FORM 101.3 (R08-04)

CERTIFICATION OF ENGINEERING CALCULATION - REVISION LOG

Station And Unit Number Oconee Nuclear Station Unit 1

Title Of Calculation RPS & ESFAS System Functional Description for AREVA TELEPERM XS

Calculation Number OSC-8623

Active Calculation / Analysis Yes ■ No □

	Calculation Pages (Vol)			Supporting Documentation (Vol)			Volumes		Orig	Chkd	Verif. Meth.	Appr[1]	Issue Date
Rev. No.	Revised	Deleted	Added	Revised	Deleted	Added	Delete	Added	Date	Date	1, 2, 3, "Other"	Date	Rec'd Date
9	N/A	ix,1	ix,1	NA	NA	NA	NA	NA	GEW	KRB	1	GDG	X
		209	210	NA	NA	NA	NA	NA	10-14-8	10-14-8		10-14-8	X
9	Owner's review and			Acceptance per EM			4.13.....		.....	.....	.....	KDW 10-20-8	DWH 10/22 sah 10/27
10	N/A	ix,1	ix,1	NA	NA	NA	NA	NA	GEW	KLB	1	CRB	X
		210	210	NA	NA	NA	NA	NA	12-17-8	12-17-8		12-17-8	X
10	Owner's review and			Acceptance per EM			4.13.....		.....	.....	.....	KDW 12-18-8	DWH 12-29-8 sah 1-9-9
11	NA	ix,	ix,	NA	NA	NA	NA	NA	KRM	GEW	1	GDG	X
		1-210	1-209	NA	NA	NA	NA	NA	2-28-9	2-28-09		3/2/09	X
11	Owner's review and			Acceptance per EM			4.13.....		.....	.....	.....	KDW 3/9/09	

AREVA NP Inc.
an AREVA and Siemens company

32-5061401-012

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Station And Unit Number Oconee Nuclear Station Unit 1

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Active Calculation / Analysis Yes ■ No ☐

	Calculation Pages (Vol)			Supporting Documentation (Vol)			Volumes		Orig	Chkd	Verif. Meth.	Appr[1]	Issue Date
Rev. No.	Revised	Deleted	Added	Revised	Deleted	Added	Delete	Added	Date	Date	1, 2, 3, "Other"	Date	Rec'd Date
5	N/A	i, 1 - 197	vi, 1 - 199	NA NA	NA NA	NA NA	NA NA	NA NA	JRM 6-4-7	JNK 6-4-7	1	EJS 6-4-7	x x
5	Owner's review and			Acceptance per EM			4.13.....		...	.....	....	MHM 6-5-07	DWH 6-5-7
6	N/A	1 199	vii,1 209	NA NA	NA NA	NA NA	NA NA	NA NA	GEW 5-28-8	CBD 6-2-8	1	GDG 6-2-8	X X
6	Owner's review and			Acceptance per EM			4.13.....		.....	(per telecon	by PNF)	KDW 6-5-8	DWH/ SAH 7-8-8
7	N/A	1 209	Viii, 1 209	NA NA	NA NA	NA NA	NA NA	NA NA	GEW 9-11-8	KFB 9-17-8	1	GDG 9-18-8	X X
7	Owner's review and			Acceptance per EM			4.13.....		.....	.....	.....	KDW 9-18-8	DWH/ SAH 9-23-8 9-25-8
8	N/A	ix,1 209	ix,1 209	NA NA	NA NA	NA NA	NA NA	NA NA	GEW 9-25-8	KRB 10-1-8	1	GDG 10-1-8	X X
8	Owner's review and			Acceptance per EM			4.13.....		.....	(per email	by PNF)	KDW 10-1-8	DWH/ SAH 10-2-8 10-6-8
9	(see next page)												

Note 1: When approving a Calculation revision with multiple Originators or Checkers, the Approver need sign only one block.

FIGURE 101-3 CERTIFICATION OF ENGINEERING CALCULATION - REVISION LOG

FIGURE 101 3 CERTIFICATION OF ENGINEERING CALCULATION - REVISION LOG

CERTIFICATION OF ENGINEERING CALCULATION · REVISION LOG

Station And Unit Number: Oconee Nuclear Station Unit 1

Title Of Calculation: RPS & ESFAS System Functional Description

Calculation Number: OSC-8623

Active Calculation/Analysis ☑ YES ☐ NO

Rev. No.	Calculation Pages (Vol) Revised	Calculation Pages (Vol) Deleted	Calculation Pages (Vol) Added	Supporting Documentation (Vol) Revised	Supporting Documentation (Vol) Deleted	Supporting Documentation (Vol) Added	Volumes Deleted	Volumes Added	ORIG Date	CHKD Date	Verif. Meth. 1,2,3, "Other"	Appr Date	Issue Date / Rec'd Date
1	n/a	1-196	ii, 1-11, 96-147, 170-187						EJS 7/14/05	EHB 7/14/05	1	R. E. Berry	D.W. Holmes 11/1/2005
		n/a	12-95, 148-169, 188-200		n/a			n/a	MDM 7/14/05	EHB 7/14/05	1		↓
		n/a	201-205						JNK 7/14/05	EHB 7/14/05	1	PB 7-14-05	↓
1	Owner's Review per EM 4.13								—	—	→	KDillard 11/1/05	ags 11/1/05
2	n/a	1-205	iii, 1-209		n/a			n/a	EJS 11/1/05	JNK 11/2/05	1	PB 11-2-05	D.W. Holmes 11/02/05
—	—	—	—	—	—	—	—	—	MDM 11/1/05	JNK 11/2/05	1	↓	↓
2	Owner's Review per EM 4.13								—	—	→	KDillard 11/7/05	ags 11/16/05
3	N/A	1-209	iv, 1-199		N/A			N/A	MDM 12/2/05	EJS 12/2/05	1	[signature] 12-2-05	D.W. Holmes 2/15/06; ags 12/20/06
3	Owner's Review per EM 4.13								—	—	—		KDillard 12/12/05
4	N/A	1-199	v, 1-197		N/A			N/A	JNK 6/15/06	EJS 6/15/06	1	PB 6/15/06	D.W. Holmes 6/21/06; DEG 6/22/06
4	Owner's Review per ~~EDM~~ EM 4.13								—	—	—	KDillard 4/19/06	↓
~~5~~	~~N/A~~	~~1-198~~	~~vi, 1-198~~		~~N/A~~			~~N/A~~	~~JRM 2/15/07~~	~~JNK 2/15/07~~	~~1~~	~~EJS 2/20/07~~	—
~~5~~	~~N/A~~	~~1-197~~	~~vi, 1-198~~		~~N/A~~			~~N/A~~	~~JRM 4/4/07~~	~~JNK 4/4/07~~	~~1~~	~~EJS 4/4/07~~	—
—	See cont. sheet ejs 5/31/07												

ejs * 4/4/07

ejs ** 5/3/07

NOTE 1: When approving a Calculation revision with multiple Originators or Checkers, the Approver need sign only one block.

* Document revision pulled back to incorporate additional information prior to owners approval. EJS 5/31/07

** Document revision pulled back to incorporate owners review comments prior to owners approval. EJS 5/31/07

Form 101.1 (R08-04)

CERTIFICATION OF ENGINEERING CALCULATION

Station And Unit Number ONS Unit 1

Title Of Calculation RPS & ESFAS System Functional Description

Calculation Number OSC-8623

Total Original Pages i, 1 Through 196

Total Supporting Documentation Attachments N/A Total Microfiche Attachments N/A

Total Volumes 1 Active Calculation/Analysis Yes ☑ No ☐

Microfiche Attachment List ☐ Yes ☑ No (See Form 101.4) If Active, is this a Type I Calculation/Analysis Yes ☐ No ☑

These engineering Calculations cover QA Condition 1 Items. In accordance with established procedures, the quality has been assured and I certify that the above Calculation has been Originated, Checked, or Approved as noted below:

Originated By John M Kurth Date 2-23-05

Checked By M. David Mustian Date 2/28/05

Verification Method: Method 1 ☒ Method 2 ☐ Method 3 ☐ Other ☐

Approved By R.S. Bondurant +/by PETE BERRY per telecon/ EMAIL DATED 3/9/05 AR Date 3/9/05

Issued To Document Management Deborah K. Hodges Date 4/14/2005

Received By Document Management Sheila Henderson Date 4/17/2005

Complete The Spaces Below For Documentation Of Multiple Originators Or Checkers

Pages 95 Through 196

Originated By John M Kurth Date 2-23-05

Checked By M. David Mustian Date 2/28/05

Verification Method: Method 1 ☒ Method 2 ☐ Method 3 ☐ Other ☐

Pages 26 ¢ 88 Through 61 ¢ 94

Originated By /CHAS P. CHARTIER Date 2-28-05

Checked By M. David Mustian Date 2/28/05

Verification Method: Method 1 ☒ Method 2 ☐ Method 3 ☐ Other ☐

Pages 1 ¢ 62 Through 25 ¢ 87

Originated By M. David Mustian Date 2/28/05

Checked By /CHAS P. CHARTIER C.B. Munns/C.B. MUNNS* Date 2-28-05

Verification Method: Method 1 ☒ Method 2 ☐ Method 3 ☐ Other ☐

*Sections I and II only

See Continuation Sheet for Additional Reviewers

Figure 101-1 Certification Of Engineering Calculation

Continuation for Additional Reviewers

OSC-8623 Rev 0

CDI Review : Doug Rabke 1/3/8/05
ESFAS System Engineer Date

CDI Review : L. Cameron 1/3/08/2005
RPS System Engineer Date

CDI Review : M.E. Henshaw via telecon 1/3/8/05
NGO Safety Analysis Date

CDI Review : M.K. Miller / K.D. Wood 13-9-05 / 3-9-05
Refurb Engineering Date

CALCULATION IMPACT ASSESSMENT (CIA)

Station / Unit Oconee / 1 Calculation No. OSC-8623 Rev. 11 Page ix

PIP No. (if applicable) N/A By Kirk Melson Date 2/28/2009

Prob. No. (stress & s/r use only) N/A Checked By [signature] Date 2-28-09

NEDL reviewed to identify calculations? (formally SAROS) ☑ **YES** ☐ **NO**

Identify in the blocks below, the groups consulted for an Impact Assessment of this calculation origination/revision.

	Indiv. Contacted/Date		Indiv. Contacted/Date
☑ RES (Power, I&C, ERRT, Reactor)	Bob Cornett / 3-9-09 Jay Bryan / 3-9-09	☐ NGO (QA Tech. Services (ISI), Severe Accident Analysis,Elect. Sys. & Equip., Design & Reactor Supp., Civil Structural, Core Mech. & T/H Analysis, Mech. Sys. & Equip., Nuclear Design and Safety Analysis, Matls/Metallurgy/Piping)	
☐ MCE (Primary Systems, Balance of Plant, Rotating Equipment, Valves & Heat Exchangers, Civil)			
☐ MOD (Mechanical Engr., Electrical Engr., Civil Engr.)		☐ Training	
☐ Operations - OPS Support		☐ Local IT	
☐ Maintenance - Tech. Support		☐ Regulatory Compliance	
☐ Work Control - Program. Supp.		☐ Chemistry	
☑ Other Group	OMP / Kevin Ward / 3-9-09 OMP / Jay Bryan / 3-9-09	☐ Radiation Protection	
		☐ **No Group required to be consulted**	

Listed below are the identified documents (ex: TECHNICAL SPECIFICATION SECTIONS, UFSAR SECTIONS, DESIGN BASIS DOCUMENTS, STATION PROCEDURES*, DRAWINGS, OTHER CALCULATIONS, ETC.) that may require revision as a result of the calculation origination or revision, the document owner/group and the change required (including any necesssary PIP Corrective Actions).
***Note: Any design changes, which require changes to Station Procedures, must be transmitted as Design Deliverable Documents.**

DOCUMENT	GROUP	CHANGE REQUIRED
See DAL for EC 0000090423	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
See DAL for EC 0000090482	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-8695	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-8856	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-8857	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-8825	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-8125	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-2820	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-8828	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-2759	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-8108	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.
OSC-7549	RPS/ESFAS/OMP	No additional changes outside OMP required at this time.

REVISION DOCUMENTATION SHEET

Revision Number	Revision Description
0	Initial Issue of Calculation.
1	General - Editorial and formatting corrections thought the document are not marked with revision bars. All existing pages have been deleted and re-issued as Rev 1 due to page number changes. General - Have changed "MSI" to "Service Unit" for making software changes. General - All OAC point descriptions have been revised to hard match PRODAC database description. For all digital points ensured that both the "RESET" and "SET" messages were included. General - Changed "Tag Number later" to "Tag Number TBD" to facilitate electronic searches. General - Removed current setpoints from discussion section of function. Section 1.5 - Changed table description to match parameter value for S/D Bypass setpoint. Section 1.10 - Clarified what NI range ICS needed. Section 1.11 - Clarified what NI range ICS needed. Section 2.1 - Deleted "fast." Section 2.5.1 - Added "...and associated alarms." Section 2.5.3 - Changed "RTDs" to "RTD." Section 2.8 - Corrected EDB tags and description to match. Section 3.1 - Completed sentence "Delta flux times the flux gain." With "...equals power imbalance." Section 3.4.2 - Clarified requirement. This is not intended to be an automatic function. Section 3.5 - Revised Proposed Algorithm and Trip Conditions to remove reference to 2.Max functions. Closed open item 29.14 for P_{AVG-A} and P_{AVG-B}. Added channel identifier to description for each gain factor. Changed units to N/A for each gain factor. Section 3.6.1 - Removed discussion of 2.Max function. Section 3.6.7 - Added section to discuss existing STAR system. Section 3.8 - Clarified that RC flow filtering can be done via either software or hardware. Section 4.1 - Added that inputs are shared with RPS function #6. Section 4.10 - "Input Signals" were incorrectly listed as "output signals." Section 4.11 - Clarified what RC pressure range the ICS needs. Section 6.6 - Removed 2.min from New Algorithm. Added "or equal to" to first sentence of discussion. Section 6.7.1 - Removed 2.min from discussion of new design features. Section 7.1 - Added that inputs are shared with RPS function #6. Section 7.7.2 - Added process signal IDs. Section 7.10 - Added reference to OSC-8695 for actual setpoints Section 8.7 - Clarified that second contact is an "open" contact to initiate a channel trip.

Revision Number	Revision Description
1 (cont.)	Section 9.7.1 - Flux in first sentence is not the 2.max value. Section 11.1 - Clarified wording. Section 12.1 - Deleted first sentence as it is not relevant to this function. Section 12.5 - Changed parameter range for second maximum of delta T to "calculated value." Section 12.6.1 - Added "...and associated alarms." Section 13.1.1.5 - Corrected ranges for NI equipment. Section 13.1.3 - Added new section for NI power supply monitoring requirements. Section 13.2.2 - Open item has been closed. Deleted reference. Section 13.3 - Revised requirement so that channel E alarms only to OAC. Section 13.5.1 - Revised wording of first two sentences for clarity. Section 13.10 - Added missing section for Manual Reactor Trip. Section 13.11 - Changed "class" to "classified." Section 13.11.2 - Added "Coolant" to header. Section 13.11.3 - Added missing section for RC Flow. Section 13.11.4 - Clarified what NI range ICS needed. Section 13.11.5 - Changed StatAlarm assignment for NI-9 Power Supply Failure from 1SA-55 to 1SA-54. Revised output ranges to ICS. Section 14.2 - Added unit to StatAlarm panel descriptor. Section 14.4.6 - Added new section to list existing S/D Bypass OAC points. Section 15.7 - The Reset value for $R_{SP\ PRESS}$ was changed from "Manual" to "Auto." Section 15.8.1 - Clarified difference between TXS Logic Channel and TXS Actuation Channel. Section 15.8.2 - Clarified how permissive state for HPI Bypass should be implemented. Section 15.8.3 - Add discussion of Concept of Operations for use of RESET function. Section 15.11 - Added information related to DLPIAS change order. Section 15.14 - Added DLPIAS pressure signals to output table. Section 15.15 - Revised order of Channel 2 devices to match equivalent device from Channel 1. Added ES actuated position for all devices to table. Section 15.16 - Added ES actuated position for all devices to table. Section 16.7 - The Reset value for $R_{SP\ PRESS}$ was changed from "Manual" to "Auto." Section 16.8.1 - Clarified difference between TXS Logic Channel and TXS Actuation Channel. Section 16.8.2 - Clarified how permissive state for LPI Bypass should be implemented. Section 16.8.3 - Add discussion of Concept of Operations for use of RESET function. Section 16.11 - Added reference to DLPIAS. Section 16.14 - Correct Ch 3 & 4 Manual pushbutton descriptions. Section 16.15 - Added ES actuated position for all devices to table. Section 16.16 - Added ES actuated position for all devices to table

Revision Number	Revision Description
1 (cont.)	Section 16.17 - Added existing OAC point 1OD1879. Section 17.7 - The Reset value for $R_{SP\ PRESS}$ was changed from "Manual" to "Auto." Section 17.8.2 - Add discussion of Concept of Operations for use of RESET function. Section 17.13 - Added "All" for consistence with similar sections. Section 17.15 - Added ES actuated position for all devices to table. Section 17.16 - Added ES actuated position for all devices to table. Section 18.8.1 - Added Concept of Operations for use of RESET function. Section 18.15 - Added ES actuated position for all devices to table. Section 18.16 - Added ES actuated position for all devices to table. Section 20.1, 20.2, and 20.3 - Revised layout (window descriptions) based on OPS feedback. Section 20.4 and 20.5 - Re-printed layout to remove graph lines. Section 20.6 - Added discussion of how Auto/Manual pushbuttons should work. Section 20.7 - Made change to Trip/Reset lens color based on humans factors review. Added reference to StatAlarm windows to be used with HPI and LPI Bypass per change order 2004-03 Section 20.8 - Removed reference to StatAlarm windows to be used with HPI and LPI Bypass and moved info to Section 20.7. Section 22 - Added requirement to REFLASH certain StatAlarm windows as shown in the tables. Added unit number to StatAlarm panel numbers were missing. Section 22.6 - Corrected existing descriptor for panel 1SA18. Section 23 - Minor wording changes through out section. Section 23.3 - Added note at beginning of section to describe how the S/D Bypass key switch will be used. Section 23.4.5 - Added table to list existing OAC points. Section 23.6.4 - Clarified that the intent is to annunciate the channel trip status and just not manual trip key switch position. Section 25.1 - Provided additional requirements on how to perform channel checks various cases. Section 25.2 - Clarified how test machine will interface with TXS. Section 25.3 - Revised wording for clarity. Section 25.4 - Renumbered section. Deleted note. Section 25.5 - Renumbered section. Added additional requirements to define OAC points. Section 25.6 - Added new section to define GSM screen requirements per change order 2005-08. Section 25.6.7.3 - Added table to list existing OAC points Section 25.7 - Added new section to define failure handling requirements. Section 26.2.1 - Corrected document ID. Section 27.1 - Added AREVA change orders. Section 27.8.8 - Corrected title of OP/1/A/6101/001.

