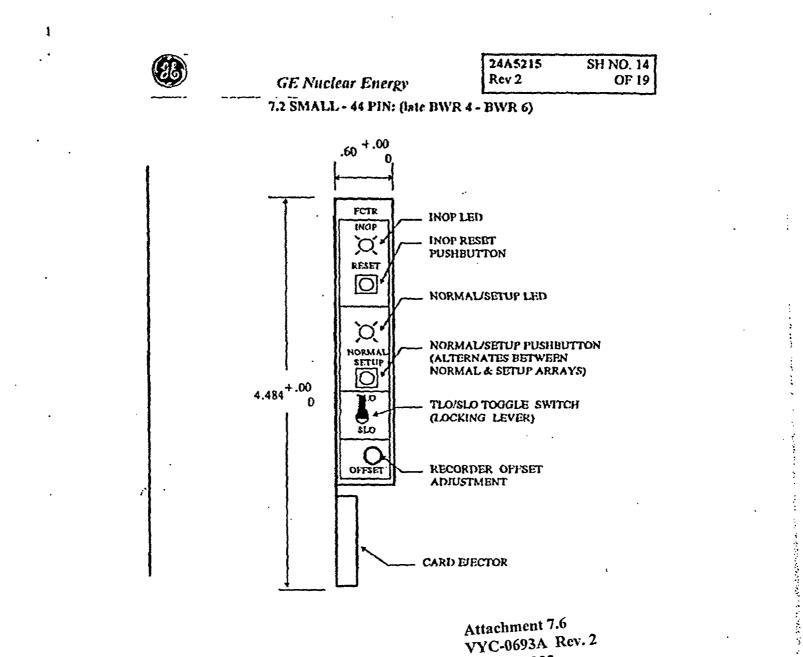
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RECORDER OFFSET ADJUSTMENT

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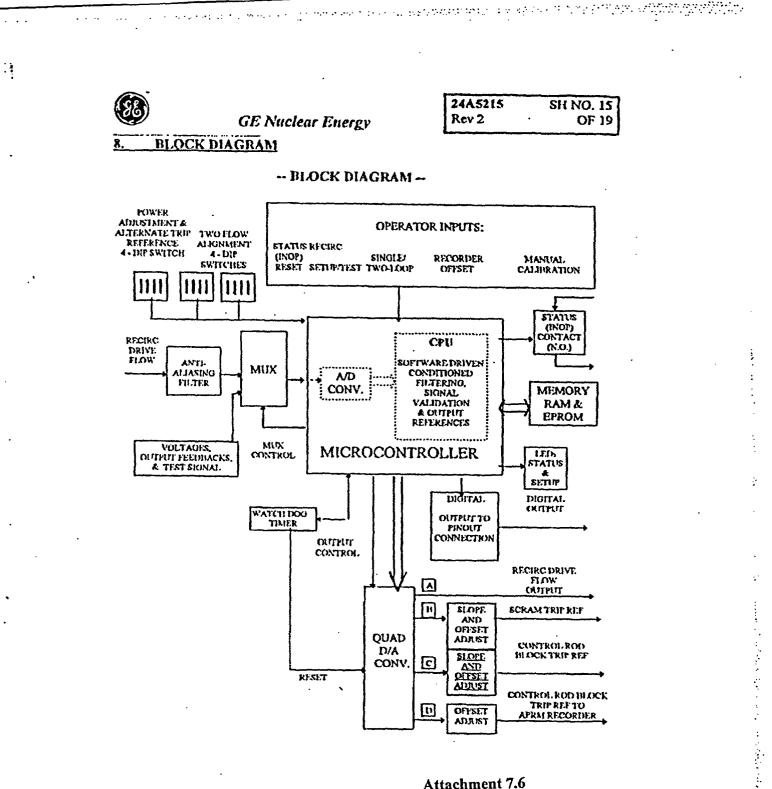
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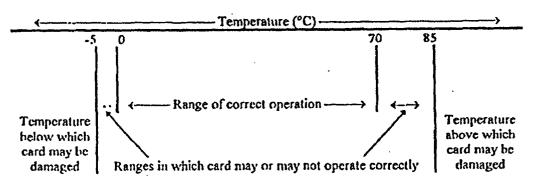
#### 9. SPECIFIED OPERATING ENVIRONMENT

The FLOW CONTROL TRIP REFERENCE CARD will not adversely affect or be affected by the operation of any other components or equipment operating within the same environment.

#### 9.1 TEMPERATURE AND HUMIDITY LIMITATIONS

This card will perform all specified functions correctly when operated within the specified temperature range illustrated in Figure 9-1 and the, specified relative humidity range illustrated in Figure 9-2 (Applicable Standard 2.2 c).

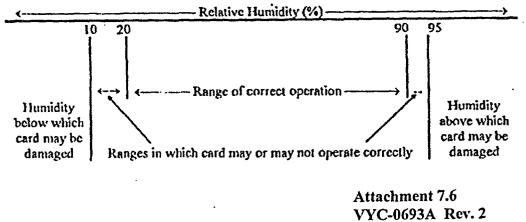
Figure 9-1, Temperature Limitations



 $(0 °C < T_8 < 70 °C)$ 

#### Figure 9-2, Humidity Limitations

(20% < Rel Humidity < 90%)



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#### 9.2 ELECTROMAGNETIC INTERFERENCE

The FCTR card is qualified for electromagnetic compatibility (EMC) by type testing and analysis. The EMC testing performed eliminates the need for utilities to perform in-plant electromagnetic environment surveys in accordance with EPRI guidelines (Reference 7).

#### 9.2.1 SUSCEPTIBILITY

The FCTR card is mounted within the existing cabinets of the NMS and derives power from NMS power supplies. Therefore, power and signal conducted noise immunity are not significantly affected by the replacement or addition of these cards. The existing power supply immunity to conducted noise and power surges remains unchanged. Thus, the only EMC susceptibility tests performed on the FCTR card are:

- Electrostatic Discharge (ESD) IEC-801-2
- Simulated Lightning Strike Conducted Immunity Test (using pulse measurements provided by Entergy Operations, Inc.)
- Radiated Electric Field Test (demonstrate that adequate margins exist for proper FCTR operation when installed into an existing NMS page under electromagnetic near-field emissions from adjacent cards)

#### 9.2.2 EMISSIONS

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The radiated emissions test confirm that the FCTR card has sufficiently low near-field emissions as to not affect the existing NMS pages. Similar to 9.2.1 above, there is no accepted test level for this application; therefore, it must be established as follows:

• Radiated Electric Field Test (demonstrate that adequate margins exist for adjacent cards to operate without electromagnetic near-field interference from the FCTR card installed into an existing NMS page)

#### 9.3 AMBIENT PRESSURE LIMITATIONS

This card will perform to specification for any absolute pressure in the range of 13 psi to 16 psi.

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**4** RADIATION EXPOSURE LIMITATIONS

#### 9.4.1 DOSE RATE

The card will perform to specification over its design life in a gamma field of 3 mR/hr or less.

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#### 9.4.2 TOTAL DOSE

This card will perform to specification over its service life for a total integrated gamma dose of  $1 \times 10^3$  Rads.

#### 9.5 SEISMIC DISTURBANCE LIMITATIONS

The FCTR Card will be qualified based on applicable areas described in IEEE 344-1975 (Applicable Standard 2.2-d). The APRM page environment will be established through analysis, and it will be determined that the addition of the FCTR into the APRM page will not significantly degrade existing system performance when subjected to seismic events. Documentation will show that qualified tests and levels (or analysis) cover APRM page environment for this application.