Revision Number	Revision Description
1 (cont.)	Section 28.1 - Added AREVA change orders. Section 28.4 - Added FSAR Chapter 15 to references. Section 28.8 - Added calculation OSC-5064 to references. Section 29 - Updated status of open items. Section 30 - Added new section to define Diverse LPI Actuation System design.
2	Overview - Revised overview section to resolve software V&V open items O1.0225 and O1.0193. Added list of Acronyms and Definitions to front of document. General - editorial and formatting changes to improve readability and consistency of use of terms through document. General - replaced usage of the term "TXS logical channel" with "TXS instrument channel" to be consistent with usage of the terms in T/S submittal to resolve software V&V open item O1.0371. General – All Sections with parameter tables having a "Trip Reset" value, clarified that the automatic reset was a "trip comparator automatic reset." General – Sections 1 through 12 Design Features, added sentence that "Following a reactor trip, the reactor trip breakers must be reset by the Operator prior to restarting the unit." General – All sections regarding Setpoints for trip functions, revised or added clarification that "Actual in-plant setpoint derives from instrument uncertainty/setpoint calculations or other references...and may include additional margin." Deleted similar clarifications from the parameter tables. General – All sections with Process Parameters for New Algorithms, added clarification concerning adjustable parameters via the TXS Service Unit and that when an adjustable parameter can be entered from a GSM screen, the GSM screen shall enforce the range limits of the entered value. General - Deleted word "measured" from algorithms and tables when refereeing to the 2.min (2.max) values. General – Deleted "NNI" term from ICS/NNI signal destinations. General – Added note that "IN TEST" computer points may be provided by a summary Test Enable point with individual pseudo points being created at the OAC. Sections 1, 2, 3, 9, 10, and 11 Algorithms and Process Parameters Tables – revised to indicate that all six functions use the same signal to indicate reactor power (total neutron flux) and that total flux = upper flux + lower flux) x Gain (flux) (Gain set to 1.000). (Open Item O1.0208). Sections 1.5, 1.6.2, and 1.6.3 - Revised to clarify the definition and requirements for Normal High Flux Trip Setpoint, S/D Bypass High Flux Trip Setpoint and Variable High Flux Trip Setpoint as requested by software V&V open item O1.0192. Section 1.10 - Revised to clarify table to indicate that NI-5, 6, 7, & 8 control room indicator signals are from the summing amp to resolve software V&V open item O1.0196. Section 2: revised portions to clarify dTgain = %RTP/100% RTP/°F (ratio relating a fractional change in NI flux signal per 1 °F change in TCOLD). Revised the preliminary dTgain value to 0.007 as requested by Duke Safety Analysis. Clarified QmaxF description and slope terms to be consistent with Section 3 Flux/Flow/Imbalance. Section 2.7: Added time response requirement for the flow signal portion of rack, due to use

Revision Number	Revision Description
2 (cont.)	of QmaxF term in the algorithm which utilizes flow, after discussions with Duke Safety Analysis. Sections 2.9, 4.12, 7.12, 8.12, 12.10: Added back in the output tables the requirement that the process signal "IN TEST" OAC points be provided over the gateway. (Open Item O1.0197) Section 3: Section rewritten entirely to provide clarify parameter terms, add additional details, and delete unneeded breakpoints and slopes that were added for potential future use. Barn curve breakpoints and slopes now provided are the same as in the existing system. Updated the parameter values to use breakpoint and slope values in the current COLR (will require update for next fuel cycle prior to startup). Updated flow gain value to most recent data (will require update after startup from refueling). (Open Items O1.0198, O1.0199, O1.0200, O1.0201, O1.0202, O1.203, O1.204, O1.0261) Section 3.8: Added time response requirement for NI signal portion of function. Section 3.10: Added ranges for flow transmitters to table. Sections 4.6, 4.7.1 and 4.7.2 - Revised to clarify the definition and requirements for Normal High RCS Pressure Trip Setpoint and Shutdown/Bypass High RCS Pressure Trip Setpoint as requested by software V&V open item O1.0209. Section 6.6 – Clarified that Kvp and Po were constants (settable). For function 6 discussion, revised first sentence to better define requirement for when a reactor trip based on this function is expected. Section 8.7.1 - Revised to clarify intent as requested by software V&V open item O1.0212. Section 10.7.1 - Replaced "ϕm2.Max" with "ϕm" in the first sentence to address software V&V open item O1.0214. Section 11.14 - Added "(Info Only - located in RCP Pump Monitor Cabinet & not RPS) to OAC points O1D2412, O1D2413, O1D2414, O1D2415 to resolve software V&V identified open item O1.0357. Section 12.6 - Corrected the cold leg to use with channels C and D to match algorithm. Section 13.8 - Deleted "downstream of summer for total flux function." Section 15.1 - Corrected section to correctly describe the relationship between HPI actuation and RB High Pressure initiation logic as identified in project open item O1.0386. Section 15.5 - Corrected section to correctly describe the relationship between HPI actuation and RB High Pressure initiation logic as identified in project open item O1.0386. Section 15.8.2 - Section revised to address issues identified in software V&V open items O1.0216 and O1.0221. Added requirement that Bypass Removal logic should be based on 2.min value of the pressure from all three channels (O1.0221). Revised last sentence to correct error. The comparators are not reset but must be bypassed prior to resetting the actuation channel (O1.0216). Section 15.12 - Corrected existing StatAlarm description for windows 1SA7-6, -15, -24 to match as-built plant drawings. Correct description is "HP" not "HPI." This discrepancy was identified in software V&V open item O1.0224. Section 16.1 - Corrected section to correctly describe the relationship between LPI actuation and RB High Pressure initiation logic as identified in project open item O1.0386. Section 16.5 - Corrected section to correctly describe the relationship between LPI actuation and RB High Pressure initiation logic as identified in project open item O1.0386. Section 16.12 - Corrected existing StatAlarm description for windows 1SA7-7, -16, -25 to match as-built plant drawings. Correct description is "HP" not "HPI." This discrepancy was

Revision Number	Revision Description
2 (cont.)	identified in software V&V open item O1.0224. Section 16.8.2 - Section revised to address issues identified in software V&V open items O1.0216, O1.0228 and O1.0367. Added requirement that Bypass Removal logic should be based on 2.min value of the pressure from all three channels (O1.0228). Revised last sentence to correct errors. The comparators are not reset but must be bypassed prior to resetting the actuation channel (O1.0216). The parameter for bypass removal setpoint was not correctly identified (O1.0367). Section 17.5 - Corrected section to correctly describe the relationship between RB High Pressure and HPI and LPI actuation as identified in project open item O1.0386. Section 17.16 - revised table to correct error identified in software V&V open item O1.0373. Correct ES position for valves 1LP-21 and 1LP-24 is "FULL OPEN." Section 20.6 - Deleted Keowee from description of Load Shed function for consistency. Section 21.0 - Revised to clarify that it is the RO Relays that are re-energized on RESET as requested by software V&V open item O1.0234. Section 22.4 - Corrected new alarm contact input status for windows 1SA5-7, -19, -31, and -43. Section 22.5 - Corrected existing StatAlarm description for windows 1SA7-15, -16, -24, and -25 to match as-built plant drawings. Correct description is "HP" and "LP" not "HPI" and "LPI." This discrepancy was identified in software V&V open item O1.0224. Section 23.3.1 deleted sentence stating that the keys are removable in the OFF and ON positions, not a software functional requirement and a change order may make these non-removable. Section 23.4.2.2 clarified that the Manual Bypass switch faults the signals to the trip functions of the other channels. Section 23.6.3 clarified that no interlocks are allowed between channels. 25.5.9: Added new general requirement for OAC alarms for indication of maintenance bypasses (including test bypasses) per IEEE 608-1998 requirements. (requirement already addressed individually for most functions, this is general requirement). Section 27 - Corrected drawing titles for OEE-138-61, OEE-138-63, OEE-138-64, and OEE-158-10 to match the title block as show on the drawings. Section 27.2 & 28.8 added OSC-8695 to references. Section 28.2 added Core Operating Limits Report to references. Section 29.18 closed OPEN Item. Section 30.8 - Corrected StatAlarm assignment for DLPIAS to match window description in Section 22.2 and on design drawings.
3	Sections 2 and 12. Removal all information concerning Functions 2 and 12 from these sections. These future functions will not be implemented in the software program at initial issue of the software to Duke. These sections will remain reserved for future use. Revision also made to Sections 1.9, 1.10 to remove references to these sections. 15.8.3, 16.8.3, 17.8.2, 18.8.1 Trip/Reset functions: Deleted the requirement that the Trip pushbutton trip the associated channel via an input to the TXS channel logic (the requirement that the Trip pushbutton initiate a trip directly to the associated Channel output relays bypassing the TXS remains). This change was made as a result of the FMEA identifying a single failure issue of the binary input.

Revision Number	Revision Description
3 (cont.)	23.5.1 Clarified that only channels A, B, and C had ESFAS functions affected by the Change Enable switches on RPS. Deleted RPS Channel E from this section on Change Enable switches, Channel E Change Enable is already addressed separately in section 23.11. 25.1.3 Deleted reference to Tcold, this was part of RPS trip functions #2 and #12 which will not be implemented in software for this modification. 25.1.8 Deleted Tcold comparisons requirements, , this was part of RPS trip functions #2 and #12 which will not be implemented in software for this modification. 29.11 and 29.16, added note that RPS Trip Function #2 has been deleted from this functional description. 30.1 Provided further clarification that the DLPIAS Figure represents the proposed design concept and is not intended to represent the final design. 30.7 Corrected the range of the isolated RC pressure signal to DLPIAS (4-20mA, not 0-20mA). Corrected header information in multiple sections to correct formatting errors and for consistency. Deleted several references that were not used.
4	Various formatting and spelling typo's were corrected. Sections 1.4, 3.4, 4.4, 5.4, 6.4, 7.4, 8.4, 9.4, 10.4, 11.4, 15.6, 16.6, 17.6, 18.6 revised note for source of setpoints to read "Actual in-plant setpoints are listed in OSC-8695, Unit 1 Software Parameters for TXS Plant Protection System". Section 1.10, 4.11, 5.11, 6.10, 7.11, 8.11, 9.11, 10.11, 11.14, 15.12, 16.12, 17.12, 18.12 added the word EXISTING to the tables to agree with section 3.11. Section 1.10, added "via SNV1" to indicate the signals from the PRTM are buffered out to the ICS & indicators (non-safety) via the SNV1's. Section 1.11, replaced "Tag Number TBD" with the EDB tag numbers for the bipolar and high voltage, added EDB tag numbers for the linear amps & high voltage power supplies, revised "See also 13.1" to "See also 13.11". Section 3.2.1, deleted "difference amplifier" from first sentence. Section 3.4.4, replaced "allowable power" with "Allowable Thermal Power", since it is a defined term in the ONS Tech. Specs. Section 3.5, corrected note below table from "provided below" to "provided above". Section 11.14, corrected 4 computer point table entries to "To Be Deleted"; added 4 new computer point entries and noted as H/W (hard wired). Section 13.2.2, reworded section, requirement for banana plugs for testing has been deleted, GSM screen is used instead. Section 13.5.1, deleted the word "switch" and replaced with "existing plug connections". Section 13.11.4, revised EDB tag numbers for linear amps and power supplies. Section 15.14, revised item 1SA7-33 description to match table 22.5 description. Section 15.15, corrected item 1GWDVA0013(1FDW-108) to 1GWDVA0013 (1GWD-13). Section 16.14, revised item 1SA7-42 description to match table 22.5 description. Section 17.12, deleted annunciator window location from descriptor column. Section 19.3, deleted second "NOT OPEN" in descriptors for points O1D0126 & O1D0127.

Revision Number	Revision Description
4 (cont.)	Section 20.1, deleted last, redundant sentence from first paragraph. Section 20.7 changed TRIPPED lights in TRIP/RESET pushbutton back to white lens color. HFE change was rejected by ONS Operations. Section 22.2, revised table new descriptors to agree with soft match descriptors as requested by ONS operations. Section 23.9.1 & 23.9.2, revised cabinet numbers to match keyswitch document. Section 27.7, added new uncertainty calculation references, removed "FUTURE" from OSC-8695 reference. Section 27.9 added 51-5045379-02, "Design Specification for Key Locks and Key Switches" Section 28.8, added new uncertainty calculation references, removed "FUTURE" from OSC-8695 reference. Section 28.11, deleted redundant entry for 38-1288545-00 (also in section 27.9). Section 30, deleted the word "proposed" from various places. Section 30.1, updated DLPIAS system sketch, revised system feature description. Section 30.2, 30.3, revised bistable trip & reset setpoints based on DLPIAS uncertainty calc. Section 30.4, revised discussion of Design Features, deleted reference to change order, added DLPIAS OVERRIDE switch discussion. Section 30.5, revised Safety Classification discussion. Section 30.7, 30.8, added DLPIAS OVERRIDE switch information, added EDB tag numbers, corrected descriptors in table. Section 30.12, added DLPIAS OVERRIDE switch to layout, revised RESET pushbutton to ENABLE pushbutton.
5	General – Changed "FANP" and "Framatome ANP" to "AREVA" where applicable. General – Changed "RO" to "R_O" throughout. General – Changed "Star" and "star" to "STAR" throughout. General – Updated table headers for consistency. General – Cleaned up font issues in Existing and Proposed Algorithm blocks. General – Replaced "TXS computer" with "TXS processor". General – Replaced "Key Switch" and "Keylock Switch" with "Keyswitch". Overview Section renamed to Purpose. Purpose, 2nd paragraph, revised to include "and ESFAS". Purpose revised to state that the setpoints contained in this document are not to be used in detailed design. Actual setpoints are provided by the Unit 1 Parameters Calculation, OSC-8695. Clarified that there are NI components manufactured by Westinghouse and Bailey. Format Section revised to add clarification to better describe the document format.

Revision Number	Revision Description
5 (cont.)	Sections added for Methodology, References & Design Inputs, and Assumptions. Key Acronyms and Definitions revised to include "DNB", "DNBR", "R_O", and "S/D". Changed "control" in the TXS definition to "protection". Formatted for consistency. Changed "Protection" to "Protective" for RPS. Section 1.1 revised to state that the NI inputs for RPS function 1 are shared with RPS functions 3, 9, 10, and 11. Section 1.2.1 revised to clarify that there is only one UCIC per power range NI channel with an upper and lower detector. Corrected grammar. Section 1.5 revised to add subscript (N) to row (b) of the Proposed Algorithm. Sections 1.5, 3.5, 4.5, 4.6, 5.5, 5.6, 6.5, 6.6, 7.5, 7.6, 9.5, 9.6, 10.5, 10.6, 11.7, 11.8, 15.4, 15.7, 16.4, 16.7, & 17.7 revised to state that the actual in-plant setpoints are provided in the Unit 1 Parameters Calculation, OSC-8695. Sections 1.6.1, 4.7.1, 7.7.2, 9.7.1, 10.7.1, and 10.7.2 revised to replace "logical channel" with "instrument channel". Section 1.6.7 added to elaborate on the Total Flux Gain in Function 1. Section 1.9 revised to clarify range of the NI UCIC Upper and Lower Chambers to 0-62.5% RTP / 0-10VDC. Section 1.10 revised to change header to "Existing Output Signals". Updated statalarm and event recorder descriptions. Clarified Note 1. Section 1.11 revised to remove reference to Section 13.11. Section 2.0 revised to correct grammar. Section 3.1 revised to correct grammar. Section 3.4.2 and 3.4.5 revised to correct formatting. Sections 3.5(f) (Current and Proposed Algorithms), 5.3.1, 5.4.2, 5.5(c), 5.6(c), 6.5, 6.6, 11.7, 11.8 revised to remove the word "setpoint" so that the sentence reads "...trip is bypassed..." Section 3.5 revised to correct font error for G_ϕ value in table. Corrected table header. Removed parameter units from "Parameter Range or Value" to be consistent with other tables. Corrected typographical mistakes. Section 3.6.3 revised to reference section 25.6.4 Section 3.10 revised to update event recorder descriptions. Section 4.1 revised to state that the RC Pressure inputs are shared by RPS functions 5 & 6. Section 4.3.2, reference to Section 24 was changed to Section 23. Section 4.11 revised to update statalarm and event recorder descriptions. Section 5.1 revised to correct grammar. Section 5.7.1 revised to correct typographical mistake.

Revision Number	Revision Description
5 (cont.)	Section 5.10 revised to correct grammar. Section 5.11 revised to update statalarm and event recorder descriptions. Section 6.1 revised to correct grammar. Section 6.5 revised to correct grammar. Section 6.6 revised to add "$_m$" to T_{HOT} in algorithm. Corrected grammar. Section 6.7.1 revised to remove reference to fiber optic cables to be consistent with other sections. Section 6.9 revised to change < to ≤ for both response times to be consistent with the Equipment Specifications. Section 6.10 revised to update statalarm and event recorder descriptions. Section 7.10 revised to remove reference to Function 12. Section 7.11 revised to update statalarm and event recorder descriptions. Section 8.1 revised to clarify that the reactor must trip before 4 psig (allowable value) and the setpoint is set to trip at or before 3.5 psig for conservatism. Also revised to change "High-High" to "High". Section 8.2 revised to add reference to RPS Design Basis Document as source of statement that the RB high pressure trip is a backup for other RPS trips. Section 8.4, 8.5, 18.6, and 18.7 revised to remove statement about in-plant setpoints. These sections refer to a contact inputs and therefore no setpoints apply. Section 8.4.1 revised to remove statement about no setpoints in RPS for the Pressure Switch. Section 8.4.3 deleted. It was redundant to Section 8.3.2 and was not relevant to Section 8.4. Section 8.7.3 deleted. Section discussed analog signal monitoring which is not applicable to binary inputs. Section 8.11 revised to update statalarm and event recorder descriptions. Section 9.1 added "#" for consistency with other sections. Corrected grammar. Last sentence reworded for clarity. Added "The Technical Specifications require that the pressure switches trip at < 75 psig (allowable value). The actual plant setpoint for this trip is ≤85 psig." to be consistent with other sections. Changed "decreasing and equal to 0.50% RTP" to "≤ 0.5% RTP " Section 9.3.2 revised to be consistent with other sections with regards to referencing Sections 14 and 23. Section 9.4.1 revised to remove statement about no setpoints in RPS for the Pressure Switch. Section 9.4.3 revised to change "0.50" to "0.5" for consistency.

Revision Number	Revision Description
5 (cont.)	Section 9.5 revised to make table consistent with the table in Section 9.6 for RESET Values of SP FLUX(ENABLE) and SP FLUX(BYPASS). Corrected grammar. Revised to change "0.50" to "0.5" for consistency. Section 9.7.6 deleted. Section discussed analog signal monitoring which is not applicable to binary inputs. Section 9.7.7 deleted. Tech. Specs. Do not require a Channel Check be performed for Loss of Main Feedwater Pumps Trip. Section 9.7.8 revised to add "≤" before "0.5%". Section 9.7.9 deleted. Information was redundant and inconsistent with format of other sections. Section 9.9 revised to change "shall" to "will". Added note to state that the RPS Equipment Specification does not provide a response time. The response time provided is to be used for testing the new system. Section 9.11 revised to update statalarm and event recorder descriptions. Added Note 1. Section 10 revised to change "hydraulic oil" to "hydraulic fluid". Section 10.1 revised to clarify intent of the Main Turbine Trip. Also changed "control oil" to "hydraulic fluid". Corrected grammar. Deleted last sentence since it was redundant. Section 10.2.1 revised to remove the tolerance on the setpoint to be consistent with other sections. Section 10.3.2 revised to be consistent with other sections with regards to referencing Sections 14 and 23. Section 10.4.1 revised to remove statement about no setpoints in RPS for the Pressure Switch. Section 10.5 revised to remove "hydraulic" from description for PS_{EHC} in the table. Changed "open contact" to "contact input". Clarified items (c) and (d) for Current and Proposed Algorithms to remove redundant wording and add that they are adjustable. Sections 10.5 and 10.6 revised tables under "Unit" to replace "EHC" with "Main Turbine". Changed "oil" to "fluid". Section 10.6 revised to change "open contact" to "contact input". Section 10.7.5 revised to correct the reference to Section 10.2. Section 10.7.7 deleted. Information was redundant and inconsistent with format of other sections. Section 10.7.8 deleted. Section discussed analog signal monitoring which is not applicable to binary inputs. Section 10.7.9 deleted. Tech. Specs. Do not require a Channel Check be performed for Main Turbine Trip.