#### 10. SAFETY PRECAUTIONS

#### 10.1 PERSONNEL SAFETY

<u>FLECTRICAL</u>

No voltage greater than 28 volts  $\pm$  tolerance (for Status INOP contact) is present on this card. This card may be removed under power without danger.

#### MECHANICAL

No moving parts will cause personal danger.

#### • <u>THERMAL</u>

None; no high temperatures are present on this card.

RADIQLOGICAL

None- no radioactive materials are incorporated into this card.

#### <u>CHEMICAL</u>

None - no corrosive or toxic substances are incorporated into this card,

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11.1 AUTOMATIC SELF-TEST

An automatic self-test feature will be used on this card. This feature will automatically test at least once per minute. If an error or occurs an INOP will be initiated.

- A known internal reference is used, with its outputs, Scram & Control Rod Block Trip References, internally checked against the expected outputs to verify correct system operation.
- The voltages; power, logic. & reference are monitored to verify they are within tolerance.
- The CPU monitors power failures to ensure fail-safe operation.
- Watch dog supervisory circuit is used to ensure correct software operation, cycle timing and logic power failure.
- Voltages from the DAC are fed back through the ADC to ensure correct hardware conversion operation
- Self-lest diagnostic testing ensures correct DAC operation and sets its output to "0" if the signal is not updated (frozen).

#### 11.2 MANUAL SURVEILLANCE/CALIBRATION

Manual surveillance will be required at least every 36 months. This will consist of inputting an existing externally known simulated recirc drive flow signal to verify correct system operation.

Test points are provided for measuring the power voltages (+5 VDC, +15 VDC & -15 VDC) and the system clock (16 MHz).

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Constraint and Advances

#### 9.2.2 EMISSIONS

Again, there is no accepted test level for this application, therefore, it must be established. The test levels for emissions for the APRM page will be established by the following:

- Qualify new FCTR CARD per emission test at derived susceptibility qualification level above
- Document how qualified tests and levels cover APRM page environment for this application

#### **9.3 AMBIENT PRESSURE LIMITATIONS**

This card will perform to specification for any absolute pressure in the range of 13 psi to 16 psi.

#### 9.4 RADIATION EXPOSURE LIMITATIONS

#### 9.4.1 DOSE RATE

This card will perform to specification over its service life in a gamma field of 1x10E-5 rads /sec or less.

#### 9.4.2 TOTAL DOSE

This card will perform to specification over its service life for a total integrated gamma dose of 1x10E4 rads.

#### 9.5 SEISMIC DISTURBANCE LIMITATIONS

The FCTR Card will be qualified based on applicable areas described in IEEE 344-1975 (Applicable Standard 2.2 d). The APRM page environment will be established through analysis, and it will be determined that the addition of the new FCTR into the APRM page will not significantly degrade existing system performance when subjected to seismic events. Documentation will show that qualified tests and levels (or analysis) cover APRM page environment for this application.

> Attachment 7.6 VYC-0693A Rev. 2 Page 20 of 23



GE Nuclear Energy PROPRIETARY

سريس مرام الجالات معمدي بالتعري

Sheet 21 of 22	
Rev 1	
24A5215	

#### **10. SAFETY PRECAUTIONS**

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#### **10.1 PERSONNEL SAFETY**

<u>ELECTRICAL</u>
 No voltage greater than 28 volts ± tolerance (for Status/INOP contact) is present on this card. This card may be removed under power without danger.

11-1

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- <u>MECHANICAL</u> No moving parts will cause personal danger.
- <u>THERMAL</u> None; no high temperatures are present on this card.
- <u>RADIOLOGICAL</u> None; no radioactive materials are incorporated into this card.
- <u>CHEMICAL</u> Nonc; no corrosive or toxic substances are incorporated into this card.

#### **<u>11. TEST REQUIREMENTS</u>**

1

#### 11.1 AUTOMATIC SELF-TEST

An automatic self-test feature will be used on this card. This feature will automatically test at least once per minute. If an error occurs an INOP will be initiated.

- A known internal reference is used, with its outputs, Scram & Alarm References, internally checked against the expected outputs to verify correct system operation.
- The voltages; power, logic & reference are monitored to verify they are within tolerance.
- The CPU monitors power failures to ensure fail-safe operation.
  - Watch dog supervisory circuit is used to ensure correct software operation, cycle timing and logic power failure.

Attachment 7.6 VYC-0693A Rev. 2 Page 21 of 23 .



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#### 11.1 AUTOMATIC SELF-TEST (con't)

- Voltages from the DAC are fedback through the ADC to ensure correct hardware conversion operation.
- Self-test diagnostic testing ensures correct DAC operation and sets its output to "0" if the signal is not updated (frozen).

#### 11.2 MANUAL SURVEILLANCE / CALIBRATION

Manual surveillance will be required at least every 36 months. This will consist of inputting an existing externally known simulated recirc drive flow signal to verify correct system operation.

Test points are provided for measuring the power voltages (+5 VDC, +15 VDC & -15 VDC) and the system clock (16 MHz).

Attachment 7.6 VYC-0693A Rev. 2 Page 22 of 23

Attachment 7.6 VYC-0693A Rev. 2 Page 23 of 23

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#### FCTR Accuracy & Drift

The 148C6411 Digital FCTR card (schematic 105E1374) has an analog front-end consisting of an analog mux (233A3701 based on the ADG516A), quad op amp (233A3709 based on the AD713), and 10-bit A/D (2-bit precision within the 233A3692P001 microcontroller based on the 80C517A). The major contributor to accuracy over the calibrated range of Drive Flow (0 to 10V) is the resolution of the microcontroller's A/D. This provides 844 counts or  $\pm$  0.47% resolution with the 2-bit precision. The analog mux, input op amps, and precision feedback resistors provide  $\pm$  0.12% accuracy. This yields (SRSS) an accuracy of  $\pm$  0.5% (all analog front-end components). The Digital FCTR performs all other operations digitally and therefore has no accuracy errors after the A/D and D/A conversions. The analog outputs of the FCTR are calibrated during the system-level calibration which includes the Quad Trip card and other components of the flow loop. In addition, the accuracy error introduced from the output 12-bit D/A converters is negligible when compared with other FCTR components. Therefore, the Digital FCTR card provides an accuracy of  $\pm$  0.5%.

The temperature drift effects are not shown above because the FCTR application provides stable temperature operation. However, the combined effects of accuracy and temperature drift (over the rated 0-70°C range of operation) are better than  $\pm$  1%.

Steve Sawyer GE Electronics & Technology

stur D Sau 11/24/2003

Leonid Sheikman GE Electronics & Technology

11/24/2003

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#### VERMONT YANKEE SETPOINT CONTROL PROGRAM INTERDEPARTMENTAL REVIEW OF CALCULATION:

VYC-<u>693A</u> Revision <u>2</u> has been prepared and independently reviewed. The Departments impacted by this calculation are requested to review the results of this calculation, concur with the results and/or recommendations, and document the department's acceptance prior to the calculation being approved.

1. <u>Summary</u>: This calculation evaluates the uncertainty & setpoint for the APRM/RBM Neutron Monitoring Trip Loops.

2. <u>Calculation Open Items:</u>

AP-0028 to be Assigned

NA

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2.1. None

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- <u>Department Review</u> contact the Setpoint Program Manager (Joe Garozzo) if not in agreement with the conclusions/statements.
   3.1. Vermont Yankee I&C
  - 3.1.a. Procedure <u>OP-4308</u> will require the following:
    - 1. Add the following in the procedure discussion:

Allowable Values:			
Allowable Values			
Output Instrument	% RxP	mV	Curve % RxP
APRM A, B, C, D, E, F Scram Trips			
ARTS/MELLLA Flow Biased			
APRM High Flux Scram (Two Loop Ops)			
Core Flow 0 to $\leq$ 31.1 % (point based on 25% flow)	71.1	5.6880	< 0.4W+61.10%
Core Flow 31.1 to $\leq$ 54.0 % (point based on 50 % flow)	97.31	7.7848	<1.28W+33.31%
Core Flow 54.0 to $\leq$ 75 % (point based on 70% flow)	113.48	9.0784	< 0.66W+67.28%
Core Flow > 75%	116.96	9.3568	N/A
APRM High Flux Scram (Single Loop Ops)			
Core Flow 0 to $\leq$ 39.1 % (point based on 25% flow)	68.09	5.4472	< 0.4W+58.09%
Core Flow 39.1 to $\leq 61.9$ % (point based on 50% flow)	87.56	7.0048	<1.28W+23.56%
Core Flow 61.9 to ≤83.0 % (point based on 70% flow)	108.3	8.6640	<0.66W+62.10%
Core Flow > 83.0%	116.96	9.3568	N/A
EPU Flow Biased			
APRM High Flux Scram (Two Loop Ops)			
Core Flow 0 to ≤30.9 % (point based on 25% flow)	58.7	4.6960	< 0.33W+50.45%
Core Flow 30.9 to $\leq 66.7$ % (point based on 50% flow)	80.73	6.4584	<1.07W+27.23%
Core Flow 66.7 to ≤99.0 % (point based on 75% flow)	103.59	8.2872	<0.55W+62.34%
Core Flow > 99.0%	116.96	9.3568	N/A
APRM High Flux Scram (Single Loop Ops)			
Core Flow 0 to ≤39.1 % (point based on 25% flow)	56.25	4.5000	<0.33W+48.00%
Core Flow 39.1 to ≤61.7 % (point based on 50% flow)	72.51	5.8008	<1.07W+19.01%
Core Flow 61.7 to ≤119.4 % (point based on 75% flow)	92.47	7.3976	<0.55W+51.22%
Core Flow > 119.4%	116.96	9.3568	N/A

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#### a. As-Left and As-Found values:

Calibration Points, As-Left and As-Found					
Output Instrument	-	1	As-Left Max	VYDC As-Found Min	VYDC As-Found Max
APRM A, B, C, D, E, F Scram Trips					
ARTS/MELLLA Flow Biased					
APRM High Flux Scram (Two Loop Ops)					
Core Flow 0 to $\leq$ 31.1 % (point based on 25% flow)	5.5880	5.538	5.638	5.488	5.688
Core Flow 31.1 to $\leq$ 54.0 % (point based on 50 % flow)	7.6848	7.635	7.735	7.585	7.785
Core Flow 54.0 to ≤75 % (point based on 70% flow)	8.9784	8.928	9.028	8.878	9.078
Core Flow > 75%	9.2568	9.207	9.307	9.157	9.357
APRM High Flux Scram (Single Loop Ops)	1	]			1
Core Flow 0 to ≤39.1 % (point based on 25% flow)	5.3472	5.297	5.397	5.247	5.447
Core Flow 39.1 to $\leq 61.9$ % (point based on 50% flow)	6.9048	6.855	6.955	6.805	7.005
Core Flow 61.9 to <83.0 % (point based on 70% flow)	8.5640	8.514	8.614	8.464	8.664
Core Flow > 83.0%	9.2568	9.207	9.307	9.157	9.357
EPU Flow Biased					
APRM High Flux Scram (Two Loop Ops)					
ow 0 to ≤30.9 % (point based on 25% flow)	4.5960	4.546	4.646	4.496	4.696
Core Flow 30.9 to $\leq 66.7$ % (point based on 50% flow)	6.3584	6.308	6.408	6.258	6.458
Core Flow 66.7 to ≤99.0 % (point based on 75% flow)	8.1872	8.137	8.237	8.087	8.28
Core Flow > 99.0%	9.2568	9.207	9.307	9.157	9.35
APRM High Flux Scram (Single Loop Ops)					
Core Flow 0 to ≤39.1 % (point based on 25% flow)	4.4000	4.350	4.450	4.300	4.50
Core Flow 39.1 to $\leq 61.7$ % (point based on 50% flow)	5.7008	5.651	5.751	5.601	5.80
Core Flow 61.7 to ≤119.4 % (point based on 75% flow)	7.2976	7.248	7.348	7.198	7.39
Core Flow > 119.4%	9.2568			9.157	1

Note: Adjustment of the As Left Calibration Tolerance in the conservative direction is acceptable

- c. Revise Head to reflect: NA
- d. Insert the following M&TE requirements: DMM's with total device error of better than ±0.05% CS (10 VDC Range) HP 3466A or the HP 34401A are acceptable devices to support this accuracy Requirements. VYC-1758
- 2. In the body of the procedure and the data sheet revise as follows:

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b. Trip Setpoint:

Limiting Setpoints and Calibration Cardinal Points			
Output Instrument	% RxP	mV	Curve % RxP
APRM A, B, C, D, E, F Scram Trips			
ARTS/MELLLA Flow Biased			
APRM High Flux Scram (Two Loop Ops)			
Core Flow 0 to $\leq$ 31.1 % (point based on 25% flow)	69.85	5.5880	< 0.4W+59.85%
Core Flow 31.1 to ≤54.0 % (point based on 50 % flow)	96.06	<u>+</u>	< 1.28W+32.06%
Core Flow 54.0 to ≤75 % (point based on 70% flow)	112.23	8.9784	< 0.66W+66.03%
Core Flow > 75%	115.71	9.2568	N/A
APRM High Flux Scram (Single Loop Ops)			
Core Flow 0 to ≤39.1 % (point based on 25% flow)	66.84	5.3472	< 0.4W+56.84%
Core Flow 39.1 to $\leq 61.9$ % (point based on 50% flow)	86.31	6.9048	<1.28W+22.31%
Core Flow 61.9 to ≤83.0 % (point based on 70% flow)	107.05	8.5640	< 0.66W+60.85%
Core Flow > 83.0%	115.71	9.2568	N/A
EPU Flow Biased			
APRM High Flux Scram (Two Loop Ops)			
Core Flow 0 to $\leq$ 30.9 % (point based on 25% flow)	57.45	4.5960	< 0.33W+49.20%
Core Flow 30.9 to $\leq 66.7$ % (point based on 50% flow)	79.48	6.3584	<1.07W+25.98%
Core Flow 66.7 to $\leq$ 99.0 % (point based on 75% flow)	102.34	8.1872	< 0.55W+61.09%
Core Flow > 99.0%	115.71	9.2568	N/A.
APRM High Flux Scram (Single Loop Ops)			
Core Flow 0 to $\leq$ 39.1 % (point based on 25% flow)	55	4.4000	< 0.33W+46.75%
Core Flow 39.1 to $\leq 61.7$ % (point based on 50% flow)	71.26	5.7008	<1.07W+17.76%
Core Flow 61.7 to $\leq$ 119.4 % (point based on 75% flow)	91.22	7.2976	<0.55W+49.97%
Core Flow > 119.4%	115.71	9.2568	N/A

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- c. Revise calibration data to reflect head correction of: NA
- d. Insert a 9-point calibration for all analog instruments: NA for Neutron Monitoring
- 3.1.b. The following comments/recommendations apply:
  - 1. Change Setpoints as identified above,

Vermont Yankee I&C Representative Sign & Date * Exact Data points may be adjusted. Final to lerance may require recombination / change, based on Field performance.