Revision Number	Revision Description
5 (cont.)	Section 10.9 revised to correct response time to ≤ 500 msec. Added "This time does not include the sensor response time." Changed "shall" to "will". Added note to state that the RPS Equipment Specification does not provide a response time. The response time provided is to be used for testing the new system. Section 10.11 revised to update statalarm and event recorder descriptions. Revised Note 1 to reference Section 22. Section 11.1 revised to change "full power" to "RTP". Moved last paragraph of Section 11.1 to Section 11.2 for consistency. Corrected grammar. Section 11.2 revised to state "less than three (3)" rather than "less than an appropriate number of". Changed "ICS" to "Steam Generator Level Control". The RCPPM does not output directly to ICS. Section 11.3 revised to add sub-sections 11.3.1 and 11.3.2 for consistency. Section 11.4 revised to remove "improved" before "Tech. Specs." Changed "full power" to "RTP" Section 11.5 revised to correct grammar. Changed "ICS" to "Steam Generator Level Control". The RCPPM does not output directly to ICS. Section 11.6 revised to add "RCP" to clarify coast-down events. Added the word "Power" and deleted "system channel" from last sentence. Section 11.7 revised to add "RESET Value" column to table for consistency. Section 11.8 revised to add "RESET Value" column to table for consistency. Section 11.9.1 revised to clarify the new system design features. Section 11.11.2 and 11.12.2 revised to clarify the redundant RCPPM strings. Section 11.11.3 revised to change the time response from ≤ 131 to ≤ 141. (Reference Duke Letter, OS-285.P-07-0111, dated February 26, 2007 from Jeff Abbott to Barbara Thomas) Section 11.13 revised note to only discuss that the Nuclear Power Range total power inputs are shared with Function 1. Section 11.14 revised to update table to show existing descriptions for statalarm windows. Also corrected descriptions for computer points and event recorders. Revised Destination column to list only the signal destinations. Section 12.0 revised to correct grammar. Section 13.1.1, 13.1.3, and 13.1.4 revised for clarification. Section 13.1.1.4 revised to change "chamber" to "detector" and "output scaling" to "voltage output range" for consistency. Section 13.1.3 revised to change "now being monitored by TXS" to "will be monitored by TXS". Clarified that the limits are established in OSC-8695. Section 13.1.4 revised to refer to new cabinets using the 1PPSCA designation.

Revision Number	Revision Description
5 (cont.)	Section 13.1.5 revised to make "instrumentation" lower case and replace "Wide Range Nuclear Instrumentation" with "WRNI". Section 13.2.1 revised to clarify that a RPS Manual Bypass feature exists in the existing design and is required in the new design. Section 13.2.2 revised to clarify that the banana plugs for testing the CRD under-voltage relays are not required in the new design. Section 13.5.1 revised to correct grammar. Added the word "cabinet" to last sentence to clarify that the signal goes to the ICS cabinet. Added "Permit" after "HPI and LPI Bypass" and added "LP1 interlock" to second sentence. Clarified that the Wide Range signal comes out of ESFAS Cabinet 1 to the ICS Cabinet and from ESFAS Cabinet 2 to ESFAS Cabinet 1. Section 13.5.2 revised to provide references for additional information on the HPI Bypass Permissive and the LPI Bypass Permissive. Added "and the LP1 interlock" to last sentence. Section 13.7 revised to correct grammar and clarify when a trip of RPS occurs. Section 13.8 revised to clarify that the Lead/Lag/Filter shall be set to zero unless otherwise specified by the Unit 1 Parameters Calculation. (To address Supplier Open Item OI.0655) Section 13.11 revised to remove discussion of Channels A and B since section is dedicated to Channel E. Removed statement regarding "median select". Section 13.11.1 revised to remove "via median select". Section 13.11.2 revised to remove the words "narrow range" for clarity. Removed "via median select". Removed discussion of Channels A and B since section is dedicated to Channel E. Removed statement regarding "median select". Section 13.11.4 revised to change "chamber" to "detector". Removed "+15" and "-15" from the ID Code column of the table. Removed reference to Section 1.11. Section 13.11.5 revised to make statalarm descriptions consistent with Section 22. Revised Note 1 to clarify how the 4-20mA signal is converted to a 0-10VDC signal. Section 14.3 revised for clarity. Section 15.4 revised to remove redundant wording for clarity. Section 15.8.2 revised to remove "(old analog channel bistable)" since it described the old system and was not relevant to the context of the section. Section 15.8.3 revised to clarify steps for performing a reset of Channel 1 (2) after an automatic or manual actuation. Section 15.10 revised to change response time from ≤ 500 msec to < 500 msec to match the Equipment Specifications. Section 15.14 revised to clarify that the RC Wide Range Pressure signal goes to ICS/NNI. Section 15.15 revised to add note regarding LOCA Load Shed, Trains A and B, being actuated by spare contacts on auxiliary relays 1EL_RLESG1X and 1EL_RLESG2X,

Revision Number	Revision Description
5 (cont.)	respectively, located in the Emergency Power Switching Logic Panel. Added note to clarify that Channel 1 has an extra R_O relay that is different from Channel 2. Section 15.16 revised to correct Even Channel Keowee Start to say "B" and not "A". Section 16.1 revised to correct grammar. Section 16.4 revised to remove redundant wording for clarity. Section 16.8.1 revised to correct typographical mistake. Section 16.8.3 revised to clarify steps for performing a reset of Channel 3 (4) after an automatic or manual actuation. Section 16.8.6 revised to change "LPSW Pump 1C" to "LPSW Pump C". Section 16.10 revised to change response time from ≤ 500 msec to < 500 msec to match the Equipment Specifications. Section 16.11 revised to correct grammar. Section 16.12 revised to update statalarm descriptions. Section 17.5 revised to include statement about degraded containment signal from ESFAS Channel A to the ICS. Section 17.6 revised to correct the channel grouping for item (c) in the Existing Algorithm. Section 17.7 revised to add item (c) in the Proposed Algorithm. Section 17.10 revised to change response time from ≤ 500 msec to < 500 msec to match the Equipment Specifications. Sections 17.12 and 17.14 revised to clarify that the signal to ICS is for degraded containment. Section 17.15 and 17.16 revised to remove note referring to NSM ON13107 which replaces 1LPSW-565 and 1LPSW-566 since the modification is installed. Note 3 was renumbered to Note 2. Section 18.10 revised to change response time from ≤ 500 msec to < 500 msec to match the Equipment Specifications. Section 18.12 revised to update statalarm descriptions. Section 20.1 added note for figure to indicate the figure is used only for general layout information. Section 20.8 changed PPSCA0013 to 1PPSCA0013. Changed "ICS" to "ICS cabinet". Changed title of section to include "and 1LP1 Interlock". Section 21 revised to clarify the operation of the emergency override. (To address Supplier Open Item OI.0641) Section 22.2 revised New Descriptor for 1SA1-58 to state "DIVERSE LPI BYP". It previously stated "DIVERSE LPI BYPASSED" which was not the correct terminology.

Revision Number	Revision Description
5 (cont.)	Section 22.5 revised existing description for 1SA7-11 to read "... Channel B..." instead of "...Channel A ..." and added the word "Trip" to the description for 1SA7-12. Section 23 revised to provide consistency throughout entire section. Section 23.2 revised to require that the keys be non-removable in the BYPASS, ENABLE, or TRIP positions. Section 23.6.4 revised to add statalarm windows for RPS trip indication. Section 23.8.4 revised to correct grammar. Section 25.1.5 and 25.1.7 revised to include the GSM screens being added per Change Order 2005-12. Section 25.2.3 revised to reorder statalarm window numbers to match corresponding channels in parenthesis. Section 25.5.8 revised to correct grammar. Section 25.6.2 revised to clarify the use of the High Flux Variable Setpoint GSM Screen. Section 25.6.7 revised to replace "needed" with "available". Also corrected grammar. Section 25.6.12 – Deleted Section 27.4 revised to update document revision levels. Section 27.6 revised to add OEE drawing references for LOCA Load Shed, trains A and B. Section 27.8 revised to update procedure names. Deleted procedures IP/0/A/0310/010A, IP/0/A/0310/010B, IP/0/A/0310/010C, IP/0/A/0310/011A, and IP/0/A/0310/011B. Deleted procedures IP/0/A/0310/019A and IP/0/A/0310/019B which have been superseded by IP/0/A/0310/0007A and IP/0/A/0310/008A respectively. Removed procedure performance intervals. Section 27.9 revised to remove reference to Keyswitch document. Section 28.1 revised to add reference to Change Order 2005-12. Section 28.6 revised to update document revision levels. Section 28.7 revised to reorder reference drawings to group all OEE references. Updated drawing titles. Deleted drawings OM-201.K-0019, OM-201.K-0020, OM-201.K-0033, and OM-201.K-0043 which were no longer applicable. Deleted reference to OEE-139-05 since it is not pertinent. Section 28.8 revised to delete incorrect reference to SRC-OSA-SA-83-004-0. Section 28.9 revised to update procedure names. Deleted procedures IP/0/A/0301/003W and IP/1/A/0305/003. Replaced superseded procedure IP/0/B/0301/002 and IP/0/A/0305/014-1 with IP/0/A/0301/002 and IP/0/A/0305/014 A respectively. Added procedure IP/0/A/0305/014 and IP/0/A/0305/001Q. Removed procedure performance intervals.

Revision Number	Revision Description
5 (cont.)	Section 28.10 revised to update procedure names. Deleted procedure OP/1/A/1102/011 and OP/0/A/1103/020. Section 28.11 revised to update/correct document revision levels. Added reference to letter OS-285.P-07-0111. Section 29.1 revised to remove last sentence since these is no impact to scope. Section 29.19 revised to provide comparison of the new versus existing RTD accuracy. Section 30.1 revised to remove the figure of the DLPIAS circuit layout. Renamed the section to "Diverse LPI Actuation System Features". Section 30.1 revised to change "bkr" to "breaker". Sections 30.2 and 30.3 revised to state that the actual in-plant setpoints are provided in the Unit 1 Diverse Low Pressure Injection Actuation System Loop Uncertainty and Setpoint Determination Calculation, OSC-8125. Section 30.4.12 revised to clarify separation requirement. Section 30.4.17 revised to correct typographical mistake.
6	Title Page, arranged Title below Calculation Number for consistency. Globally changed revision number to revision 6, dated May 28, 2008. Section 1.10 Table revised to add NI-7 & 8 signals to the ICS. Section 9.11 revised to note that Event Recorder is bypassed when Main Feedwater Pump Trip is bypassed. Section 10.11 revised to note that Event Recorder is bypassed when Main Turbine Trip is bypassed. Section 11.14 revised to note that Event Recorder is bypassed when RCP/Flux Ratio Trip is bypassed. Section 13.1.1.2 through 13.1.1.6 components noted as no longer used. Section 13.1.3 revised to clarify Channel E NI High Voltage Power Supply reference and to delete statalarm 1SA5-54 reference. Section 13.4 revised to correct the new OAC points in TEST. Section 13.11-1, 4 & 5 revised to reflect changes made to Unit 1 due to Oconee modification OD101542: Provide NI Signals to ICS from NI-5, 6, 7, 8, which has already been installed. Section 15.14 revised to add DHPIAS outputs for RC Pressure Channels A, B & C. Section 16.11 revised to add DHPIAS scope and Bypass Pushbuttons for Ch. A, B & C. Table in Section 22.2 revised for DHPIAS BYP & TRIP fin 1SA1-56 & 57. Section 22.4 revised 1SA5-54 to be a spare. Section 25.6.7 revised to add notation for future LTOP modifications.

Revision Number	Revision Description
6 (cont.)	Section 27.1 revised to add Change Order 2007-02, Rev. 1, which approved the addition of DHPIAS to the modification scope. Section 27.6 revised to add O EEs for ES Status Panels 1SA20 & 1SA21. Section 27.7, 30.2 & 3 revised title for calculation OSC-8125 to match current revision. Section 28.9 revised to add reference to Oconee modification OD101542. Section 29.4 revised to discuss NI-9 changes in RPS Channel E Power Range inputs. Section 30.4.1 revised DLPIAS switch locations to 1UB2 (as DHPIAS are on 1UB1). Section 30.4.3 removed wording for bistables in second sentence. Section 30.4.4 revised 'Low' RC Pressure to 'Low-Low'. Section 30.4.6 revised bistable to plural context, bistables. Section 30.4.17 revised to indicate TRIPPED light is on when any/all bistables are tripped. Section 30.4.20 was revised to use correct SLC term as "Licensee". Section 31 added in its entirety for the addition of DHPIAS as a result of Change Order 2008-02 being approved.
7	Section 4.12, deleted OAC Points O1A1688, O1A1689, O1A1690 & O1A1691 from Gateway Points list as they are to remain Hardwired per Change Order 2008-10. Section 7.12, deleted OAC Points O1A1692, O1A1693, O1A1694 & O1A1695 from Gateway Points list as they are to remain Hardwired per Change Order 2008-10. Section 15.17, deleted OAC Points O1A1416 & O1A1417 from Gateway Points list as they are to remain Hardwired per Change Order 2008-10. Sections 13.1.1.2 through 13.1.1.6; 13.1.3; 13.11.1; 13.11.4; 13.11.5; and 29.4: Removed changes due to NI-9 removal which will not be reflected until a later revision. Section 21.0 changed requirement from 'flip' covers to allow the use of 'slide' covers as well per Open Item 01.0641. Also incorporated Open Item 01.0641 in wording for power interruption instead of deletion. Section 28.1, added Change Order 2008-10 to the Reference List. Section 28.8, added ATWS Calc OSC-8784 & LOCA Analysis Calc OSC-7362 to the Calculation References. Section 31.2, replaced 'High High' with 'Low' to remove typo in algorithm table.
8	* Revised in support of EC0000090482 & EC0000090423 * Section 4.12*, restored OAC Points O1A1688, O1A1689, O1A1690 & O1A1691 to Gateway Points as the Change Order (2008-10) for keeping these points hard-wired has yet to be implemented. [*Revision 7 implemented the change prematurely.]

Revision Number	Revision Description
8 (cont.)	Section 7.12*, restored OAC Points O1A1692, O1A1693, O1A1694 & O1A1695 to GW Points as CO 2008-10 for keeping these points hard-wired has yet to be implemented. Section 15.11, 15.12 & 16.11, corrected typos for HPI PBs located on UB1 instead of UB2. Section 15.17*, restored OAC Points O1A1416 & O1A1417 to Gateway Points as the Change Order (2008-10) for keeping these points hard-wired has yet to be implemented. Section 11.11.1 & 2, revised RCP PM time delay relay settings to agree with Duke's procedural changes implemented as a result of PIP O-07-00940, CA # 67. Minor wording changes implemented as requested by RES and GO Engineering comments.
9	Revised in support of EC0000090482 & EC0000090423 Page 10 'Purpose', revised Framatome to AREVA for STAR module OEM and clarified note on trip and actuation setpoints in regards to use with the Software Parameters Calculation. Section 1.10, removed NI-9 related additions for NI-7 & 8 that were added prematurely. Section 4.9, 5.9 & 6.9, revised Function 4, 5 & 6 response times from 1.75 to 1.85 per Duke letter date September 19, 2008 from Ron LeGrand to Bill Marcum. Section 9.11, 10.11 and 11.14, inserted 'automatically' in front of 'bypassed' to denote actual configuration of design. Section 13.7, removed semi-colons where not needed. Section 15.11 & 15.12, added reference to DHPIAS and added notation for PIP on incorrectly labeled HPI pushbutton nomenclature on existing plant switches. Section 15.17, corrected typos in table for Existing Point IDs O1A1417 & O1A1418. Section 16.11, removed HPI pushbuttons since they were correctly included in Section 15. Section 22.2, revised 1SA-56 & 57 from 'SPARE' to 'Closed' for Contact Input to Alarm. Section 22.4, put 'NI-9 PWR FAIL' back in since the change order is not yet incorporated. Section 25.1.5 & 25.1.7, revised to add 'via a GSM screen' for clarity. Section 25.6, removed reference to Change Order 2005-08 for traceability issues and incorporated net changes into the text. Includes 25.6.3, 25.6.9, 25.6.10, 25.6.11 & 25.6.15. Section 25.6.7 Note, removed note relating to LTOP removal from design (after FAT). Section 28.1, deleted reference to Change Order 2008-10, to be added after FAT. Section 28.6, updated revision level on RPS Equipment Specification to rev. 4. Section 28.11, deleted reference to NI-9 changes in associated modification OD101542. Sections 30.4.4 & 31.4.4, revised reference to LOCA instead of SB or LB LOCA as it did not apply, per say – ES Channels 1 & 2 and 3 & 4 are actuated in their entirety from TSX. Section 31.7. added 2500 that was omitted in error and left blank in 'Range' column.