Concur

Page 3 of 10

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#### VERMONT YANKEE SETPOINT CONTROL PROGRAM INTERDEPARTMENTAL REVIEW OF CALCULATION:

VYC-<u>693A</u> Revision <u>2</u> has been prepared and independently reviewed. The Departments impacted by this calculation are requested to review the results of this calculation, concur with the results and/or recommendations, and document the department's acceptance prior to the calculation being approved.

1. <u>Summary</u>: This calculation evaluates the uncertainty & setpoint for the APRM/RBM Neutron Monitoring Trip Loops.

2. <u>Calculation Open Items:</u>

AP-0028 to be Assigned

<u>NA</u>

2.1. None

3. <u>Department Review</u> - contact the Setpoint Program Manager (Joe Garozzo) if not in agreement with the conclusions/statements.

#### 3.2. Vermont Yankee Reactor Engineering

#### 3.2.a. None

1. Improved Technical Specifications

improved recimical specifications	
Analytical Limits	
APRM High Flux Scram (Two Loop Ops)	
Core Flow 0 to $\leq$ 31.1 %	< 0.4W+64.4%
Core Flow 31.1 to $\leq$ 54.0 %	<1.28W+37.0%
Core Flow 54.0 to $\leq$ 75 %	< 0.66W+70.5%
Core Flow > 75%	Maximum of 120%
APRM High Flux Scram (Single Loop Ops)	
Core Flow 0 to $\leq$ 39.1 %	<0.4W+61.2%
Core Flow 39.1 to $\leq 61.9$ %	<1.28W+26.8%
Core Flow 61.9 to $\le 83.0$ %	<0.66W+65.2%
Core Flow >83%	Maximum of 120%
APRM High Flux Scram (Two Loop Ops)	
Core Flow 0 to $\leq$ 30.9 %	<0.33W+53.7%
Core Flow 30.9 to $\leq 66.7$ %	<1.07W+30.8%
Core Flow 66.7 to $\leq$ 99 %	<0.55W+65.5%
Core Flow > 99%	Maximum of 120%
APRM High Flux Scram (Single Loop Ops)	
Core Flow 0 to $\leq$ 39.1 %	<0.33W+51.1%
Core Flow 39.1 to $\leq 61.7$ %	<1.07W+22.2%
Core Flow 61.7 to $\leq$ 119.4 %	<0.55W+54.3%
Core Flow >119.4	Maximum of 120%

Concur O VERIFY SLO Value @ CF 39.1 0 4 61.7 (21.07W+22.290 of 26.880) ()22.270 PHIL PC-263 3 correct CTP limit. (159 TO IGIZ ; LPSP from 20% TO LASP. OWORDING REVISED JY 12/1/03

Sign & Date <u>Bob Vita</u> <u>V1+-</u> <u>12-1-03</u> Vermont Yankee RE Representative

## Attachment 7.7 Vermont Yankee Setpoint Control Program Interdepartmental Review of Calculation VYC-0693A_Revision 2

## VERMONT YANKEE SETPOINT CONTROL PROGRAM INTERDEPARTMENTAL REVIEW OF CALCULATION:

VYC- <u>693A</u> Revision <u>2</u> has been prepared and independently reviewed. The Departments impacted by this calculation are requested to review the results of this calculation, concur with the results and/or recommendations, and document the department's acceptance prior to the calculation being approved.

1. <u>Summary</u>: This calculation evaluates the uncertainty & setpoint for the APRM/RBM Neutron Monitoring Trip Loops.

2. Calculation Open Items:

AP-0028 to be Assigned

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2.1. None

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3. <u>Department Review</u> - contact the Setpoint Program Manager (Joe Garozzo) if not in agreement with the conclusions/statements.

**3.3. Vermont Yankee Operations** 

3.3.a. Recalibrate APRMs, LPRMs etc after seismic event Sign & Date <u>Source J. Control 1000/2003</u> Vermont Yankee Operations Representative

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NA

Page 5 of 10

## Attachment 7.7 Vermont Yankee Setpoint Control Program Interdepartmental Review of Calculation VYC-0693A_Revision 2

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## VERMONT YANKEE SETPOINT CONTROL PROGRAM INTERDEPARTMENTAL REVIEW OF CALCULATION:

VYC- <u>693A</u> Revision <u>2</u> has been prepared and independently reviewed. The Departments impacted by this calculation are requested to review the results of this calculation, concur with the results and/or recommendations, and document the department's acceptance prior to the calculation being approved.

1. <u>Summary</u>: This calculation evaluates the uncertainty & setpoint for the APRM/RBM Neutron Monitoring Trip Loops.

2.	Calculation Open Items:		AP-0028 to be Assigned
		·	
	2.1. None		<u>NA</u>

3. <u>Department Review</u> - contact the Setpoint Program Manager (Joe Garozzo) if not in agreement with the conclusions/statements.

3.4. Vei	rmont Yankee Systems Manager		
		Concur	Comments
3.4.a.	This analysis supports the design bases for the	F	NONE
	APRM/RBM Neutron Monitoring Trip System	—	
	$\bigcirc$		
<b>6</b>			
Sign &	Date / 12-1-2003 Vermont Yankee System Engineering Representative		
	Vernight Tankee System Engineering Representative		
	$\bigcirc$		

Page 6 of 10

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Attachment 7.7 Vermont Yankee Setpoint Control Program Interdepartmental Review of Calculation VYC-0693A_Revision 2

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 Comments:
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 None
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Page 7 of 10

Calculation Number:	<u>VYC-693A</u>	Revision	Number:	2_CCN	Number <u>:N/A</u>	_Attachment	л. <b>ў</b>	PAGE	8	0F11
					ER RESOURC	E USE	5412/1/	03		

CALCULATION NO .:	VYC-0693A	<b>REVISION NO.:</b>	2	CCN No.: N/A

Computer Used (include manufacturer, CPU Type, and operating system version and level): Dell Dimension 8200 Pentium 4 2.4 MHz; Windows XP Professional version 5.1 service pack 1 Microsoft Excel version 2002 Service Pack 2._

Computer Input Attached*? 🗌 Yes 🖾 No

Location/Identifier:_____

Computer Output Attached*? 🗌 Yes 🖾 No

Location/Identifier:_____

* Large volume input/output should be provided on CD. See Appendix E for format requirements.

List the computer codes used, and complete the following:

	Approv PP 7			riateness ified	Outstanding SPR or Code Errors ¹		
Code Name/Version and/or Script File	Yes ³	No	Yes	No	Yes ²	No	
Calculation Detail and Charts (Attachments B1 through B4) Microsoft Excel Version 2002 SR 2		✓ 	✓			✓	

¹ Software Problem Report (SPR), does not exist as a reporting method in PP 7800 and AP 6030. Contact the Code sponsor and review any outstanding SPRs or Code errors. [ER2000805]

² If yes, fill out information below.

³ If yes, include the Code name on the Computer Code line of the title page, VYAPF 0017.01.

If a computer code was not verified in accordance with PP 7800 and AP 6030, or if there are outstanding SPRs, state below why it is appropriate.