Revision Number	Revision Description
10	Revised in support of EC0000090482 & EC0000090423: Removed notations for reference to Software Parameters Calculation from Sections: 1.4, 1.5, 3.4, 3.5, 4.4, 4.5, 4.6, 5.4, 5.5, 5.6, 6.4, 6.5, 6.6, 7.4, 7.5, 7.6, 9.4, 9.5, 9.6, 10.4, 10.5, 10.6, 11.4, 11.7, 11.8, 15.4, 15.6, 15.7, 16.4, 16.6, 16.7, 17.6 & 17.7; Section 1.5, added description of acronyms for Normal Ops, S/D and Variable modes; Section 1.10, added NI-7 & 8 inputs that replaced NI-9 per Duke modification OD101542; Section 4.7.1, clarified the Normal/Shutdown meaning for Pressure Setpoint in $P_{SP\ PRESS()}$; Section 4.12 and 7.12, denoted OAC Points sent via Gateway AND remain hard-wired (HW) (See Change Order 2008-10 for more information); Section 9.1 and 10.2.1, revised 'actual plant setpoint' to 'current plant setpoint'; Section 11.5, added 'nominal' before range of time delay values of trip relays; Section 13.1 & 13.11, revised to show impact of NI-9 changes and deletions on Channel E; Section 13.3, clarified that the TXS Test Machine can be used for testing, if desired; Section 15.11 & 15.12, corrected component IDs for HPI Bypass Pushbuttons, see PIP #O-08-05867; Section 15.17, denoted OAC Points O1A1416 & O1A1417 to Gateway AND remain hard-wired (HW) (See Change Order 2008-10 for more information); Section 16.15 & 16.16, corrected nomenclature for A, B & C LPSW Pumps; Section 20.7 & 20.8, revised note regarding Change Order 2004-03; Section 20.8, revised Transient Recorder nomenclature to 1RCCR0045 to match plant; Section 21.0, revised graphic for OVERRIDE buttons, removing 'ODD' and 'EVEN' from actual buttons; Section 25.1.6, deleted LTOP transmitter from current design; Section 22.4, revised 1SA5-54 to 'SPARE' since NI-9 components are removed; Section 23.1, removed reference to old Bailey Cabinets 17 & 18 as they are being replaced; Section 25.2.4, removed 'surveillance' to remove association with the Test Machine; Section 25.6.7 Note, deleted note relating to LTOP as a result of being removed from design; Section 26.1, revised to state TXS Cabinets are tied to Station Ground and an Isolated Instrument Ground would also be located in each cabinet; Section 27.4, updated revision level on ES Equipment Spec from 4 to 5; Section 28.1, Added reference to AREVA Change Orders for NI-9 and CTP Hardwired Point approval letters from Duke; Section 28.6, updated RPS Equipment Specification to revision 5; Section 28.9, deleted IP/0/A/0305/001Q as LTOP was deleted from design;

Revision Number	Revision Description
10 (cont.)	Section 28.11, added reference to NI-9 changes in associated modification OD101542; Section 29.8, reworded reference to Software Parameters Calculation to address initial and reset values; Section 29.9, deleted LTOP from Open Items as well as from current design; Section 29.19, closed Open Item for EQ Report and the Time Responses Calculation as these documents have now been issued; Section 30.4 & 31.4, added note for reference to Change Order 2005-01; Section 30.9, corrected nomenclature for A, B & C LPSW Pumps.
11	Revised in support of EC0000090482 & EC0000090423: Overall, Revision 11 removes the reset/hysteresis values that are contained within the software parameters calculation, OSC-8695, and provides cross-references to OSC-8695 for these values. Also, information is added to Sections 4.12, 7.12 and 15.17 to define the hardwired input signal ranges for the OAC for the computer points supporting the station Core Thermal Power (CTP) calculation. The following specific changes are made: Section 1.5 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $\Phi_{SP\ FLUX(N)}$ with "Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value." • replaced the reset value for $\Phi_{SP\ FLUX(S/D)}$ with "Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value." • replaced the reset value for $\Phi_{SP\ FLUX(V)}$ with "Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value." Section 3.5 in the table under "Process Parameters for New Algorithm," • replaced the COLR values from Cycle 22 with values from Unit 1 Cycle 24. Section 4.6 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $P_{SP\ PRESS(N)}$ with "Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value." • replaced the reset value for $P_{SP\ PRESS(S/D)}$ with "Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value." Section 4.12 in the table under "Existing Hardwired Computer Points," • added double asterisk to "Existing Physical Range" for O1A1688, O1A1689, O1A1690, and O1A1691. • Added note below the table, "** The hardwired input signal to the OAC is 0 to 10 VDC, representing 1700 to 2500 psig." Section 5.6 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $P_{SP\ PRESS}$ with "Trip comparator auto-resets once

Revision Number	Revision Description
11 (cont.)	pressure is above the auto-reset value; see OSC-8695 for the auto-reset value." Section 6.6 in the table under "Process Parameters for New Algorithm," • replaced the reset value for P_{VAR} with "Trip comparator auto-resets at the setpoint value + hysteresis; see OSC-8695 for the hysteresis value." Section 7.6 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $T_{SP\ TEMP}$ with "Trip comparator auto-resets once temperature is below the auto-reset value; see OSC-8695 for the auto-reset value." Section 7.12 in the table under "Existing Hardwired Computer Points," • added double asterisk to "Existing Physical Range" for O1A1692, O1A1693, O1A1694, and O1A1695. • Added note below the table, "** The existing hardwired input signal to the OAC is 0 to 100 mVDC, representing 520 to 620°F. These inputs will be changed to 0 to 10 VDC per EC0000090482." Section 9.6 in the box under "New Algorithm Equations for Channel Trip Functions," • replaced the value for $\phi_{SP\ FLUX(BYPASS)}$ of 0.5% RTP with "(See OSC-8695 for value)" Section 9.6 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $\phi_{SP\ FLUX(ENABLE)}$ with "Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value." • slightly changed the description of $\phi_{SP\ FLUX(BYPASS)}$ to clearly indicate that this is a reset value for $\phi_{SP\ FLUX(ENABLE)}$, replaced the value with "See OSC-8695 for value," and changed the reset to "NA." Section 9.7.3, 9.7.4, 9.7.5 and 9.7.8, • slightly reworded these paragraphs to remove the specific value of the reset, $\phi_{SP\ FLUX(BYPASS)}$ and refer to OSC-8695 for this value. Section 10.6 in the box under "New Algorithm Equations for Channel Actuation Functions," • replaced the value for $\phi_{SP\ FLUX(BYPASS)}$ of 27.75% RTP with "(See OSC-8695 for value)" Section 10.6 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $\phi_{SP\ FLUX(ENABLE)}$ with "Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value." • slightly changed the description of $\phi_{SP\ FLUX(BYPASS)}$ to clearly indicate that this is a reset value for $\phi_{SP\ FLUX(ENABLE)}$, replaced the value with "See OSC-8695 for value," and changed the reset to "NA." Section 10.7.3, 10.7.4, 10.7.5 and 10.7.6,

Revision Number	Revision Description
11 (cont.)	• slightly reworded these paragraphs to remove the specific value of the reset, $\phi_{SP\ FLUX(BYPASS)}$ and refer to OSC-8695 for this value. Section 11.8 in the box under "New Algorithm for Channel Trip Functions," • replaced the value for $\phi_{SP\ FLUX(BYPASS)}$ of 0.5% RTP with "(See OSC-8695 for value)" Section 11.8 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $\phi_{SP\ FLUX(trip)}$ with "Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value." • slightly changed the description of $\phi_{SP\ FLUX(reset)}$ to clearly indicate that this is a reset value for $\phi_{SP\ FLUX(trip)}$, replaced the value with "See OSC-8695 for value," and changed the reset to "NA." Section 15.7 in the box under "New Algorithm Equations for Channel Actuation Functions," • replaced the value for $P_{SP\ PRESS\ BYP}$ of 1715 psig with "(See OSC-8695 for value)" Section 15.7 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $P_{SP\ PRESS}$ with "Trip comparator auto-resets once pressure is above the auto-reset value; see OSC-8695 for the auto-reset value. (See 15.8.3.)" • replaced the reset value for $P_{SP\ PRESS\ RBYP}$ with "Allow manual bypass on decreasing pressure. Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value." • slightly changed the description of $P_{SP\ PRESS\ BYP}$ to clearly indicate that this is a reset value for $P_{SP\ PRESS\ RBYP}$, replaced the value with "See OSC-8695 for value," and changed the reset to "NA." Section 15.17 in the table under "Existing Hardwired Computer Points," • added asterisk to "Existing Physical Range" for O1A1416 and O1A1417. • Added note below the table, "* The hardwired input signal to the OAC is 0 to 10 VDC, representing 0 to 2500 psig." Section 16.7 in the box under "New Algorithm Equations for Channel Actuation Functions," • replaced the value for $P_{SP\ PRESS\ BYP}$ of 865 psig with "(See OSC-8695 for value)". Section 16.7 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $P_{SP\ PRESS}$ with "Trip comparator auto-resets once pressure is above the auto-reset value; see OSC-8695 for the auto-reset value. (See 16.8.3.)" • replaced the reset value for $P_{SP\ PRESS\ RBYP}$ with "Trip comparator auto-resets once pressure is below the auto-reset value, to allow manual bypass on decreasing pressure. See OSC-8695 for the auto-reset value."

Revision Number	Revision Description
11 (cont.)	• slightly changed the description of $P_{SP\ PRESS\ BYP}$ to clearly indicate that this is a reset value for $P_{SP\ PRESS\ RBYP}$, replaced the value with "See OSC-8695 for value," and changed the reset to "NA." Section 17.7 in the table under "Process Parameters for New Algorithm," • replaced the reset value for $P_{SP\ PRESS}$ with "Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value." • corrected typographical error; added close parenthesis, ")" to the end of the description for variable $TRIP_{RBHP}$. Added the following clarifying note to the end of Section 20.8, regarding the OPEN interlock permissive to 1LPVA0001" "Note that in order to prevent overpressurization of the Low Pressure Injection System, caused by premature opening of the valve, the actual setpoint for the permissive is below 400 psig to ensure that the permissive is removed automatically (via reset) at 400 psig. (See OSC-8695 for the permissive setpoint value.)" Removed redundant reference to COLR under Section 28.2. The COLR is already listed as a reference under Section 28.11, and corrected revision level to match Cycle 24.

Oconee Nuclear Station Unit 1

Calculation # OSC-8623

RPS & ESFAS

SYSTEM FUNCTIONAL DESCRIPTION

for

AREVA TELEPERM XS

Revision 11

** NUCLEAR SAFETY RELATED **

February 28, 2009

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PURPOSE

The Reactor Protection System (RPS) and Engineered Safety Feature Actuation System (ESFAS) is currently a Bailey Meter Company analog, solid state design. The RPS Flux/ΔFlux/Flow modules are digital AREVA STAR processor modules. The power range Nuclear Instrumentation (NI) portion of the RPS is made up of components manufactured by Westinghouse and Bailey. The source range/wide range Nuclear Instrumentation (NI) portion of the RPS is made up of components manufactured by Gamma-Metrics. The upper and lower NI chamber amplifier portions of the NI system are being replaced, as well as the ±15 VDC and high voltage power supplies, reference Section 13. The replacement RPS & ESFAS systems are AREVA TELEPERM XS (TXS) digital processor based systems.

The purpose of this calculation is to (1) capture the design functions and features of the existing Bailey design and (2) detail the new functions and features to be provided by the new TXS system. The functional description of RPS Reactor trip functions and ESFAS Actuation functions in the following sections covers the existing Bailey RPS and ESFAS functions. The new TXS RPS & ESFAS design features are discussed in the New Design Features section of each Functional Description. Where the requirements for new design features conflict with the description of existing Bailey functions, the requirements of the new design features take precedence. All other existing Bailey RPS and ESFAS functions described in this calculation should be included in the new design.

For the existing RPS & ESFAS functions, this document provides a high level description of the protective action, a description of the inputs required to perform the function, a description of the existing algorithm and a description of the outputs currently provided by the system. New proposed algorithms are provided for each RPS & ESFAS function. In the course of converting these functions to a detailed TXS application, the description of the functions provided here may be added to, changed or revised to meet the design and licensing requirements for the new combined RPS/ESFAS or Plant Protection System (PPS).

Note: The trip setpoints and actuation setpoints must adhere to the requirements of this specification. The remainder of the parameters provided in this functional description may be changed by project documentation. Refer to OSC-8695, "Unit 1 Software Parameters for TXS Plant Protection System" for all detailed design information related to any TXS parameter other than trip/actuation setpoints.

FORMAT

As permitted by EDM 101, section 101.5.2, the sequential presentation of EDM 101.5.2 is not used. The general format of this calculation is a section for each function and feature of the RPS and ESFAS providing a description of the Bailey system, a description of what the TXS system will provide, and the QA condition of each function. All required content is included.

METHODOLOGY

This calculation performs an evaluation of the existing Bailey RPS and ESFAS functions and features and details the new TXS RPS and ESFAS functions and features. There are no acceptance criteria for this evaluation and therefore no conclusions are stated.

TYPE

This document is transmitted as a QA Condition 1 Engineering Calculation.

REFERENCES & DESIGN INPUTS

See sections 27 and 28.

ASSUMPTIONS

There are no assumptions made in this evaluation.

Key Acronyms and Definitions

COLR ..... Core Operating Limits Report

DNB ..... Departure from Nucleate Boiling

DNBR..... Departure from Nucleate Boiling Ratio

ESFAS..... Engineered Safety Features Actuation System - protection system designed to protect two of the four barriers to radionuclide release (nuclear fuel clad integrity and Reactor Building integrity) during certain accidents.

ESPS ..... *Engineered Safeguards Protection System - the term used in licensing documents* (Technical Specifications and Final Safety Analysis Report) for the ESFAS.

HPI..... High Pressure Injection - Engineered Safeguards system designed to inject a low volume of borated water at a high pressure.

ICS..... Integrated Control System - control system that provides coordination of reactor controls, steam generator/feedwater controls and turbine controls under normal operating conditions.

LPI ..... Low Pressure Injection - Engineered Safeguards system designed to inject a high volume of borated water against a low pressure.

LTOP ..... Low Temperature Over-pressure Protection

NI ..... Nuclear Instrumentation - provides instrument input indicative of reactor power to RPS and ICS upon which both protective actions and control actions are based.

NNI..... Non-Nuclear Instrumentation - provides process instrument input (pressures, temperatures, flows) to RPS, ESFAS, and ICS upon which both protective actions and control actions are based.

OAC..... Operator Aid Computer

ONS..... Oconee Nuclear Station

PPS..... Plant Protection System - new system designation for combined TXS based RPS and ESFAS.

RCS ..... Reactor Coolant System

R_O..... ESFAS Actuation Output Relay

RPS ..... Reactor Protective System - protection system designed to protect the integrity of the reactor core and RCS by limiting energy input to the RCS.

S/D..... Shutdown Bypass

TXS..... TELEPERM XS - safety related digital protection system being used for the new combined RPS and ESFAS protection systems

TXS Instrument Channel ..... An arrangement of TXS components and modules as required to generate a single protective action signal. This term applies to RPS instrument channels A, B, C, D, E and ESFAS instrument channels A, B, C.

TXS Actuation Logic Channel..... An arrangement of TXS components and modules where protective action signals from the TXS Instrument Channels are logically combined to generate actuation signals to a group of equipment to perform the safety function. This term applies to ESFAS actuation logic channels 1, 2, 3, 4, 5, 6, 7, 8.

TXS EVEN Voter ..... TXS Actuation Logic Channels 2, 4, 6, 8

TXS ODD Voter ..... TXS Actuation Logic Channels 1, 3, 5, 7

RPS

Each of the ten existing RPS Reactor Trip functions are discussed in the following sections. The Oconee Technical Specifications (TS) and TS Bases, the RPS Design Basis Document, existing RPS operating and calibration procedures and other references (see Section 28) have been used to develop this System Functional Description document. Two sections in this calculation previously included functional descriptions of potential future modifications, the addition of a Temperature Compensated High Flux Trip (Section 2) and a RCS Delta Temperature Trip (Section 12). These functional descriptions have been deleted from this calculation since the functions will not be implemented with this modification.

1.0 Nuclear Overpower (Neutron Flux) Trip

1.1 Existing Automatic Trip Function Description

Neutron Flux is measured using the Power Range Nuclear Instrumentation (NI) located in each RPS channel cabinet. The NI System provides four QA-1 power range neutron flux channels (NI-5, 6, 7 & 8) to RPS channels A, B, C & D respectively. These NI inputs are shared with RPS Functions #3, #9, #10, and #11.

1.1.1 Nuclear Overpower High Setpoint.

The Nuclear Overpower (High) Setpoint trip provides protection for the design thermal overpower condition based on the measured out-of-core neutron leakage flux. When any of the NI-5, 6, 7 or 8 power signals reach the High Flux Trip Setpoint, the associated protective channel bistable is tripped. When any two or more RPS channels have tripped on Nuclear Overpower, a Reactor Trip is initiated.

Technical Specifications require that the reactor trip ≤ 105.5% Rated Thermal Power (RTP) (Allowable Value); actual RPS TRIP setpoint is 104.75% for conservatism.

1.1.2 Nuclear Overpower High Flux Trip Setpoint during Shutdown Bypass (S/D).

Prior to initiating shutdown bypass, the Nuclear Overpower High Flux Trip Setpoint must be **manually** reset to the S/D high flux trip setpoint of 4% RTP. The setpoint Allowable Value was chosen to be as low as practical and still lie within the range of the out of core instrumentation.

When any of the NI-5, 6, 7 or 8 power signals reach the S/D High Flux Trip Setpoint, the associated protective channel bistable is tripped. When any two or more RPS channels have tripped on Nuclear Overpower, a Reactor Trip is initiated. Technical Specifications require that the reactor trip ≤ 5% RTP (Allowable Value); actual RPS TRIP setpoint is 4% for conservatism.

1.2 Description of Functions Related to Existing Trip

1.2.1 Each QA-1 power range NI (nuclear flux measuring) channel has an uncompensated ion chamber (UCIC), with one upper and one lower detector. The upper chamber monitors flux in the upper part of the core, and the lower chamber monitors flux in the lower part of the core. Each chamber provides a signal to an associated linear amplifier. The outputs from each linear amplifier are inputs to a summing amplifier which then sums the two signals and provides a total power signal. The linear amplifier outputs are calibrated to agree with the heat balance calculation. Because thermal power lags the neutron power, tripping when the neutron power reaches the design overpower setpoint will limit THERMAL POWER to prevent exceeding fuel damage limits. Thus, the Nuclear Overpower high flux trip protects against violation of the DNBR and fuel centerline-melt Safety Limits.

1.2.2 See RPS Trip Function #3 for a discussion of Power Imbalance determination.

1.3 **Existing Shutdown Bypass Function**

1.3.1 The High Flux (nuclear overpower) Trip is NOT bypassed when each RPS channel is placed in Shutdown Bypass.

1.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

1.4 **Existing Algorithm Equations for Channel Trip Functions**

Nuclear Overpower (Neutron Flux) Trip
CURRENT ALGORITHM
Trip: $\Phi_m \geq \Phi_{SP\ FLUX}$

(a) Φ_m = measured Total Flux (% RTP) into each RPS channel A, B, C & D.
(b) $\Phi_{SP\ FLUX}$ = 104.75% RTP, High Flux Reactor Trip setpoint on increasing power – normal power operation. Shutdown High Flux setpoint is administratively controlled and manually reset to 4.0% RTP prior to placing RPS channel in Shutdown Bypass.
(c) No automatic Shutdown Bypass features.

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	Reset Value	Units
Φ_m	Measured Total Flux in each RPS channel. (sum of upper & lower chamber)	0 - 125	N/A	% RTP
$\Phi_{SP\ FLUX}$	High Flux Reactor Trip Setpoint Tech Spec Allowable Value is ≤ 105.5% RTP.	104.75 Automatically Trip on increasing power	manual reset once power is below setpoint	% RTP
$\Phi_{SP\ FLUX(S/D)}$	High Flux Reactor Trip Setpoint is administratively reduced to ≤ 5% RTP (Tech Spec Allowable Value) prior to placing the RPS in shutdown bypass.	4.0 Automatically Trip on increasing power	manual reset once power is below setpoint	% RTP

1.5 **New Algorithm Equations for Channel Actuation Functions**

Nuclear Overpower (Neutron Flux) Trip
PROPOSED ALGORITHM

Trip: $\Phi_{m2.Max} \geq \Phi_{SP\ FLUX()}$

Where () indicates mode of Normal Operations (N), Shutdown Bypass (S/D) or Variable (V)

(a) $\Phi_{m2.Max}$ = **Total Flux; 2nd maximum value of RPS Channel A, B, C and D.**

(b) $\Phi_{SP\ FLUX(N)}$ = **104.75% RTP; High Flux Reactor Trip setpoint on increasing power.**

(c) $\Phi_m = [\Phi_{(upper\ chamber)} + \Phi_{(lower\ chamber)}] \times G_\phi$

(d) $\Phi_{SP\ FLUX(S/D)}$ = **4.0% RTP when Shutdown Bypass enabled; High Flux Reactor Trip setpoint on increasing power.**

(e) $\Phi_{SP\ FLUX(V)}$ = **variable High Flux Trip setpoint function; enabled in software using the TXS Service Unit.**

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$\Phi_{m2.Max}$	Second maximum Total Flux value of Φ_m	0 - 125	NA	% RTP
Φ_m	Total Flux (% Rated Thermal Power) = $[\Phi_{(upper)} + \Phi_{(lower)}] \times G_\phi$	0 - 125	NA	% RTP
G_ϕ	Gain Factor for Total Flux ϕ_m	(Range = 0.5 to 1.5) G_ϕ = **1.000**	NA	NA
$\Phi_{(upper\ chamber)}$	Upper Detector Chamber Nuclear Flux (calibrated to reflect thermal power best estimate)	0-62.5	NA	% RTP
$\Phi_{(lower\ chamber)}$	Lower Detector Chamber Nuclear Flux (calibrated to reflect thermal power best estimate)	0-62.5	NA	% RTP
$\Phi_{SP\ FLUX(N)}$	Normal High Flux Trip Setpoint on increasing power. Tech Spec Allowable Value is ≤ 105.5% RTP.	104.75	Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value.	% RTP
$\Phi_{SP\ FLUX(S/D)}$	S/D Bypass High Flux Trip setpoint is automatically implemented when the S/D bypass keyswitch is placed to Bypass.	4.0	Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value.	% RTP

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$\Phi_{SP\ FLUX(V)}$	Variable High Flux Trip Setpoint on increasing power is administratively controlled and enabled in software using the TXS Service Unit.	(Range = 0 to 125) 104.75	Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value.	% RTP

1.6 **New Design Features**

1.6.1 Each RPS instrument channel (A, B, C & D) processes the associated NI flux signal value as well as the NI flux signal values from the other three instrument channels. For the High Flux channel trip, each RPS instrument channel selects the second maximum (2.Max) measured High Flux value ($\phi_{m2.Max}$) from all four channels. If the value of $\phi_{m2.Max}$ exceeds the High Flux trip setpoint ($\phi_{SP\ FLUX()}$), the channel provides a Reactor Trip output signal. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

1.6.2 An S/D Bypass High Flux Trip setpoint is automatically implemented when the S/D Bypass keyswitch is placed to BYPASS.