Code Name/Script File	Appropriateness
Calculation Detail and Charts (Attachments B1 through B4) Microsoft Excel Version 2002 SR 2	Appropriateness was verified through hand calculation

	<u> </u>
VY CALCUL	
	mber: 2 CCN Number: N/A
Title: <u>APRM/RBM Neutron Monitoring Trip Loops</u>	
Reviewer Assigned: <u>Kirk Melson</u> Requ	ired Date:
□ INTERDISCIPLINE REVIEW ☑ INDEPENDENT REVIE	EW
¢OMMENTS*	RESOLUTION
<ol> <li>Excel Sheets - For TLU terms, the inputs to the equation are mixed with some being listed in terms of a decimal value and labeled as percent of span, and others formatted as percent of span. Need to express input terms the same.</li> <li>Excel Sheets - For TLU terms, the inputs to the equation are</li> </ol>	1. Made all input terms in values which format to percent of span. 2. Changed input values to percent of Reactor Power.
mixed, in that some terms are actually in percent of span, and others are in percent Reactor Power. Need input terms to be consistent. 3. Either remove flow noise as a PMA term or provide specific reference. 4. Calibration tolerances for Fixed Hi Scram and Reduced Fixed Scram are different than for Flow Bias. Please revise, based on. procedure.	3. All uncertainties for flow are covered by VYC-690. Removed flow noise as an uncertainty parameter with PMA. 4. Corrected Cal Tolerances, based on OP-4308 and OP-43108.
	dded Tables 8 and 9.
Qualification Testing	Calculation Preparer (Comments Resolved)       Date         Kulfp R. melon       /_09/21/03_         Reviewer Signature (Comments Resolved)       Date         gestions unless suggesting wording to ensure the correct interpretation of issues.

VYAPF 0017.04 (Sample) AP 0017 Rev. 8, LPC 2 Page 1 of 1

Calculation Number: <u>VYC-693A</u> Revision Number <u>: 2</u> CCN N	umber: N/A_Attachment 7.8				
	$\frac{\mathcal{J}\mathcal{L}}{\mathcal{J}\mathcal{L}^{03}} = \frac{\mathcal{J}\mathcal{L}}{\mathcal{J}\mathcal{L}^{03}} \text{ of } \frac{\mathcal{J}\mathcal{L}}{\mathcal{L}^{0}}$				
VY CALCULA	ATION REVIEW FORM				
Calculation Number: VYC-693A Revision Num	ber: 2 CCN Number:N/A				
Title:APRM/RBM Neutron Monitoring Trip Loops					
Reviewer Assigned: Kirk Melson	Required Date:				
	N				
COMMENTS*	RESOLUTION				
6. Correct Flow Break Points for ARTS/MELLLA Single Loop Ops	6. Corrected.				
in Table 3 of Word document. 7. Change AL from 13.5 to 15 in spreadsheets. 8. Correct cross references in Cells A25, A26, and E16 to reflect 9. LPRM drift term is extrapolated from 700 hours to 1250 hours, which is no longer necessary. Please remove the extrapolation. 10. Remove APRM Avg Circuit and LPRM items from testing error.					
11. Remove Scientific notations in the spreadsheets. 12. Remove all equations, values for other than Method 1.	11. Corrected formatting to decimal. 12. Removed.				
13. Set Cal Effect equal to Accuracy, as it is larger than CT.	13. Set equal to accuracy term.				
14. Biases are negative, and the negative error is to be used for AV.	14. Showed bias in negative uncert comp and changed to use neg for AV.				
Kukly R. Melen / 09/21/03 Reviewer Signature Date	Calculation Preparer (Comments Resolved) Date				
Method of Review: 🗵 Calculation/Analysis Review					
<ul> <li>Alternative Calculation</li> <li>Qualification Testing</li> <li>*Comments shall be specific, not general. Do not list questions or sugged Questions should be asked of the preparer directly.</li> </ul>	Kickly R. melon       /_09/21/03_         Reviewer Signature (Comments Resolved)       Date         estions unless suggesting wording to ensure the correct interpretation of issues.				

VYAPF 0017.04 (Sample) AP 0017 Rev. 8 LPC 2 Page 1 of 1

Docket No. 50-271 BVY 03-115

Attachment 3

Vermont Yankee Nuclear Power Station

Technical Specification Proposed Change No. 257

Discussion of Changes for Revised Technical Specifications



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## DISCUSSION OF CHANGES TO REVISED TECHNICAL SPECIFICATIONS

### TS 2.1.A.1.a (current page 6)

The heading of this section is changed from "APRM Flux Scram Trip Setting (Run Mode)" to "APRM Flux Scram Allowable Value (Run Mode)."

The Standard Technical Specifications nomenclature of "Allowable Value" is adopted for this trip function of the reactor protection system. This change is made to clarify that the specification is an Allowable Value that corresponds to the limiting value that the instrument may have for operability. This change is made to draw a distinction from other TS that may specify trip settings that differ from the definition of an Allowable Value. This change is acceptable because it represents the appropriate operability limitation for the parameter (Neutron Flux Trip Settings).

## TS 2.1.A.1.a (current page 6)

The specification for this limiting safety system setting is changed from "When the mode switch is in the RUN position, the APRM flux scram trip setting shall be as shown on Figure 2.1.1 and shall be:  $S \le 0.66(W-\Delta W)+54\%$ " to "When the mode switch is in the RUN position, the APRM flux scram Allowable Value shall be:

<u>Two loop op</u>	eration:								
S≤	0.4 W	+	61.10%	for	0%	< W ≤	31.1%		
S≤	1.28 W	+	33.31%	for	31.1%	< W <u>&lt;</u>	54.0%		
S≤	0.66 W	+	67.28%	for	54.0%	< W ≤	75.0%		
	with a ma	xim	um of 117.	0% pov	wer for W	′ > 75.0%			
Single loop	operation:								
S≤	0.4 W	+	58.09%	for	0%	< W ≤	39.1%		
S <u>≤</u>	1.28 W	+	23.56%	for	39.1%	< W ≤	61.9%		
S≤	0.66 W	+	62.10%	for	61.9%	< W ≤	83.0%		
with a maximum of 117.0% power for W > 83.0%"									

The change in the neutron flux trip setting algorithm is supported by the ARTS/MELLLA analysis provided as part of Proposed Change No. 257. The deletion of reference to TS Figure 2.1.1 is discussed below.

## <u>TS Figure 2.1.1</u> (current page 11)

TS Figure 2.1.1 does not provide any requirement not included in the stated algorithms for this function. Because the figure is redundant, it can be eliminated from TS without any change in technical requirements. In addition, elimination of this figure is consistent with Standard Technical Specifications.

## TS Table 3.1.1 (current page 21)

Trip function no. 4, "APRM (APRM A-F) High Flux (flow bias)," is changed consistent with the algorithm change described above for TS 2.1.A.1.a. The algorithm specified in the "Trip Settings" column is changed to the Allowable Value algorithms resulting from the adoption of ARTS/MELLLA. In addition, Footnote (4) to Table 3.1.1 is changed to add a clarifying statement: "The specified APRM High Flux scram (flow bias) Trip Setting is an Allowable Value, which is the limiting value that the trip setpoint may have when tested periodically. The actual scram trip setting is conservatively set in relation to the Allowable Value." The change is made to emphasize that the specification is an Allowable Value that corresponds to the limiting value trip setpoint that the instrument have for operability. This change is made to draw a distinction from other TS that may specify trip settings that differ from the definition of an Allowable Value.