1.6.3 A Variable High Flux Trip setpoint value feature shall be enabled in software using the TXS Service Unit. This feature will allow insertion of a Variable High Flux Trip setpoint lower than the Normal High Flux Trip setpoint (or the S/D Bypass High Flux Trip setpoint when the S/D Bypass keyswitch is placed to Bypass). Use of the Variable High Flux Trip setpoint will be administratively controlled by procedure. The Normal High Flux Trip setpoint is still operable with this feature enabled.

1.6.4 New Nuclear Instrumentation will be provided as part of this modification, including linear amplifiers, power range test modules, low voltage and high voltage power supplies. The summing amplifier is located on the power range test module. See Section 13 for details of the new NI hardware replacement. Nuclear power (flux) is derived in the new TXS system software by summing the inputs from the linear amplifiers for Power Range Detector (NI-5, 6, 7, & 8) Upper Chamber and Lower Chamber inputs. The summing amp total power (flux) signals are not used as TXS analog inputs or in the software. This differs from the existing system, where total power input to the RPS was provided by the summing amp. The summing amp input to the new TXS system will only go to an isolator to provide isolated outputs to the ICS control system and indicators.

1.6.5 Analog Signal Monitoring discussion, see Section 25.4.

1.6.6 CHANNEL CHECK discussion, see Section 25.1.

1.6.7 An adjustable gain factor G_ϕ (Total Flux Gain) is included in the new design in order to allow the algorithm to be adjusted in the future if needed. The gain will be set to 1.000. This algorithm is equivalent to that used in the existing AREVA STAR processor module and is the same Total Flux Gain as shown in Function 3.

1.7 **Safety Classification**

This function is classified QA Condition 1 (Class 1E).

1.8 **Response Time Requirements**

The response time for the TXS rack/processing equipment shall be ≤ 186 msec for Function 1. This time does not include the sensor response time.

1.9 **Existing Input Signals from Nuclear Instrumentation**

Reactor Power (Flux) values are shared with Functions 3, 9, 10 & 11.

ID Code	Description	Physical Range	Electrical Range
1RPSDT0005	NI-5 UCIC Upper Chamber	0 - 62.5% RTP	0 – 10 VDC
1RPSDT0005	NI-5 UCIC Lower Chamber	0 - 62.5% RTP	0 – 10 VDC
1RPSDT0006	NI-6 UCIC Upper Chamber	0 - 62.5% RTP	0 – 10 VDC
1RPSDT0006	NI-6 UCIC Lower Chamber	0 - 62.5% RTP	0 – 10 VDC
1RPSDT0007	NI-7 UCIC Upper Chamber	0 - 62.5% RTP	0 – 10 VDC
1RPSDT0007	NI-7 UCIC Lower Chamber	0 - 62.5% RTP	0 – 10 VDC
1RPSDT0008	NI-8 UCIC Upper Chamber	0 - 62.5% RTP	0 – 10 VDC
1RPSDT0008	NI-8 UCIC Lower Chamber	0 - 62.5% RTP	0 – 10 VDC
NI-5 Power Range Power Supply	Bi-Polar Power Supply	0 to 15 VDC	0 to 15 VDC
NI-5 Power Range Power Supply	Bi-Polar Power Supply	-15 to 0 VDC	-15 to 0 VDC
NI-6 Power Range Power Supply	Bi-Polar Power Supply	0 to 15 VDC	0 to 15 VDC
NI-6 Power Range Power Supply	Bi-Polar Power Supply	-15 to 0 VDC	-15 to 0 VDC
NI-7 Power Range Power Supply	Bi-Polar Power Supply	0 to 15 VDC	0 to 15 VDC
NI-7 Power Range Power Supply	Bi-Polar Power Supply	-15 to 0 VDC	-15 to 0 VDC
NI-8 Power Range Power Supply	Bi-Polar Power Supply	0 to 15 VDC	0 to 15 VDC

ID Code	Description	Physical Range	Electrical Range
NI-8 Power Range Power Supply	Bi-Polar Power Supply	-15 to 0 VDC	-15 to 0 VDC
NI-5 Power Range Power Supply	High Voltage Power Supply	300 - 800 VDC	300 - 800 VDC
NI-6 Power Range Power Supply	High Voltage Power Supply	300 - 800 VDC	300 - 800 VDC
NI-7 Power Range Power Supply	High Voltage Power Supply	300 - 800 VDC	300 - 800 VDC
NI-8 Power Range Power Supply	High Voltage Power Supply	300 - 800 VDC	300 - 800 VDC

1.10 Existing Output Signals

Reactor Power (Flux) values are shared with Functions 3, 9, 10 & 11.

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1RPSDT0005	Analog Output Signal to ICS from NI-5 summing amp via SNV1 (see Note 1)	0 – 125% RTP	0 – 10 VDC	ICS
1RPSDT0006	Analog Output Signal to ICS from NI-6 summing amp via SNV1 (see Note 1)	0 – 125% RTP	0 – 10 VDC	ICS
1RPSDT0007	Analog Output Signal to ICS from NI-7 summing amp via SNV1 (see Note 1)	0 – 125% RTP	0 – 10 VDC	ICS
1RPSDT0008	Analog Output Signal to ICS from NI-8 summing amp via SNV1 (see Note 1)	0 – 125% RTP	0 – 10 VDC	ICS
1RPSP1NI5	Analog Output Signal to Control Room Indicator from NI-5 summing amp via SNV1 (see Note 1)	0 - 125% RTP	0 - 10 VDC	Indicator on 1UB1
1RPSP1NI6	Analog Output Signal to Control Room Indicator from NI-6 summing amp via SNV1 (see Note 1)	0 - 125% RTP	0 - 10 VDC	Indicator on 1UB1
1RPSP1NI7	Analog Output Signal to Control Room Indicator from NI-7 summing amp via SNV1 (see Note 1)	0 - 125% RTP	0 - 10 VDC	Indicator on 1UB1
1RPSP1NI8	Analog Output Signal to Control Room Indicator from NI-8 summing amp via SNV1 (see Note 1)	0 - 125% RTP	0 - 10 VDC	Indicator on 1UB1
1SA1-8	RP NI-5 High Flux Trip	Binary	145 VDC	Statalarm
1SA1-20	RP NI-6 High Flux Trip	Binary	145 VDC	Statalarm
1SA1-32	RP NI-7 High Flux Trip	Binary	145 VDC	Statalarm
1SA1-44	RP NI-8 High Flux Trip	Binary	145 VDC	Statalarm
1SA5-7	NI Power Range 5 Power Supply Failure	Binary	145 VDC	Statalarm
1SA5-19	NI Power Range 6 Power Supply Failure	Binary	145 VDC	Statalarm
1SA5-31	NI Power Range 7 Power Supply Failure	Binary	145 VDC	Statalarm
1SA5-43	NI Power Range 8 Power Supply Failure	Binary	145 VDC	Statalarm
ER-160*	R.P. Channel A Hi Flux Trip	Binary	125 VDC	Event Recorder

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
ER-169*	R.P. Channel B Hi Flux Trip	Binary	125 VDC	Event Recorder
ER-178*	R.P. Channel C Hi Flux Trip	Binary	125 VDC	Event Recorder
ER-188*	R.P. Channel D Hi Flux Trip	Binary	125 VDC	Event Recorder

*Contact Input Open to Alarm

Note 1: The Power Range Test (PRT) Summing Amp provides a 4-20mA signal output to the TXS SNV1 module for isolation. The SNV1 module converts the 4-20mA signal to a 0-20mA signal. A precision resistor will be used to convert the SNV1 output from a 0-20mA signal to a 0-10VDC (0-125% RTP signal for outputs to the ICS and % power indicator).

1.11 New Input Signals from Nuclear Instrumentation

ID Code	Description	Physical Range	Electrical Range
1RPSDT0005, 6, 7 & 8 Upper & lower (Qty 8 signals)	NI-5,6,7 & 8 UCIC Upper & Lower Detector	0 - 62.5% RTP	0 – 10 VDC (linear Amplifier output)
ON1NIAF01(3,5,7)HA02 - upper ON1NIAF01(3,5,7)HA03 - lower Linear Amplifier (Qty 8)	Upper & Lower Linear Amp		
ON1NIPY01(3,5,7)HA05 NI-5, 6, 7 & 8 Power Range -15 VDC Power Supply (Qty 4)	Bi-Polar Power Supply	-15 to 0 VDC	-1.364 to 0 VDC
ON1NIPY01(3,5,7)HA05 NI-5, 6, 7 & 8 Power Range 15 VDC Power Supply (Qty 4)	Bi-Polar Power Supply	0 to +15 VDC	0 to 1.364 VDC
ON1NIPY01(3,5,7)JA01 NI-5, 6, 7 & 8 Power Range High Voltage Power Supply (Qty 4)	High Voltage Power Supply	0 – 1000 VDC	0 – 1 VDC

1.12 Existing Hardwired Computer Points

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2290	NI 5 PR TEST (FALSE) (TRUE)	Binary	Gateway
O1D2291	NI 6 PR TEST (FALSE) (TRUE)	Binary	Gateway
O1D2292	NI 7 PR TEST (FALSE) (TRUE)	Binary	Gateway
O1D2293	NI 8 PR TEST (FALSE) (TRUE)	Binary	Gateway
O1D2391	RPS CH A NI 5 HI FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2392	RPS CH B NI 6 HI FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2393	RPS CH C NI 7 HI FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2394	RPS CH D NI 8 HI FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1A1544	NI 5 PR FLUX	0 – 125% RTP	Gateway
O1A1545	NI 6 PR FLUX	0 – 125% RTP	Gateway
O1A1546	NI 7 PR FLUX	0 – 125% RTP	Gateway
O1A1547	NI 8 PR FLUX	0 – 125% RTP	Gateway
O1A1558	NI 5 PR PS VOLTS	0 – 1000 VDC	Gateway
O1A1559	NI 6 PR PS VOLTS	0 – 1000 VDC	Gateway
O1A1560	NI 7 PR PS VOLTS	0 – 1000 VDC	Gateway
O1A1561	NI 8 PR PS VOLTS	0 – 1000 VDC	Gateway
O1A1697	RPS CH A -15V PS VOLTS	-15 to 0 VDC	Gateway
O1A1698	RPS CH A +15V PS VOLTS	0 to 15 VDC	Gateway
O1A1699	RPS CH B -15V PS VOLTS	-15 to 0 VDC	Gateway
O1A1701	RPS CH B +15V PS VOLTS	0 to 15 VDC	Gateway
O1A1703	RPS CH C -15V PS VOLTS	-15 to 0 VDC	Gateway
O1A1704	RPS CH C +15V PS VOLTS	0 to 15 VDC	Gateway
O1A1706	RPS CH D -15V PS VOLTS	-15 to 0 VDC	Gateway
O1A1707	RPS CH D +15V PS VOLTS	0 to 15 VDC	Gateway

1.13 New Statalarm Panel Changes

Statalarm Panel changes are shown in Section 22.

1.14 References

See Section 28.

2.0 Reserved

This RPS function number has been reserved for possible future use. This section previously included a functional description for a future Temperature Compensated High Flux Trip. This description has been deleted since the function will not be implemented with this modification.

3.0 Nuclear Overpower Flux/Flow/Imbalance Trip

3.1 Existing Automatic Trip Function Description

Nuclear Overpower Flux/Flow Imbalance Trip based on reactor power, power imbalance and reactor coolant flow.

Reactor Power (Flux) inputs are shared with RPS Function #1.

The Flux/Flow/Imbalance trip shall provide protection against DNB or fuel centerline temperature limits during steady state and transient operation. The parameters monitored to generate the Flux/Flow/Imbalance trip are Reactor Coolant System (RCS) Flow, Power Range Neutron Flux and Power Range Delta Flux. The Flux/Flow/Imbalance trip defines the maximum allowable power (flux) level based on the measured RCS Flow and a Delta Flux Imbalance.

The Flux/Flow/Imbalance trip function is best understood by reference to Figure 3.1 "Flux/Flow/Imbalance Barn Curve." The following is a description of the Barn Curve:

3.1.1 The region between breakpoints B2 and B3, the "barntop," represents the maximum allowed reactor power limit, $\phi_{MAX}(F)$. $\phi_{MAX}(F)$ varies with RCS Flow. When operating with a Delta Flux Imbalance in this region, the Flux/Flow/Imbalance trip condition is defined as total reactor power (flux) $\phi_M > \phi_{MAX}(F)$.

$\phi_{MAX}(F)$ "barntop" moves down with decreasing total RCS flow and up with increasing flow, with an absolute upper limit of P_{MAX}. This relationship is expressed in the trip algorithm as $\phi_{MAX}(F) = F_T \times G_{Flux/Flow} \leq P_{MAX}$. P_{MAX} is a constant that represents the absolute upper limit of $\phi_{MAX}(F)$ and is the "Tech. Spec Barntop" from the Core Operating Limits Report (COLR) and station procedures.

3.1.2 When operating with a Delta Flux Imbalance in the region between breakpoints B1 and B2 (Slope M1), the Flux/Flow/Imbalance trip setpoint is lowered by the Delta Flux Imbalance as defined in the algorithm: reactor power (ϕ_m) > [Slope M1 x $\Delta\phi$ + [$\phi_{MAX}(F)$ - Slope M1 x B_2]].

3.1.3 When operating with a Delta Flux Imbalance in the region between breakpoints B3 and B4 (Slope M2), the Flux/Flow/Imbalance trip setpoint is lowered by the Delta Flux Imbalance as defined in the algorithm: reactor power (ϕ_m) > [Slope M2 x $\Delta\phi$ + [$\phi_{MAX}(F)$ - Slope M2 x B_3]].

3.1.4 With the inclusion of the term $\phi_{MAX}(F)$ in the Barn Curve slope M1 and M2 regions as described above, it can be seen that these regions of the Barn Curve, in addition to varying with the Delta Flux Imbalance, also varies with RCS Flow. Thus the entire Barn "roof" (barn top and slopes) effectively moves down as RC total flow decreases, and up as RCS total flow increases.

3.1.5 The Flux/Flow/Imbalance trip function also has trip setpoints based solely on maximum limits for Delta Flux Imbalance as defined by breakpoints B1 (negative Imbalance limit) and B4 (positive Imbalance limit) . These trip setpoints are defined in the trip algorithm as $\Delta\phi < B_1$ (negative Imbalance trip), and as $\Delta\phi > B_4$ (positive Imbalance trip).

3.1.6 Whenever two or more RPS channels have tripped on any of the Flux/Flow/Imbalance trip conditions as described above, a Reactor Trip shall be initiated.

In addition to limiting the allowable core power distribution, the Flux/Flow/Imbalance trip function also provides DNB protection during partial pump coast-downs. The allowable power level for any given flow, assuming zero imbalance, is determined by multiplying the measured flow times the Flux/Flow ratio. This ratio is calculated by using the maximum flux trip setpoint allowed by the flux/flow trip divided by the measured RCS flow at 100% RTP conditions.

3.2 Description of Existing System Functions Related to Trip

3.2.1 In the existing RPS channels, power imbalance is determined in the Framatome STAR module. For each of the NI power range detectors, the top detector value minus the bottom detector value times the flux gain factor equals Delta Flux Imbalance. This power imbalance signal value is adjusted by procedure to agree with the power imbalance indicated by the incore instruments, since the incore power imbalance is more accurate (at steady state power).

3.2.2 Four delta-pressure transmitters measure RCS differential pressure across the flow element in each hot leg and provide the signal to each of the four RPS channels. For the existing system, the 4-20 mA differential pressure signals from the transmitters are converted across a shunt resistor to 2-10 VDC signal for input. This voltage signal is acquired by a STAR processor module which converts the differential pressure to flow and combines the Loop A and Loop B flows into total RCS Flow.

3.2.3 The STAR system converts the RCS Loop A and B differential pressure signals to flow using the following equations:

Loop A: $F_A = [(\Delta P_A)^{1/2}] \times [50\%/(\Delta P_{AVG\text{-}A})^{1/2}]$
Loop B: $F_B = [(\Delta P_B)^{1/2}] \times [50\%/(\Delta P_{AVG\text{-}B})^{1/2}]$

3.2.4 For the STAR system, ΔP_A and ΔP_B are the input signals with units in VDC, and $\Delta P_{AVG\text{-}A}$ and $\Delta P_{AVG\text{-}B}$ are constants set to 10.000VDC. Therefore the VDC units cancel by division and the result is a square root output in terms of % flow.

3.2.5 F_A and F_B units are in terms of % of flow, and denoted as % Total Flow Range (%TFR). For each loop, a full scale differential pressure of 43.3 psid into the transmitter = 50% TFR. For each loops signal to the OAC the relation between % TFR and kLB/HR is linear with 50%TFR = 90,000 kLB/HR.

3.2.6 Total Flow is calculated in the STAR as follows:

$F_T = F_A + F_B$.

With both loops at full scale input, total flow =100%TFR. For the total RCS flow signal to the OAC, 100%TFR= 180,000 kLB/HR.

3.3 **Existing Shutdown Bypass Function**

3.3.1 This function is manually bypassed when the Shutdown Bypass Keyswitch is placed in Bypass.

3.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitches.

3.4 **Existing Setpoints for Trip Functions**

3.4.1 Breakpoint and slope values for the Barn Curve are provided for each new fuel core cycle in the Core Operating Limits Report (COLR). Delta Flux Gain values and P_{MAX} (Tech Spec Barntop) are also provided in the COLR. These values are incorporated in station instrument procedures and inserted into the STAR system prior to unit startup for the new core cycle.

3.4.2 P_{MAX} is a constant that provides an absolute upper limit of $\phi_{MAX}(F)$. P_{MAX} is the upper power value in the Maximum Allowable RPS Power Imbalance Limits from the COLR for each new fuel cycle and is referred to in station procedures as the Tech. Spec Barntop. There are separate limits for four RC pump operation and for three RC pump operation, therefore for three pump operation at power the station must enter the three pump lower limit value into the STAR system.

3.4.3 After startup from each refueling or other long outage, station procedures establish a new RCS Total Flow Range (%TFR) value for 100% power operation. (i.e., baseline RCS flow). The $G_{Flux/Flow}$ (flux/flow gain factor) is then verified to be within the required tolerance, and if it is not a new gain value is calculated as follows:

$G_{Flux/Flow}$ = Normal Barntop (% RTP) / F_T (% TFR)

The new gain value is then entered into the STAR system. [Note: an interim check/calculation at 73% power uses a different formula. The "Normal Barntop" is obtained from station procedures and is derived from the COLR "RPS Power Imbalance Setpoints" upper power limit (barntop) for four pump operation].

3.4.4 The Flux/Flow/Imbalance Trip Setpoint ($\phi_{MAX}(F)$) shall be capable of being reduced as required to meet the Technical Specification requirements to operate with a quadrant power tilt, dropped control rod or other condition by manually reducing the Flow Gain Setpoint $G_{Flux/Flow}$. The Technical Specifications call for a 2% reduction of the Flux/Flow/Imbalance trip points for each 1% of tilt beyond the steady state limit, or a reduction to 65.5% of the Allowable Thermal Power.

3.4.5 $\phi_{MAX}(F)$ is the maximum allowed power level based on total flow, not to exceed PMAX (thermal power upper limit). Since PMAX is adjustable, procedures exist to change PMAX if the limits change for cycle specific limits, burn-up dependent limits, or if the plant enters 3-pump operation.

3.5 **Algorithm Equations for Trip Functions**

Nuclear Overpower Flux/Flow Imbalance Trip
CURRENT ALGORITHM

Flow Inputs: $F_T = [F_A + F_B]$
Where: $F_A = [(\Delta P_A)^{1/2}] \times [50\%/(\Delta P_{AVG\text{-}A})^{1/2}]$ (Loop A)
Where: $F_B = [(\Delta P_B)^{1/2}] \times [50\%/(\Delta P_{AVG\text{-}B})^{1/2}]$ (Loop B)

Maximum Allowed Thermal Power (Barntop):

$\phi_{MAX}(F) = F_T \times G_{Flux/Flow} \leq P_{MAX}$

For Example:

$\phi_{MAX}(F)$ at Flow (F_T) of 77.57 %TFR (4 RC Pump Operation) = 107.9% RTP

$\phi_{MAX}(F)$ at Flow (F_T) of 57.94 %TFR (3 RC Pump Operation) = 80.6% RTP

[Note: above examples based on $G_{Flux/Flow}$ of 1.391, and the COLR minimum for 3 pump flow being 74.7% of 4 pump flow]

Total Flux Calculated Input: $\phi_m = [\phi_{upper} + \phi_{lower}] \times G_\phi$

Imbalance (Delta Flux) Input: $\Delta\phi = (\phi_{upper} - \phi_{lower}) \times G_{\Delta\phi}$

Flux/Flow/Imbalance Trip:

A Flux/Flow/Imbalance Trip exists for the following Conditions

(a) $\Delta\phi < B_1$

(b) $B_1 \leq \Delta\phi \leq B_2$ AND $\phi_M > [SlopeM1 \times \Delta\phi + [\phi_{MAX}(F) - Slope\ M1 \times B_2]]$

(c) $\phi_m > \phi_{MAX}(F)$

(d) $B_3 \leq \Delta\phi \leq B_4$ AND $\phi_M > [Slope\ M2 \times \Delta\phi + [\phi_{MAX}(F) - Slope\ M2 \times B_3]]$

(e) $\Delta\phi > B_4$

(f) With Shutdown Bypass enabled, the Flux/Flow/Imbalance Trip is bypassed.

Nuclear Overpower Flux/Flow Imbalance Trip
PROPOSED ALGORITHM

Total RC Flow Inputs: $F_T = [F_A + F_B]$
Where: $F_A = [(\Delta P_A)^{1/2}] \times [50\%/(\Delta P_{AVG\text{-}A})^{1/2}]$ (Loop A)
Where: $F_B = [(\Delta P_B)^{1/2}] \times [50\%/(\Delta P_{AVG\text{-}B})^{1/2}]$ (Loop B)

Maximum Allowed Thermal Power (Barntop):

$\phi_{MAX}(F) = \text{minimum } [F_T \times G_{Flux/Flow}, P_{MAX}]$

For Example:

$\phi_{MAX}(F)$ at Flow (F_T) of 77.57 %TFR (4 RC Pump Operation) = 107.9% RTP
$\phi_{MAX}(F)$ at Flow (F_T) of 57.94 %TFR (3 RC Pump Operation) = 80.6% RTP
[Note: above examples based on $G_{Flux/Flow}$ of 1.391, and the COLR minimum for 3 pump flow being 74.7% of 4 pump flow]

Total Flux (Thermal Power) Calculated Input: $\phi_m = [\phi_{Upper} + \phi_{Lower}] \times G_\phi$

Imbalance (Delta Flux) Input: $\Delta\phi = (\phi_{upper} - \phi_{lower}) \times G_{\Delta\phi}$

TRIP CONDITIONS

Flux/Flow/Imbalance Trip:

A Flux/Flow/Imbalance Trip exists for the following Conditions:

(a) $\Delta\phi < B_1$
(b) $B_1 \le \Delta\phi \le B_2$ **AND** $\phi_m > [\text{Slope M1} \times \Delta\phi + [\phi_{MAX}(F) - \text{Slope M1} \times B_2]]$
(c) $\phi_m > \phi_{MAX}(F)$
(d) $B_3 \le \Delta\phi \le B_4$ **AND** $\phi_m > [\text{Slope M2} \times \Delta\phi + [\phi_{MAX}(F) - \text{Slope M2} \times B_3]]$
(e) $\Delta\phi > B_4$
(f) With Shutdown Bypass enabled, the Flux/Flow/Imbalance Trip is bypassed.

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	Units
Φ_m	Total Flux (% Rated Thermal Power) = $[\Phi_{(upper)} + \Phi_{(lower)}] \times G_\phi$	0 - 125	% RTP
G_ϕ	Gain Factor for Total Flux ϕ_m	(Range = 0.5 to 1.5) **(G_ϕ = 1.000)**	N/A
Φ (upper)	Upper Detector Chamber Nuclear Flux (calibrated to reflect thermal power best estimate)	0 to 62.5	% RTP
Φ (lower)	Lower Detector Chamber Nuclear Flux (calibrated to reflect thermal power best estimate)	0 to 62.5	% RTP
$\Delta\phi$	Delta Flux = $(\phi_{upper} - \phi_{lower}) \times G_{\Delta\phi}$	-62.5 to + 62.5	% RTP
$G_{\Delta\phi}$	Gain Factor for Delta Flux, $\Delta\phi$ (each RPS channel has a separate gain value)	(Range = 0.5 to 8) $G_{\Delta\phi A}$ = **4.17*** (NI-5) $G_{\Delta\phi B}$ = **4.19*** (NI-6) $G_{\Delta\phi C}$ = **4.11*** (NI-7) $G_{\Delta\phi D}$ = **4.21*** (NI-8)	N/A
$\phi_{MAX}(F)$	Barntop Maximum Allowed Thermal Power = $F_T \times G_{Flux/Flow} \leq P_{MAX}$	0 to 125	% RTP
P_{MAX}	Upper Limit of Maximum Allowed Thermal Power (constant)	(Constant setting range = 0 to 125) P_{MAX} constant = **109.4**	% RTP
ΔP_A	Loop A RCS Delta Pressure (2 pumps in Loop A)	0 to 43.3	psid
ΔP_B	Loop B RCS Delta Pressure (2 pumps in Loop B)	0 to 43.3	psid
F_A	Measured Loop A RCS Flow (2 pumps in Loop A)	0 to 50	% Total Flow Range (TFR)
F_B	Measured Loop B RCS Flow (2 pumps in Loop B)	0 to 50	% TFR
F_T	Total Loop RCS Flow (4 pumps in Loop A & B)	0 to 100	% TFR
ΔP_{AVG-A}	Coefficient - Average Loop A RCS Delta Pressure at 50% Total Flow Range	43.3	psid
ΔP_{AVG-B}	Coefficient - Average Loop B RCS Delta Pressure at 50% Total Flow Range	43.3	psid

Logical ID	Description	Parameter Range or Value	Units
$G_{Flux/Flow}$	Flux/flow Gain factor = Normal Barntop (% RTP) / F_T (% TFR)	0.30 to 1.50 **($G_{FLUX/FLOW}$ = 1.391)***	% RTP/ % TFR
B_1	Break Point 1 Negative Imbalance Reactor Trip Setpoint	- 62.5 to 0 **(B_1 = -33.0)***	% Imbalance
B_2	Break Point 2 ($\Delta\phi$ Value)	- 62.5 to 0 **(B_2 = -12.9)***	% Imbalance
B_3	Break Point 3 ($\Delta\phi$ Value)	0 - 62.5 **(B_3 = +14.4)***	% Imbalance
B_4	Break Point 4 Positive Imbalance Reactor Trip Setpoint	0 - 62.5 **(B_4 = +33.0)***	% Imbalance
Slope M1	Slope from Break Point B_1 to Break Point B_2	0.25 to 3 **(Slope M1 = 0.942)***	% RTP/ % Imbalance
Slope M2	Slope from Break Point B_3 to Break Point B_4	-0.25 to -3 **(Slope M2 = -0.942)***	% RTP/ % Imbalance

*** The parameter settings provided above must be updated for each new fuel cycle as required by the Core Operating Limits Report (COLR) and station procedures.**

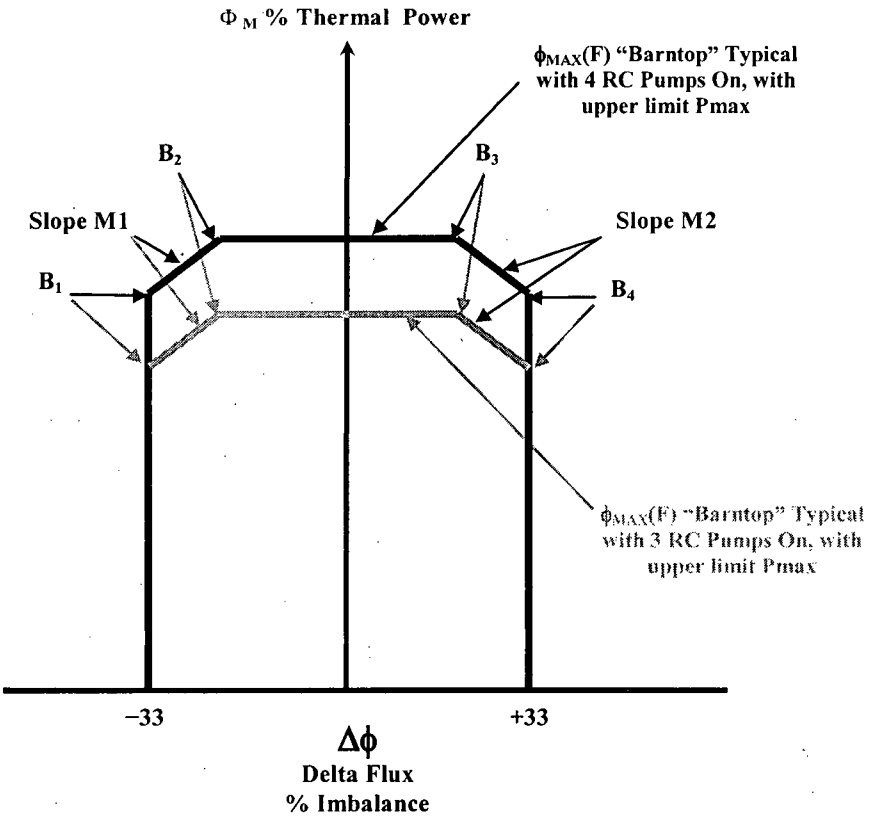


FIGURE 3.1
Flux/Flow/Imbalance Barn Curve

3.6 **New Design Features**

3.6.1 Each RPS instrument channel receives Flux/Flow/Imbalance trip function signals from the other channels over fiber optic communications cables. If an RPS channel sees two or more channels of Flux/Flow/Imbalance trip function in the tripped condition, a channel trip will occur. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

3.6.2 With Shutdown Bypass enabled, the Flux/Flow/Imbalance Trip is bypassed.

3.6.3 RCS Flow Loops A & B averages use at least 20 data points for each instrument. (See Section 25.6.4)

3.6.4 Analog Signal Range Limit Monitoring discussion, see Section 25.4.

3.6.5 CHANNEL CHECK discussion, see Section 25.1.

3.6.6 Refer to STAR Instruction Manual 01-1228962-00 and 01-1228962-04 (latest Appendix B Flux/Delta Flux Flow Trip revision) for additional information on how the existing STAR system scales variables and implements the Flux/Flow/Imbalance algorithms. ONS procedures are also available for reference.

3.7 **Safety Classification**

This function is classified QA Condition 1 (Class 1E).

3.8 **Response Time Requirements**

The response time for the TXS rack/processing equipment shall be ≤ 769 msec for the Flow input signal portion of Function 3. The response time for the TXS rack/processing equipment shall be ≤ 186 msec for NI portion of Function 3. The channel response time does not include the sensor response time.

Note that the current RPS STAR Module processor has a response time of ≤ 150 msec with a **594 msec filter** on the input for RCS Flow per the STAR Technical Manual. The RCS flow filtering shall be accounted for in the new TXS system using the hardware signal filtering capabilities of the SAA1 (up to 188 ms time constant, adjustable), software filtering, or both.

3.9 **Existing Input Signals**

ID Code	Description	Physical Range	Electrical Range
1RCFT0014B (RC14A-DPT1)	Reactor Coolant System differential pressure Loop A (Channel A)	0.0 to 43.3 psid	4 - 20 mA
1RCFT0014C (RC14A-DPT2)	Reactor Coolant System differential pressure Loop A (Channel B)	0.0 to 43.3 psid	4 - 20 mA
1RCFT0014D (RC14A-DPT3)	Reactor Coolant System differential pressure Loop A (Channel C)	0.0 to 43.3 psid	4 - 20 mA

ID Code	Description	Physical Range	Electrical Range
1RCFT0014E (RC14A-DPT4)	Reactor Coolant System differential pressure Loop A (Channel D)	0.0 to 43.3 psid	4 - 20 mA
1RCFT0015B (RC14B-DPT1)	Reactor Coolant System differential pressure Loop B (Channel A)	0.0 to 43.3 psid	4 - 20 mA
1RCFT0015C (RC14B-DPT2)	Reactor Coolant System differential pressure Loop B (Channel B)	0.0 to 43.3 psid	4 - 20 mA
1RCFT0015D (RC14B-DPT3)	Reactor Coolant System differential pressure Loop B (Channel C)	0.0 to 43.3 psid	4 - 20 mA
1RCFT0015E (RC14B-DPT4)	Reactor Coolant System differential pressure Loop B (Channel D)	0.0 to 43.3 psid	4 - 20 mA

3.10 Existing Output Signals

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA1-3	RP Channel A Flux/Imb/Flow Trip	Binary	145 VDC	Statalarm
1SA1-15	RP Channel B Flux/Imb/Flow Trip	Binary	145 VDC	Statalarm
1SA1-27	RP Channel C Flux/Imb/Flow Trip	Binary	145 VDC	Statalarm
1SA1-39	RP Channel D Flux/Imb/Flow Trip	Binary	145 VDC	Statalarm
ER-161*	R.P. Channel A Power Imbalance/Flow Ratio Trip	Binary	125 VDC	Event Recorder
ER-170*	R.P. Channel B Power Imbalance/Flow Ratio Trip	Binary	125 VDC	Event Recorder
ER-179*	R.P. Channel C Power Imbalance/Flow Ratio Trip	Binary	125 VDC	Event Recorder
ER-189*	R.P. Channel D Power Imbalance/Flow Ratio Trip	Binary	125 VDC	Event Recorder
1RCFT0014B (RC14A-DPT1)	RP Reactor Coolant System Flow ΔP Loop A Output to ICS (Channel A)	0 – 43.3 psid	0 – 10 VDC	ICS
1RCFT0014C (RC14A-DPT2)	RP Reactor Coolant System Flow ΔP Loop A Output to ICS (Channel B)	0 – 43.3 psid	0 – 10 VDC	ICS
1RCFT0015B (RC14B-DPT1)	RP Reactor Coolant System Flow ΔP Loop B Output to ICS (Channel A)	0 – 43.3 psid	0 – 10 VDC	ICS
1RCFT0015C (RC14B-DPT2)	RP Reactor Coolant System Flow ΔP Loop B Output to ICS (Channel B)	0 – 43.3 psid	0 – 10 VDC	ICS
1RPSP1NI5 ΔΦ	NI-5 Detector Flux Differential (Dixson Indicator)	-62.5 to +62.5 % RTP	0 – 10 VDC	Control Room Indicator
1RPSP1NI6 ΔΦ	NI-6 Detector Flux Differential (Dixson Indicator)	-62.5 to +62.5 % RTP	0 – 10 VDC	Control Room Indicator
1RPSP1NI7 ΔΦ	NI-7 Detector Flux Differential (Dixson Indicator)	-62.5 to +62.5 % RTP	0 – 10 VDC	Control Room Indicator
1RPSP1NI8 ΔΦ	NI-8 Detector Flux Differential (Dixson Indicator)	-62.5 to +62.5 % RTP	0 – 10 VDC	Control Room Indicator

*Contact Input Open to Alarm

3.11 Existing Hardwired Computer Points

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2355	RPS CH A FLOW/FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2429	RPS CH B FLOW/FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2430	RPS CH C FLOW/FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2431	RPS CH D FLOW/FLUX (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2408	RPS CH A RC FLOW (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2409	RPS CH B RC FLOW (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2410	RPS CH C RC FLOW (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2411	RPS CH D RC FLOW (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1A1549	RPS CH A TOTAL RCS FLOW	0 – 180,000 kLB/Hr	Gateway
O1A1550	RC LOOP A FLOW 1	0 – 90,000 kLB/Hr	Gateway
O1A1551	RC LOOP B FLOW 1	0 – 90,000 kLB/Hr	Gateway
O1A0877	RPS CH B TOTAL RCS FLOW	0 – 180,000 kLB/Hr	Gateway
O1A0878	RC LOOP A FLOW 2	0 – 90,000 kLB/Hr	Gateway
O1A0879	RC LOOP B FLOW 2	0 – 90,000 kLB/Hr	Gateway
O1A1420	RPS CH C TOTAL RCS FLOW	0 – 180,000 kLB/Hr	Gateway
O1A1421	RC LOOP A FLOW 3	0 – 90,000 kLB/Hr	Gateway
O1A1422	RC LOOP B FLOW 3	0 – 90,000 kLB/Hr	Gateway
O1A1712	RPS CH D TOTAL RCS FLOW	0 – 180,000 kLB/Hr	Gateway
O1A1713	RC LOOP A FLOW 4	0 – 90,000 kLB/Hr	Gateway
O1A1714	RC LOOP B FLOW 4	0 – 90,000 kLB/Hr	Gateway
O1A1280	NI 5 DETECTOR FLUX DIFF	-62.5 to +62.5 % RTP	Gateway
O1A1281	NI 6 DETECTOR FLUX DIFF	-62.5 to +62.5 % RTP	Gateway
O1A1282	NI 7 DETECTOR FLUX DIFF	-62.5 to +62.5 % RTP	Gateway
O1A1283	NI 8 DETECTOR FLUX DIFF	-62.5 to +62.5 % RTP	Gateway

* These computer points may be provided by a summary Test Enable (see Section 25.2.3) point with individual pseudo points being created at the OAC.

3.12 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

3.13 **References**

See Section 28.