In addition, Footnote (4) is also modified to eliminate the statement: " $\Delta W$  is the difference between the two loop and single loop drive flow at the same core flow. This difference must be accounted for during single loop operation.  $\Delta W = 0$  for two recirculation loop operation." This statement can be eliminated because separate algorithm specifications are now provided for two loop and single recirculation loop operation, and the term " $\Delta W$ " has been eliminated from TS.

## Bases Changes

The TS Bases provide explanation and rationale for associated TS requirements, and in some cases, how they are to be implemented. Associated changes to the TS Bases are being made to conform to the changed TS and to add clarity to existing requirements. Bases do not establish actual requirements, and as such do not change technical requirements of the TS. The Bases changes are therefore acceptable, since they administratively document the reasons and provide additional understanding for the associated TS requirements.

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Docket No. 50-271 BVY 03-115

# Attachment 4

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Vermont Yankee Nuclear Power Station

Technical Specification Proposed Change No. 257

Replacement Mark-Ups of the Current Technical Specifications

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- 1.1 SAFETY LIMIT
- 1.1 FUEL CLADDING INTEGRITY

#### Applicability:

Applies to the interrelated variable associated with fuel thermal behavior.

#### **Objective:**

To establish limits below which the integrity of the fuel cladding is preserved.

### Specification:

A. Bundle Safety Limit (Reactor Pressure >800 psia and Core Flow >10% of Rated)

When the reactor pressure is >800 psia and the core flow is greater than 10% of rated:

 A Minimum Critical Power Ratio (MCPR) of less than
 1.10 (1.12 for Single Loop Operation) shall constitute violation of the Fuel Cladding Integrity Safety Limit (FCISL).

**Allowable Value** 

<INSERT #1>

2.1 LIMITING SAFETY SYSTEM SETTING

#### 2.1 FUEL CLADDING INTEGRITY

#### Applicability:

Applies to trip setting of the instruments and devices which are provided to prevent the nuclear system safety limits from being exceeded.

#### **Objective:**

To define the level of the process variable at which automatic protective action is initiated.

#### Specification:

### A. Trip Settings

The limiting safety system trip settings shall be as specified below:

1. <u>Neutron Flux Trip Settings</u>

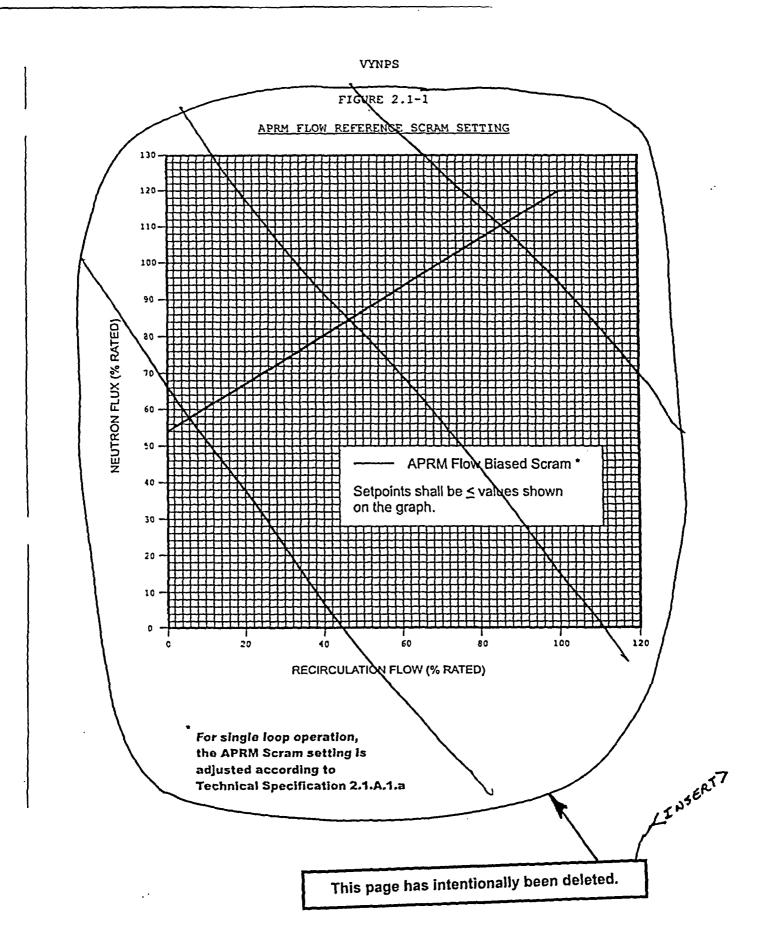
a. APRM Flux Scram (Trip)

When the mode switch is in the RUN position, the APRM flux scram trip setting shall be as shown on Figure 2.1.1 apd shall be:

## Sc0.66 (W- 4W) + 548

#### where:

- S = setting in
   percent of
   rated thermal
   power
   (1593 MWt)
- W = percent rated two loop drive flow where 100% rated drive flow is that flow equivalent to 48 x 10⁶ lbs/hr core flow



BASES:

- 2.1 FUEL CLADDING INTEGRITY
  - A. <u>Trip Settings</u>

setting

<INSERT #2>

<INSERT #3>

The bases for individual trip settings are discussed in the following paragraphs.

**Allowable Value** 

- 1. <u>Neutron Flux Trip Settings</u>
  - a. APRM Flux Scram Trip-Setting (Run Mode)

The average power range monitoring (APRM) system, which is calibrated using heat balance data taken during steady state conditions, reads in percent of rated thermal power (1593 MWt). Because fission chambers provide the basic input signals, the APRM system responds directly to average neutron flux. During transients, the instantaneous rate of heat transfer from the fuel (reactor thermal power) is less than the instantaneous neutron flux due to the time constant of the fuel. Therefore, during abnormal operational transients, the thermal power of the fuel will be less than that Indicated by the neutron flux at the scram setting. Analyses are performed to demonstrate that the APRM flux scram over the range of settings from a maximum of 120% to the minimum flow biased extpoint of 540 provide protection from the fuel safety limit for all abnormal operational transients including those that may result in a thermal hydraulic instability.

An increase in the APRM scram trip setting would decrease the margin present before the fuel cladding integrity Safety Limit is reached. The APRM scram trip setting was determined by an analysis of margins required to provide a reasonable range for maneuvering during operation. Reducing this operating margin would increase the frequency of spurious scrams which have an adverse effect on reactor safety because of the resulting thermal stresses. Thus, the APRM scram trip setting was selected because it provides adequate margin for the fuel cladding integrity Safety Limit yet allows operating margin that reduces the possibility of unnecessary scrams.

APRM-Flux Scram Trip Setting (Run Hode)

The scram trip setting must be adjusted to ensure that the LHGR transient peak is not increased for any combination of MFLPD and reactor core thermal power. If the scram requires a change due to an abnormal peaking condition, it will be accomplished by increasing the APRM gain by the ratio in Specification 2.1.A.1.a, thus assuring a reactor scram at lower than design overpower conditions. For single recirculation loop operation, the APRM flux scram trip setting is reduced in accordance with the analysis presented in NEDO-30060, February 1983. This adjustment accounts for the difference between the single loop and two loop drive flow at the same core flow, and ensures that the margin of safety is not reduced during single loop operation.

Analyses of the limiting transients show that no scram adjustment is required to assure fuel cladding integrity when the transient is initiated from the operating limit MCPR defined in the Core Operating Limits Report.