4.0 RCS High Pressure Trip

4.1 Existing Automatic Trip Function Description

High RCS Pressure Trip

Reactor Coolant System Pressure inputs are shared with RPS Functions #5 and #6.
Reactor Coolant System (RCS) pressure transmitters 1RCPT0017P, 18P, 19P and 20P provide inputs to the RPS protective channels A, B, C and D respectively. When any of these signals reach the High Pressure Trip Setpoint, the associated protective channel bistable is tripped. If two or more protective channel bistables are in the tripped state, a reactor trip is generated.
Tech Specs requires that the reactor trip before 2355 psig (allowable value) to prevent the RCS from exceeding the safety limit of 2750 psig. Actual RPS trip setpoint is 2345 psig for conservatism.

4.2 Description of Functions Related to Existing Trip

The trip bistables have toggle switches associated with them and are required to be manually reset when the bistable changes from its non-tripped state to its tripped state. In addition the trip bistables have indicating lamps associated with them (output lamp and memory lamp). The bistable lamps and toggle switches general operation are to provide a dim lamp when the bistable is in the non-tripped condition and provide a bright lamp when in the tripped condition. The toggle switches are required to be manually toggled to clear the bistable and reset the lamps.

4.3 Existing Shutdown Bypass Function

4.3.1 When the channel is placed in Shutdown (S/D) Bypass, the High RCS Pressure Trip setpoint is changed to less than 1720 psig (allowable value, actual RPS setpoint is 1710 for conservatism). S/D bypass for each RPS channel is manually initiated once the plant has been maneuvered past the low RCS pressure trip setpoint.

4.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

4.4 Existing Setpoints for Trip Functions

4.4.1 The High RCS Pressure Trip setpoint during normal operation is 2345 psig.

4.4.2 With Shutdown Bypass enabled, the High RCS Pressure Trip setpoint is reduced to 1710 psig.

4.4.3 Trip occurs on increasing RCS Pressure.

4.5 **Existing Algorithm Equations for Channel Trip Functions**

RCS High Pressure Trip

CURRENT ALGORITHM

Trip: $P_m \geq P_{SP\ PRESS()}$

(a) P_m = measured RCS pressure into each RPS channel A (B, C and D).

(b) $P_{SP\ PRESS(N)}$ = 2345 psig, High Pressure Reactor Trip setpoint – normal Power Operation.

(c) $P_{SP\ PRESS(S/D)}$ = 1710 psig, High Pressure setpoint – Shutdown Bypass enabled.

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	Reset Value	Units
P_m	Measured Reactor Coolant System Pressure	1700 – 2500	N/A	psig
$P_{SP\ PRESS(N)}$	Normal High RCS Pressure Reactor Trip Setpoint Tech Spec Allowable Value is ≤ 2355 psig.	2345	Manual	psig
$P_{SP\ PRESS(S/D)}$	S/D Bypass High RCS Pressure Reactor Trip Setpoint Tech Spec Allowable Value is ≤ 1720 psig.	1710	Manual	psig

4.6 **New Algorithm Equations for Channel Actuation Functions**

RCS High Pressure Trip

PROPOSED ALGORITHM

Trip: $P_{m2.Max} \geq P_{SP\ PRESS()}$

(a) $P_{m2.Max}$ = RC pressure, 2nd maximum value of pressure from RPS channel A, B, C and D.

(b) $P_{SP\ PRESS(N)}$ = 2345 psig, High Pressure setpoint – normal Power Operation.

(c) $P_{SP\ PRESS(S/D)}$ = 1710 psig, High Pressure setpoint – Shutdown Bypass enabled.

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$P_{m2.Max}$	Second maximum RCS pressure	1700 – 2500	N/A	psig
$P_{SP\ PRESS(N)}$	Normal High RCS Pressure Reactor Trip Setpoint Tech Spec Allowable Value is ≤ 2355 psig.	2345	Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value.	psig
$P_{SP\ PRESS(S/D)}$	Shutdown/Bypass High RCS Pressure Reactor Trip Setpoint is automatically enabled when the S/D bypass keyswitch is placed to Bypass. Tech Spec Allowable Value is ≤ 1720 psig.	1710	Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value.	psig

4.7 New Design Features

4.7.1 Each RPS instrument channel (A, B, C & D) processes the associated RCS pressure signal value as well as the RCS pressure signal values from the other three instrument channels. For the High RCS Pressure channel trip, each RPS channel selects the second maximum (2.Max) measured High pressure value ($P_{m2.Max}$) from all four channels. If the value of $P_{m2.Max}$ exceeds the High RC Pressure trip setpoint ($P_{SP\ PRESS(N)}$) [or $P_{SP\ PRESS(S/D)}$ for Shutdown/Bypass plant conditions], the channel provides a channel trip output signal. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

4.7.2 An S/D Bypass High RCS Pressure trip setpoint is automatically implemented when the S/D Bypass keyswitch is placed to BYPASS.

4.7.3 The trip comparators associated with the new TXS design are software driven and do not require to be manually reset. The new TXS design does not provide local indication for each comparator condition. However, the comparator condition is viewable via the maintenance work station.

4.7.4 Analog Signal Monitoring discussion, see Section 25.4.

4.7.5 CHANNEL CHECK discussion, see Section 25.1.

4.8 Safety Classification

This function is classified QA Condition 1 (Class 1E).

4.9 Response Time Requirements

The response time for the TXS rack/processing equipment shall be ≤ 185 msec for Function 4. This time does not include the sensor response time.

4.10 Existing Input Signals

Note RC Pressure Input Signals are shared with Functions 5 and 6.

ID Code	Description	Physical Range	Electrical Range
1RCPT0017P (RC1A-PT1)	RC Pressure Ch. A	1700 – 2500 psig	4 - 20 mA
1RCPT0018P (RC1A-PT2)	RC Pressure Ch. B	1700 – 2500 psig	4 - 20 mA
1RCPT0019P (RC1B-PT1)	RC Pressure Ch. C	1700 – 2500 psig	4 - 20 mA
1RCPT0020P (RC1B-PT2)	RC Pressure Ch. D	1700 – 2500 psig	4 - 20 mA

4.11 Existing Output Signals

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA1-6	RP Channel A High Press Trip	Binary	145 VDC	Statalarm
1SA1-18	RP Channel B High Press Trip	Binary	145 VDC	Statalarm
1SA1-30	RP Channel C High Press Trip	Binary	145 VDC	Statalarm
1SA1-42	RP Channel D High Press Trip	Binary	145 VDC	Statalarm
ER-163*	R.P. Channel A Hi Press Trip	Binary	125 VDC	Event Recorder
ER-172*	R.P. Channel B Hi Press Trip	Binary	125 VDC	Event Recorder
ER-181*	R.P. Channel C Hi Press Trip	Binary	125 VDC	Event Recorder
ER-191*	R.P. Channel D Hi Press Trip	Binary	125 VDC	Event Recorder
1RCPT0017P (RC1A-PT1)	RP Reactor Coolant System Pressure - Loop A Output to ICS (Channel A – Isolated Output)	1700 – 2500 psig	0 - 10 VDC	ICS
1RCPT0018P (RC1A-PT2)	RP Reactor Coolant System Pressure - Loop A Output to ICS (Channel B – Isolated Output)	1700 – 2500 psig	0 - 10 VDC	ICS

*Contact Input Open to Alarm

4.12 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design. [Note that O1A1688, O1A1689, O1A1690 & O1A1691 remain hardwired (HW), in support of the station Core Thermal Power (CTP) calculation requirements, and will also be available on the Gateway.]

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2372	RPS CH A HI PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2373	RPS CH B HI PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2374	RPS CH C HI PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2376	RPS CH D HI PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2404	RPS CH A RC PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2405	RPS CH B RC PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2406	RPS CH C RC PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2407	RPS CH D RC PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D1246	RPS CH A SD BYPASS HIGH RCS PRESS TRIP (NOT TRIP) (TRIP)	Binary	Gateway
O1D1248	RPS CH B SD BYPASS HIGH RCS PRESS TRIP (NOT TRIP) (TRIP)	Binary	Gateway
O1D1249	RPS CH C SD BYPASS HIGH RCS PRESS TRIP (NOT TRIP) (TRIP)	Binary	Gateway
O1D1250	RPS CH D SD BYPASS HIGH RCS PRESS TRIP (NOT TRIP) (TRIP)	Binary	Gateway
O1A1688	RC LOOP A NR PRESS 1 (RPS CH A)	1700 – 2500 psig**	Gateway/HW
O1A1689	RC LOOP A NR PRESS 1 (RPS CH B)	1700 – 2500 psig**	Gateway/HW
O1A1690	RC LOOP A NR PRESS 1 (RPS CH C)	1700 – 2500 psig**	Gateway/HW
O1A1691	RC LOOP A NR PRESS 1 (RPS CH D)	1700 – 2500 psig**	Gateway/HW

* These computer points may be provided by a summary Test Enable (see Section 25.2.3) point with individual pseudo points being created at the OAC.

** The hardwired input signal to the OAC is 0 to 10 VDC, representing 1700 to 2500 psig.

4.13 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

4.14 **References**

See Section 28.

5.0 RCS Low Pressure Trip

5.1 Existing Automatic Trip Function Description

Low RCS Pressure Trip

Reactor Coolant System pressure inputs are shared with RPS Function 4.

When any of these signals reach the Low Pressure Trip Setpoint, the associated protective channel bistable is tripped. If two or more protective channel bistables are in the tripped state, a reactor trip is generated.

Tech Specs require reactor trip before 1800 psig (allowable value) to prevent DNB. Actual RPS setpoint is 1810 psig for conservatism.

5.2 Description of Functions Related to Existing Trip

Tech Specs requires reactor trip < 1800 psig RCS pressure to prevent power production at low pressures, so that the DNB is maintained greater than or equal to requirements for those design accidents that result in a pressure reduction.

5.3 Existing Shutdown Bypass Function

5.3.1 The Low RCS Pressure Trip is bypassed when each RPS channel is placed in Shutdown Bypass.

5.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

5.4 Existing Setpoints for Trip Functions

5.4.1 The Low RCS Pressure Trip setpoint during normal operation is 1810 psig.

5.4.2 With Shutdown Bypass enabled, the Low RCS Pressure Trip is bypassed.

5.4.3 Trip occurs on decreasing RCS Pressure.

5.5 Existing Algorithm Equations for Channel Trip Functions

RCS Low Pressure Trip
CURRENT ALGORITHM
Channel Trip: $P_m \leq P_{SP\ PRESS}$

(a) **P_m = measured RCS pressure into each RPS channel A (B, C and D).**
(b) **$P_{SP\ PRESS}$ = 1810 psig, Low Pressure Reactor Trip setpoint – normal Power Operation.**
(c) **With Shutdown Bypass enabled, the RCS Low Pressure Trip is bypassed.**

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	RESET Value	Units
P_m	Measured Reactor Coolant System Pressure	1700 – 2500	NA	psig
$P_{SP\ PRESS}$	Low RCS Pressure Reactor Trip Setpoint Tech Spec Allowable Value is ≥ 1800 psig.	1810	Manual	psig

5.6 **New Algorithm Equations for Channel Trip Functions**

RCS Low Pressure Trip
PROPOSED ALGORITHM
Channel Trip: $P_{m2.Min} \leq P_{SP\ PRESS}$

(a) **$P_{m2.Min}$ = RC pressure, 2nd minimum value of RPS Channel A, B, C & D.**
(b) **$P_{SP\ PRESS}$ = 1810 psig.**
(c) **With Shutdown Bypass enabled, the RCS Low Pressure Trip is bypassed.**

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Range/Value	RESET Value	Units
$P_{m2.Min}$	Second minimum RCS pressure	1700 – 2500	NA	psig
$P_{SP\ PRESS}$	Low RCS Pressure Reactor Trip Setpoint Tech Spec Allowable Value is ≥ 1800 psig.	1810	Trip comparator auto-resets once pressure is above the auto-reset value; see OSC-8695 for the auto-reset value.	psig

5.7 New Design Features

5.7.1 Each RPS instrument channel (A, B, C & D) processes the associated RCS pressure signal value as well as the RCS pressure signal values from the other three RPS instrument channels. For the Low RCS Pressure channel trip, each RPS channel selects the second minimum (2.Min) measured Low pressure value ($P_{m2.Min}$) from all four channels. If the value of $P_{m2.Min}$ falls below the Low RC Pressure trip setpoint ($P_{SP\ PRESS}$), the channel provides a channel trip output signal. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the Operator prior to restarting the unit.

5.7.2 This function is manually bypassed when the Shutdown Bypass Keyswitch is placed in Bypass.

5.7.3 Analog Signal Range Limit Monitoring discussion, see Section 25.4.

5.7.4 CHANNEL CHECK discussion, see Section 25.1.

5.8 Safety Classification

This function is classified QA Condition 1 (Class 1E).

5.9 Response Time Requirements

The response time for the TXS rack/processing equipment shall be ≤ 185 msec for Function 5. This time does not include the sensor response time.

5.10 Existing Input Signals

Pressure Inputs shared with RPS Function 4.

5.11 Existing Output Signals

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA1-2	RP Channel A Low Press Trip	Binary	145 VDC	Statalarm
1SA1-14	RP Channel B Low Press Trip	Binary	145 VDC	Statalarm
1SA1-26	RP Channel C Low Press Trip	Binary	145 VDC	Statalarm
1SA1-38	RP Channel D Low Press Trip	Binary	145 VDC	Statalarm
ER-164*	R.P. Channel A Lo Press Trip	Binary	125 VDC	Event Recorder
ER-173*	R.P. Channel B Lo Press Trip	Binary	125 VDC	Event Recorder
ER-182*	R.P. Channel C Lo Press Trip	Binary	125 VDC	Event Recorder
ER-192*	R.P. Channel D Lo Press Trip	Binary	125 VDC	Event Recorder

*Contact Input Open to Alarm

5.12 Existing Hardwired Computer Points

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2356	RPS CH A LO PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2357	RPS CH B LO PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2358	RPS CH C LO PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2359	RPS CH D LO PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway

5.13 New Statalarm Panel Changes

Statalarm Panel changes are shown in Section 22.

5.14 References

See Section 28.

6.0 RCS Variable Low Pressure Trip

6.1 Existing Automatic Trip Function Description

RCS Variable Low Pressure Trip (based on RCS Outlet Temperature)

Reactor Coolant System Pressure inputs are shared with RPS Function #4.

Reactor Coolant System Hot Leg Temperature inputs are shared with RPS Function #7.

The pressure trip setpoint is calculated based on the measured Hot Leg Temperature. The measured RCS pressure is an input to the bistable, if the measured RC pressure is below the calculated pressure setpoint, a Trip signal is generated. If two or more protective channels are in the tripped state, a reactor trip is generated.

Technical Specifications requires that the reactor trip before the RCS pressure exceeds the setpoint generated by the curve: RCS Pressure $\leq$ [(11.14 x T_{HOT}) - 4706]. The actual RPS Trip setpoint curve is RCS Pressure $\leq$ [(11.14 x T_{HOT}) - 4696] for conservatism.

6.2 Description of Functions Related to Existing Trip

6.2.1 This Trip prevents DNB by preventing significant production of power should RCS pressure decrease to an unacceptable value for the RCS outlet temperature present, or should T_{HOT} increase to an unacceptable value for the RCS pressure present.

6.2.2 This function causes a trip prior to the normal low RCS pressure trip point if T_{HOT} remains high, or prior to the normal high T_{HOT} trip point if RCS pressure remains low.

6.2.3 Using the formula [(11.14 x T_{HOT}) – 4696], the RPS develops a curve for every possible T_{HOT}/RCS pressure combination between the low RCS pressure trip value of 1810 psig and the high RCS temperature trip value of 617°F (plant setpoint).

6.2.4 The required Variable Low RCS Pressure/Temp trip setpoint curves are provided in each unit's respective Core Operating Limits Report.

6.3 Existing Shutdown Bypass Function

6.3.1 The Variable Low RCS Pressure Trip is bypassed when each RPS channel is placed in Shutdown Bypass.

6.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

6.4 **Existing Setpoints for Trip Functions**

6.4.1 The Variable Low RCS Pressure Trip setpoint curve during normal operation is [(11.14 x T_{HOT}) – 4696].

6.4.2 The Variable Low RCS Pressure Trip function is bypassed when each RPS channel is placed in Shutdown Bypass.

6.5 **Existing Algorithm Equations for Trip Functions**

RCS Variable Low Pressure Trip

CURRENT ALGORITHM

Trip: $P_m \leq P_{VAR} = (11.14 \times T_{HOTm}) - 4696$
into each RPS channel A, B, C and D.

P_m = measured RCS pressure into each RPS channel A, B, C, D.
T_{HOTm} = measured RCS temperature Ch. A, B, C, D.
P_{VAR} = Variable Low Pressure Trip Setpoint

Note: With Shutdown Bypass enabled, the RCS Variable Low Pressure Trip is bypassed

Existing Process Parameters for Current Algorithm

Pressure Inputs shared with RPS Function 4. Temperature Inputs shared with RPS Function 7.

Logical ID	Description	Parameter Range or Value	Reset Value	Units
T_{HOTm}	Hot Leg Temperature (measured)	520 – 620	N/A	°F
P_{VAR}	Variable Low Pressure Trip Setpoint Tech Spec Allowable Value is shown in variable pressure-temperature figure.	(11.14 x T_{HOTm}) – 4696	Manual	psig
P_m	Reactor Coolant System Pressure (measured)	1700 – 2500	N/A	psig

6.6 **New Algorithm Equations for Channel Trip Functions**

RCS Variable Low Pressure Trip
PROPOSED ALGORITHM
Trip: $P_m \leq P_{VAR} = [(K_{VP} \times T_{HOTm}) - P_0]$

(a) P_m = measured RCS pressure
(b) T_{HOTm} = measured RCS temperature
(c) K_{VP} = Constant (see table)
(d) P_0 = Constant (see table)
(e) P_{VAR} = Variable Low Pressure Trip Setpoint

Note: With Shutdown Bypass enabled, the RCS Variable Low Pressure Trip is bypassed

Process Parameters for New Algorithm

Pressure Inputs are shared with RPS Function 4. Temperature Inputs are shared with RPS Function 7.