Amendment No. 18, 25, 39, 47, 61, 94, 116, 146

<INSERT #4>

#### TABLE 3.1.1

## REACTOR PROTECTION SYSTEM (SCRAM) INSTRUMENT REQUIREMENTS

	•			hich Functions • Operating	Must	Minimum Number Operating Instrument Channels Per	Required ACTIONS When Minimum Conditions For Operation Are Not
	Trip Function	Trip Settings	<u>Refuel (1)</u>	<u>Startup (12)</u>	Run	Trip System (2)	Satisfied (3)
1.	Mode Switch in Shutdown (5A-S1)		x	x	x	1	A
2. 3.	Manual Scram (5A-S3A/B) IRM (7-41(A-F))		x	x	x	1	A
	High Flux INOP	<u>&lt;</u> 120/125	x x	x x		2 2	A A
4.	APRM (APRM A-F)						
	High Flux (flow bias)	$<0.66$ (W- $\Delta$ W)+54% with a maximum of 120% (4)		SERT #5>	x	2	A or B
	High Flux (reduced) INOP	<u>&lt;</u> 15%	<b>x</b>	x x	x	2 2 (5)	A A or B
5.	High Reactor Pressure (PT-2-3-55(A-D)(M))	<u>&lt;</u> 1055 psig	x	x	x	2	А
6.	High Drywell Pressure (PT-5-12(A-D)(M))	<u>&lt;</u> 2.5 psig	x	x	x	2	Α
7.	Reactor Low (6) Water Level (LT-2-3-57A/B(M)) (LT-2-3-58A/B(M))	<u>&gt;</u> 127.0 inches	x	x	x	2	<b>A</b> .
8.	Scram Discharge Volume High Level (LT-3-231(A-H)(M))	<pre>&lt;21 gallons</pre>	x	x	<b>X</b>	2 (per volume)	A

Amendment No. 21, 44, 64, 68, 76, 78, 79, 90, 94, 164, 186, 187

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TABLE 3.1.1 NOTES (Cont'd)

3. When the requirements in the column "Minimum Number of Operating Instrument Channels Per Trip System" cannot be met for one system, that system shall be tripped. If the requirements cannot be met for both trip systems, the appropriate ACTIONS listed below shall be taken:

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<insertion of operable rods and complete insertion of all
</pre>
sble rods within four hours.

- ...uuce power level to IRM range and place mode switch in the "Startup/Hot Standby" position within eight hours.
- c) Reduce turbine load and close main steam line isolation valves within 8 hours.
- d) Reduce reactor power to less than 30% of rated within 8 hours.
- 4. "W" is percent rated two loop drive flow where 100% rated drive flow is that flow equivalent to 48 x 10⁶ lbs/hr core flow.  $\Delta W$  is the difference between the two loop and single loop drive flow at the same core flow. This difference must be accounted for during single loop operation  $\Delta W = 0$  for two recirculation loop operation.
- 5. To be considered operable an APRM must have at least 2 LPRM inputs per level and at least a total of 13 LPRM inputs, except that channels A, C, D, and F may lose all LPRM inputs from the companion APRM Cabinet plus one additional LPRM input and still be considered operable.
- 6. The top of the enriched fuel has been designated as 0 inches and provides common reference level for all vessel water level instrumentation.
- 7. Deleted.
- 8. Deleted.
- 9. Channel signals for the turbine control valve fast closure trip shall be derived from the same event or events which cause the control valve fast closure.
- 10. Turbine stop valve closure and turbine control valve fast closure scram signals may be bypassed at <30% of reactor Rated Thermal Power.
- 11. Not used.
- 12. While performing refuel interlock checks which require the mode switch to be in Startup, the reduced APRM high flux scram need not be operable provided:
  - a. The following trip functions are operable:
    - 1. Mode switch in shutdown,
    - 2. Manual scram,
    - 3. High flux IRM scram
    - 4. High flux SRM scram in noncoincidence,
    - 5. Scram discharge volume high water level, and;
  - b. No more than two (2) control rods withdrawn. The two (2) control rods that can be withdrawn cannot be face adjacent or diagonally adjacent.

## INSERT #1

<u>Two loop o</u>	peration:									
S <u>&lt;</u>		+	61.10%	for	0%	< W ≤	31.1%			
S ≤	1.28 W	+	33.31%	for	31.1%	< W ≤	54.0%			
S≤	0.66 W	+	67.28%	for	54.0%	< W ≤	75.0%			
with a maximum of 117.0% power for $W > 75.0\%$										
Single loop	operation:									
S≤	0.4 W	+	58.09%	for	0%	< W ≤	39.1%			
S≤	1.28 W	+	23.56%	for	39.1%	<₩≤	61.9%			

# $S \le 0.66 W + 62.10\%$ for $61.9\% < W \le 83.0\%$ with a maximum of 117.0% power for W > 83.0%

### INSERT #2

The relationship between recirculation drive flow and reactor core flow is non-linear at low core flows. Due to stability concerns, separate APRM flow biased scram trip setting equations are provided for low core flows.

## **INSERT #3**

The APRM flow biased flux scram Allowable Value is the limiting value that the trip setpoint may have when tested periodically, beyond which appropriate action shall be taken. For Vermont Yankee, the periodic testing is defined as the calibration. The actual scram trip is conservatively set in relation to the Allowable Value to ensure operability between periodic testing.

### **INSERT #4**

The single loop operation equations are based on a bounding (maximum) difference between two loop and single loop drive flow at the same core flow of 8%.

# INSERT #5

Two loop operation: (4)									
S ≤	0.4 W	+	61.10%	for	0%	< W ≤	31.1%		
S <u>&lt;</u>	1.28 W	+	33.31%	for	31.1%	< W ≤	54.0%		
s≤	0.66 W	+	67.28%	for	54.0%	< W ≤	75.0%		
-	with a ma	xim	um of 117.	0% pov	wer for W	> 75.0%			
				•					
Single loop o	operation:	<u>(4)</u>							
S ≤	0.4 W	+	58.09%	for	0%	< W ≤	39.1%		
S <u>≤</u>	1.28 W	+	23.56%	for	39.1%	< W ≤	61.9%		
S≤	0.66 W	+	62.10%	for	61.9%	< W ≤	83.0%		
with a maximum of 117.0% power for W > 83.0%									

## INSERT #6

The specified APRM High Flux scram (flow bias) Trip Setting is an Allowable Value, which is the limiting value that the trip setpoint may have when tested periodically. The actual scram trip setting is conservatively set in relation to the Allowable Value.

Docket No. 50-271 BVY 03-115

Attachment 5

Vermont Yankee Nuclear Power Station

Technical Specification Proposed Change No. 257

Replacement Re-typed Technical Specifications Pages

- 1.1 SAFETY LIMIT
- 1.1 FUEL CLADDING INTEGRITY

#### Applicability:

Applies to the interrelated variable associated with fuel thermal behavior.

#### **Objective:**

To establish limits below which the integrity of the fuel cladding is preserved.

#### Specification:

- A. Bundle Safety Limit (Reactor Pressure >800 psia and Core Flow >10% of Rated)
- When the reactor pressure is >800 psia and the core flow is greater than 10% of rated:
  - A Minimum Critical Power Ratio (MCPR) of less than 1.10 (1.12 for Single Loop Operation) shall constitute violation of the Fuel Cladding Integrity Safety Limit (FCISL).

2.1 LIMITING SAFETY SYSTEM SETTING

#### 2.1 FUEL CLADDING INTEGRITY

### Applicability:

Applies to trip setting of the instruments and devices which are provided to prevent the nuclear system safety limits from being exceeded.

#### **Objective:**

To define the level of the process variable at which automatic protective action is initiated.

#### Specification:

A. Trip Settings

The limiting safety system trip settings shall be as specified below:

- 1. Neutron Flux Trip Settings
  - a. <u>APRM Flux Scram</u> <u>Allowable Value</u> (Run Mode)

When the mode switch is in the RUN position, the APRM flux scram Allowable Value shall be:

Two loop operation:

 $S \le 0.4W + 61.10$  for 0 <  $W \le 31.1$  $S \le 1.28W + 33.31$  for 31.1 <  $W \le 54.0$  $S \le 0.66W + 67.28$  for 54.0 <  $W \le 75.0$ With a maximum of 117.0 power for W > 75.0

```
Single loop operation:
```

 $S \le 0.4W + 58.09$  for 0 <  $W \le 39.1$  $S \le 1.28W + 23.56$  for 39.1 <  $W \le 61.9$  $S \le 0.66W + 62.10$  for 61.9 <  $W \le 83.0$ With a maximum of 117.0 power for W >83.0

where:

S = setting in percent of rated thermal power (1593 MWt) L

# This page has intentionally been deleted.

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#### BASES:

#### 2.1 FUEL CLADDING INTEGRITY

A. Trip Settings

The bases for individual trip settings are discussed in the following paragraphs.

1. Neutron Flux Trip Settings

#### a. APRM Flux Scram Allowable Value (Run Mode)

The average power range monitoring (APRM) system, which is calibrated using heat balance data taken during steady state conditions, reads in percent of rated thermal power (1593 MWt). Because fission chambers provide the basic input signals, the APRM system responds directly to average neutron flux. During transients, the instantaneous rate of heat transfer from the fuel (reactor thermal power) is less than the instantaneous neutron flux due to the time constant of the fuel. Therefore, during abnormal operational transients, the thermal power of the fuel will be less than that indicated by the neutron flux at the scram setting. Analyses are performed to demonstrate that the APRM flux scram over the range of settings from a maximum of 120% to the minimum flow biased setting provide protection from the fuel safety limit for all abnormal operational transients including those that may result in a thermal hydraulic instability.

An increase in the APRM scram trip setting would decrease the margin present before the fuel cladding integrity Safety Limit is reached. The APRM scram trip setting was determined by an analysis of margins required to provide a reasonable range for maneuvering during operation. Reducing this operating margin would increase the frequency of spurious scrams which have an adverse effect on reactor safety because of the resulting thermal stresses. Thus, the APRM scram trip setting was selected because it provides adequate margin for the fuel cladding integrity Safety Limit yet allows operating margin that reduces the possibility of unnecessary scrams. The relationship between recirculation drive flow and reactor core flow is non-linear at low core flows. Due to stability concerns, separate APRM flow biased scram trip setting equations are provided for low core flows.

The APRM flow biased flux scram Allowable Value is the limiting value that the trip setpoint may have when tested periodically, beyond which appropriate action shall be taken. For Vermont Yankee, the periodic testing is defined as the calibration. The actual scram trip is conservatively set in relation to the Allowable Value to ensure operability between periodic testing. For single recirculation loop operation, the APRM flux scram trip setting is reduced in accordance with the analysis presented in NEDO-30060, February 1983. This adjustment accounts for the difference between the single loop and two loop drive flow at the same core flow, and ensures that the margin of safety is not reduced during single loop operation. The single loop

## BASES: 2.1 (Cont'd)

operation equations are based on a bounding (maximum) difference between two loop and single loop drive flow at the same core flow of 8%.

Analyses of the limiting transients show that no scram adjustment is required to assure fuel cladding integrity when the transient is initiated from the operating limit MCPR defined in the Core Operating Limits Report.

#### TABLE 3.1.1

#### REACTOR PROTECTION SYSTEM (SCRAM) INSTRUMENT REQUIREMENTS

			Modes in Which Functions Must be Operating			Minimum Number Operating Instrument Channels Per	Required ACTIONS When Minimum Conditions For Operation
	Trip Function	Trip Settings	<u>Refuel (1)</u>	Startup(12)	Run	Trip System (2)	Are Not Satisfied (3)
1.	Mode Switch in Shutdown (5A-S1)		x	x	x	1	A
2.	Manual Scram (5A-S3A/B)		x	x	х	1	A
з.	IRM (7-41(A-F))						
	High Flux	<u>&lt;120/125</u>	x	x		2	A
	INOP		x	x		2	Α
4.	APRM (APRM A-F)						
	High Flux (flow bias)	Two loop operation: (4) $S \le 0.4W$ + $61.10$ % for $0$ % $< W \le 31.1$ % $S \le 1.28W$ + $33.31$ % for $31.1$ % $< W \le 54.0$ % $S \le 0.66W$ + $67.28$ % for $54.0$ % $< W \le 75.0$ %With a maximum of 117.0% powerfor W > 75.0%			x	2	A or B
		Single loop operation: (4) $S \le 0.4W + 58.09$ for $0 \le W \le 39.1 \le 55$ $S \le 1.28W + 23.56 \le for 39.1 \le W \le 61.9 \le 55$ $S \le 0.66W + 62.10 \le for 61.9 \le W \le 83.0 \le 53.0 \le$					
	High Flux (reduced)	<u>&lt;</u> 15 <b>†</b>	x	x		2	А
	INOP			x	x	2(5)	A or B
5.	High Reactor Pressure (PT-2-3-55(A-D) (M)	<u>&lt;</u> 1055 psig	x	x	x	2	A

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#### TABLE 3.1.1 NOTES (Cont'd)

- 3. When the requirements in the column "Minimum Number of Operating Instrument Channels Per Trip System" cannot be met for one system, that system shall be tripped. If the requirements cannot be met for both trip systems, the appropriate ACTIONS listed below shall be taken:
  - a) Initiate insertion of operable rods and complete insertion of all operable rods within four hours.
  - b) Reduce power level to IRM range and place mode switch in the "Startup/Hot Standby" position within eight hours.
  - c) Reduce turbine load and close main steam line isolation valves within 8 hours.
  - d) Reduce reactor power to less than 30% of rated within 8 hours.
- 4. The specified APRM High Flux scram (flow bias) Trip Setting is an Allowable Value, which is the limiting value that the trip setpoint may have when tested periodically. The actual scram trip setting is conservatively set in relation to the Allowable Value. "W" is percent rated two loop drive flow where 100% rated drive flow is that flow equivalent to 48 x 10⁶ lbs/hr core flow.
- 5. To be considered operable an APRM must have at least 2 LPRM inputs per level and at least a total of 13 LPRM inputs, except that channels A, C, D, and F may lose all LPRM inputs from the companion APRM Cabinet plus one additional LPRM input and still be considered operable.
- 6. The top of the enriched fuel has been designated as 0 inches and provides common reference level for all vessel water level instrumentation.
- 7. Deleted.
- 8. Deleted.
- 9. Channel signals for the turbine control valve fast closure trip shall be derived from the same event or events which cause the control valve fast closure.
- 10. Turbine stop valve closure and turbine control valve fast closure scram signals may be bypassed at <30% of reactor Rated Thermal Power.
- 11. Not used.
- 12. While performing refuel interlock checks which require the mode switch to be in Startup, the reduced APRM high flux scram need not be operable provided:
  - a. The following trip functions are operable:
    - 1. Mode switch in shutdown,
    - 2. Manual scram,
    - 3. High flux IRM scram
    - 4. High flux SRM scram in noncoincidence,
    - 5. Scram discharge volume high water level, and;
  - b. No more than two (2) control rods withdrawn. The two (2) control rods that can be withdrawn cannot be face adjacent or diagonally adjacent.

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