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	Reset Value	Units
K_{VP}	Variable Low Pressure constant (settable)	11.14	N/A	psig/°F
P_0	Variable Low Pressure constant (settable)	4696.0	N/A	psig
T_{HOTm}	Hot Leg Temperature (measured)	520 – 620	N/A	°F
P_{VAR}	Variable Low Pressure Trip Setpoint Tech Spec Allowable Value is shown in variable pressure-temperature figure.	$(11.14 \times T_{HOTm}) - 4696$	Trip comparator auto-resets at the setpoint value + hysteresis; see OSC-8695 for the hysteresis value.	psig
P_m	Reactor Coolant System Pressure (measured)	1700 – 2500	N/A	psig

FUNCTION 6 DISCUSSION - RCS VARIABLE LOW PRESSURE TRIP

When the actual measured RCS Pressure P_m is less than or equal to P_{VAR} in two or more RPS instrument channels, a reactor trip shall occur. P_{VAR} is the trip setpoint which is a variable that

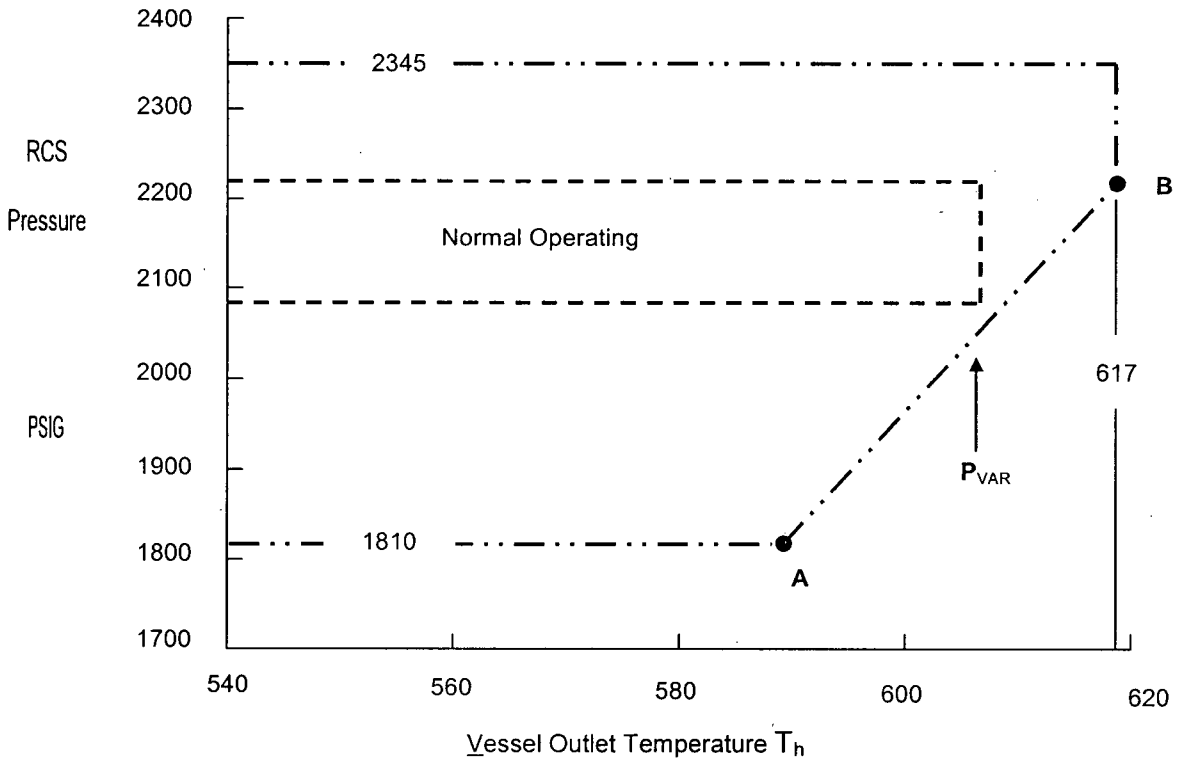
relates to Temperature. Note that the diagram below shows the variable low RCS Pressure trip boundary lines as being limited by other trip functions for Low RCS Pressure trip of 1810 psig, High RCS Pressure trip of 2345 psig and High RCS Outlet Temperature of 617°F.

The variable low RCS Pressure trip provides protection against exceeding steady state DNB Limits. RCS Pressure and Temperature conditions are monitored and the reactor is tripped when the equivalent core exit pressure and temperature near a DNB Limit. This trip is equivalent to a floating low pressure trip dependent upon measured core outlet temperature. The range of pressure-temperature conditions for which the variable low RCS Pressure trip function provides DNB protection is limited by the low RCS pressure and the high RCS outlet temperature trip functions. The variable low RCS Pressure trip setpoint is determined via a synthesis of steady-state thermal-hydraulic analyses. The locus of pressure-temperature conditions at which the DNBR limit is violated is calculated for both 3 & 4 RCP operation. The trip setpoint is determined by adjusting the safety limit to account for measurement uncertainty, pressure tap locations and additional safety margins such that:

A combined temperature / pressure function of $P_{VAR} \leq [11.14 \times T_{HOTm}] - 4706$ (Tech Spec Values)

To obtain:

A combined temperature / pressure function of $P_{VAR} \leq [11.14 \times T_{HOTm}] - 4696$ (Plant setpoints)



VARIABLE PRESSURE-TEMPERATURE

6.7 New Design Features

6.7.1 Each RPS instrument channel receives its associated RCS Pressure and RCS Hot Leg Temperature input and calculates an RCS Variable Low Pressure function signal based on the algorithm. Each RPS instrument channel also receives the calculated RCS Variable Low Pressure function signals from the other channels. Each channel shall select the 2.Min value of the RCS Variable Low Pressure function signals to determine if a Variable Low Pressure Trip condition exists for that channel. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

6.7.2 This function is manually bypassed when the Shutdown Bypass Keyswitch is placed in Bypass.

6.7.3 Analog Signal Monitoring discussion, see Section 25.4.

6.7.4 CHANNEL CHECK discussion, see Section 25.1.

6.8 Safety Classification

This function is classified QA Condition 1 (Class 1E).

6.9 **Response Time Requirements**

6.9.1 The response time for the TXS rack/processing equipment shall be ≤ 185 msec for pressure change input for Function 6. This time does not include the sensor response time.

6.9.2 The response time for the TXS rack/processing equipment shall be ≤ 425 msec for temperature change input for Function 6.

6.10 Existing Output Signals

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA1-5	RP Channel A Press/Temp Trip	Binary	145 VDC	Statalarm
1SA1-17	RP Channel B Press/Temp Trip	Binary	145 VDC	Statalarm
1SA1-29	RP Channel C Press/Temp Trip	Binary	145 VDC	Statalarm
1SA1-41	RP Channel D Press/Temp Trip	Binary	145 VDC	Statalarm
ER-165*	R.P. Channel A Press./Temp Ratio Trip	Binary	125 VDC	Event Recorder
ER-174*	R.P. Channel B Press/Temp Ratio Trip	Binary	125 VDC	Event Recorder
ER-183*	R.P. Channel C Press/Temp Ratio Trip	Binary	125 VDC	Event Recorder
ER-193*	R.P. Channel D Press/Temp Ratio Trip	Binary	125 VDC	Event Recorder

*Contact Input Open to Alarm

6.11 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2377	RPS CH A PRESS/TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2378	RPS CH B PRESS/TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2379	RPS CH C PRESS/TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2380	RPS CH D PRESS/TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway

6.12 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

6.13 **References**

See Section 28.

7.0 RCS High Outlet Temperature Trip

7.1 Existing Automatic Trip Function Description

RCS High Outlet Temperature Trip

Reactor Coolant System Hot Leg Temperature inputs are shared with RPS Function #6.

Reactor Coolant System Hot Leg temperature RTD elements 1RCRD0001A, 2B, 3A and 4B provide Reactor Coolant Hot Leg Temperature inputs to the RPS. When any of these signals reach the High Temperature Trip Setpoint, the associated protective channel bistable is tripped. If two or more protective channel bistables are in the tripped state, a reactor trip is generated. Tech Specs require that the reactor trip before 618°F (allowable value). Actual RPS trip setpoint is at 617°F for conservatism.

7.2 Description of Functions Related to Existing Trip

7.2.1 The RCS High Outlet Temperature trip, in conjunction with the RCS Low Pressure and RCS Variable Low Pressure trips, provides protection for the DNBR Safety Limits. A trip is initiated whenever the reactor vessel outlet temperature approaches the conditions necessary for DNB. Portions of each RCS High Outlet Temperature trip channel are common with the RCS Variable Low Pressure trip. The RCS High Outlet Temperature trip provides steady state protection for the DNBR Safety Limit.

7.2.2 The RCS High Outlet Temperature trip sets the maximum RCS outlet temperature at which the reactor can operate before exceeding steady state or transient DNB limits. The trip setpoint Allowable Value is selected to ensure that a trip occurs before hot leg temperatures reach the point beyond which the RCS Low Pressure and Variable Low Pressure trips are analyzed.

7.3 Existing Shutdown Bypass Function

7.3.1 The RCS High Outlet Temperature Trip setpoint is NOT bypassed when each RPS channel is placed in Shutdown Bypass.

7.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitches.

7.4 Existing Setpoints for Trip Functions

7.4.1 The RCS High Outlet Temperature setpoint during normal operation is 617°F.

7.4.2 This function is not bypassed when the Shutdown Bypass Keyswitch is placed in Bypass.

7.4.3 Trip actuates on Increasing Reactor Coolant System Hot Leg Temperature.

7.5 **Existing Algorithm Equations for Channel Trip Functions**

RCS High Outlet Temperature Trip
CURRENT ALGORITHM
Trip: $T_{HOTm} \geq T_{SP\ TEMP}$

(a) T_{HOTm} = measured RCS Temperature into each RPS channel A, B, C and D.

(b) $T_{SP\ TEMP}$ = 617 °F setpoint.

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	RESET Value	Units
T_{HOTm}	Hot Leg Temperature (measured)	520 - 620	NA	°F
$T_{SP\ TEMP}$	High Temperature Reactor Trip Setpoint	617	manual reset once temperature is below setpoint	°F

7.6 **New Algorithm Equations for Channel Trip Functions.**

RCS High Outlet Temperature Trip
PROPOSED ALGORITHM
Trip: $T_{HOTm2.Max} \geq T_{SP\ TEMP}$

(a) $T_{HOTm2.Max}$ = RC temperature, 2nd maximum value of temperature from RPS channel A, B, C and D.

(b) $T_{SP\ TEMP}$ = 617 °F.

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	RESET Value	Units
$T_{HOTm2.Max}$	Second maximum Hot Leg Temperature	520 - 620	NA	°F
$T_{SP\ TEMP}$	High Temperature Reactor Trip Setpoint Tech Spec Allowable Value is ≤ 618°F.	617	Trip comparator auto-resets once temperature is below the auto-reset value; see OSC-8695 for the auto-reset value.	°F

7.7 New Design Features

7.7.1 New TXS system temperature transmitter converts standard 100-ohm platinum RTD resistance input into 4 – 20 mADC input to the TXS analog input channel. TXS scaling software shall be capable of adjusting the scaling of the standard 100-ohm platinum RTD input values to represent the actual RCS T_{HOT} RTD resistance curve for each channel.

7.7.2 Each RPS instrument channel (A, B, C & D) processes the associated Hot Leg Outlet Temperature (T_{HOTm}) signal value as well as the T_{HOT} signal values from the other three instrument channels. For the RCS Outlet Temperature channel trip, each RPS channel selects the second maximum (2.Max) T_{HOT} Value from all four channels ($T_{HOTm2.Max}$). If the value of $T_{HOTm2.Max}$ is greater than or equal to 617°F ($T_{SP\ TEMP}$), the channel provides a channel trip output signal. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

7.7.3 With Shutdown Bypass enabled, there is no effect to the RCS Hot Leg Outlet Temperature Trip function, since the setpoint comparator is not bypassed via the S/D bypass keyswitch. It remains active and armed.

7.7.4 Analog Signal Monitoring discussion, see Section 25.4.

7.7.5 CHANNEL CHECK discussion, see Section 25.1.

7.8 Safety Classification

This function is classified QA Condition 1 (Class 1E).

7.9 Response Time Requirements

The response time for the TXS rack/processing equipment shall be ≤ 425 msec for Function 7. This time does not include the sensor response time.

7.10 Existing Input Signals

RC T_{HOT} Temperature Inputs are shared with Function 6.

ID Code	Description	Physical Range	Electrical Range
1RCRD0001A	RC Hot Leg A Temperature Ch. A	520 - 620 °F	RTD 204 to 224Ω*
1RCRD0002B	RC Hot Leg A Temperature Ch. B	520 - 620 °F	RTD 204 to 224Ω*
1RCRD0003A	RC Hot Leg B Temperature Ch. C	520 - 620 °F	RTD 204 to 224Ω*
1RCRD0004B	RC Hot Leg B Temperature Ch. D	520 - 620 °F	RTD 204 to 224Ω*

* Approximate values. The specific resistance/temperature data for each RTD serial number/ID will be provided in OSC-8695 Unit 1 Software Parameters Calculation.

7.11 Existing Output Signals

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA1-4	RP Channel A High Temp Trip	Binary	145 VDC	Statalarm
1SA1-16	RP Channel B High Temp Trip	Binary	145 VDC	Statalarm
1SA1-28	RP Channel C High Temp Trip	Binary	145 VDC	Statalarm
1SA1-40	RP Channel D High Temp Trip	Binary	145 VDC	Statalarm
ER-166*	R.P. Channel A Hi Temp Trip	Binary	125 VDC	Event Recorder
ER-175*	R.P. Channel B Hi Temp Trip	Binary	125 VDC	Event Recorder
ER-184*	R.P. Channel C Hi Temp Trip	Binary	125 VDC	Event Recorder
ER-194*	R.P. Channel D Hi Temp Trip	Binary	125 VDC	Event Recorder

*Contact Input Open to Alarm

7.12 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design. [Note that O1A1692, O1A1693, O1A1694 & O1A1695 remain hardwired (HW), in support of the station Core Thermal Power (CTP) calculation requirements and will also be available on the Gateway.]

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2368	RPS CH A HI TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2369	RPS CH B HI TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2370	RPS CH C HI TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2371	RPS CH D HI TEMP (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2400	RPS CH A RC TEMP (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2401	RPS CH B RC TEMP (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2402	RPS CH C RC TEMP (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D2403	RPS CH D RC TEMP (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1A1692	RPS CH A HOT LEG A TEMP	520 – 620 °F**	Gateway/HW*
O1A1693	RPS CH B HOT LEG A TEMP	520 – 620 °F**	Gateway/HW*
O1A1694	RPS CH C HOT LEG B TEMP	520 – 620 °F**	Gateway/HW*
O1A1695	RPS CH D HOT LEG B TEMP	520 – 620 °F**	Gateway/HW*

* These computer points may be provided by a summary Test Enable (see Section 25.2.3) point with individual pseudo points being created at the OAC.

** The existing hardwired input signal to the OAC is 0 to 100 mVDC, representing 520 to 620°F. These inputs will be changed to 0 to 10 VDC per EC0000090482.

7.13 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

7.14 **References**

See Section 28.

8.0 Reactor Building High Pressure Trip

8.1 Existing Automatic Trip Function Description

Reactor Building High Pressure Channel Trip

Reactor Building High pressure is monitored by four Reactor Building pressure switches 1BSPS0065, 0066, 0067 and 0068, which provide inputs to the RPS protective channels A, B, C and D respectively. The normally closed contact is wired to the RPS Channels and the switches open on increasing RB pressure.

When any of these signals reach the High Pressure Trip Setpoint, the associated protective channel bistable is tripped. If two or more protective channel bistables are in the tripped state, a reactor trip is generated.

Tech Specs require that the reactor trip before 4 psig (allowable value). Actual RPS trip setpoint is 3.5 psig for conservatism.

8.2 Description of Functions Related to Trip

The Reactor Building High Pressure trip provides an early indication of a high energy line break (HELB) inside the RB. By detecting changes in the RB pressure, the RPS can provide a reactor trip before the other system parameters have varied significantly. Thus, this trip acts to minimize accident consequences. It also provides a backup for RPS trip instruments exposed to an RB HELB environment. (Ref. OSS-0254.00-00-2002)

8.3 Existing Shutdown Bypass Function

8.3.1 The Reactor Building High Pressure Trip is NOT automatically bypassed when the RPS channel is placed in Shutdown Bypass.

8.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

8.4 Existing Setpoints for Trip Functions

8.4.1 The Reactor Building High Pressure Trip is a contact input from field mounted pressure switches.

8.4.2 The Reactor Building High Pressure Trip is NOT bypassed when each RPS channel is placed in Shutdown Bypass via the S/D keyswitch.

8.4.3 Deleted

8.5 **Existing Algorithm Equations for Channel Trip Functions**

Reactor Building High Pressure Trip
CURRENT ALGORITHM

Trip: $PS_{RB\ PRESS}$ = open contact

(a) $PS_{RB\ PRESS}$ = open contact from Reactor Building Pressure Switches in each RPS channel A, B, C & D.
(b) Two or more channel bistables tripped = Reactor Trip.
(c) No automatic Shutdown Bypass features.

Reactor Building High Pressure Trip
PROPOSED ALGORITHM

Trip: $PS_{RB\ PRESS} \geq$ 2 out of 4 open contact signals

(a) $PS_{RB\ PRESS}$ = open contact from Reactor Building Pressure Switches in each RPS channel A, B, C & D.
(b) Two or more channels tripped = Reactor Trip.
(c) No automatic Shutdown Bypass features.

8.6 **Processing Parameters for Algorithm**

Logical ID	Description	Value	Units
$PS_{RB\ PRESS}$	Reactor Building Pressure switch contact input	Binary	Open contact input

8.7 **New Design Features**

8.7.1 The TXS RPS system uses a 2 out of 4 logic scheme on contact only signals. The 2/4 logic scheme is slightly different from the existing design, since a failed pressure switch will not cause a channel trip. The 2/4 logic within each RPS looks for a second open contact from the other field devices to initiate a channel trip. This logic eliminates a single failure from tripping an RPS channel and will only provide a reactor trip when there is valid Reactor Building High Pressure (2 out of 4). A single open contact will be annunciated via the respective channel's Trouble Statalarm and via the OAC computer. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

8.7.2 This function is not bypassed when the Shutdown Bypass Keyswitch is placed in Bypass.

8.7.3 Deleted

8.7.4 CHANNEL CHECK discussion, see Section 25.1.

8.8 **Safety Classification**

This function is classified QA Condition 1 (Class 1E).

8.9 **Response Time Requirements**

The response time for the TXS rack/processing equipment shall be ≤ 150 msec for Function 8. This time does not include the sensor response time.

8.10 **Existing Input Signals**

(contact inputs wetted by RPS – 120 VAC)

ID Code	Description	Physical Range	Electrical Range
1BSPS0065	RB Pressure Switch Channel A	Contact inputs (RB Pressure High / RB Pressure Not-High)	open contact / closed contact
1BSPS0066	RB Pressure Switch Channel B	Contact input (RB Pressure High / RB Pressure Not-High)	open contact / closed contact
1BSPS0067	RB Pressure Switch Channel C	Contact input (RB Pressure High / RB Pressure Not-High)	open contact / closed contact
1BSPS0068	RB Pressure Switch Channel D	Contact input (RB Pressure High / RB Pressure Not-High)	open contact / closed contact

8.11 **Existing Output Signals**

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA1-9	RP Channel A R.B. High Press Trip	Binary	145 VDC	Statalarm
1SA1-21	RP Channel B R.B. High Press Trip	Binary	145 VDC	Statalarm
1SA1-33	RP Channel C R.B. High Press Trip	Binary	145 VDC	Statalarm
1SA1-45	RP Channel D R.B. High Press Trip	Binary	145 VDC	Statalarm
ER-167*	R.P. Channel A Hi RB Press Trip	Binary	125 VDC	Event Recorder
ER-176*	R.P. Channel B Hi RB Press Trip	Binary	125 VDC	Event Recorder
ER-185*	R.P. Channel C Hi RB Press Trip	Binary	125 VDC	Event Recorder
ER-195*	R.P. Channel D Hi RB Press Trip	Binary	125 VDC	Event Recorder

*Contact Input Open to Alarm

8.12 Existing Hardwired Computer Points

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D1451	RPS CH A HI RB PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1452	RPS CH B HI RB PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1453	RPS CH C HI RB PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1454	RPS CH D HI RB PRESS (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1455	RPS CH A HI RB PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D1456	RPS CH B HI RB PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D1457	RPS CH C HI RB PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*
O1D1458	RPS CH D HI RB PRESS (NOT IN TEST) (IN TEST)	Binary	Gateway*

* These computer points may be provided by a summary Test Enable (see Section 25.2.3) point with individual pseudo points being created at the OAC.

8.13 New Statalarm Panel Changes

Statalarm Panel changes are shown in Section 22.

8.14 References

See Section 28.

9.0 Loss of Both Main Feedwater Pumps Trip

9.1 Existing Automatic Trip Function Description

Loss of Both Main Feedwater Pumps

Reactor Power (Flux) inputs are shared with RPS Function #1.

An Anticipatory Reactor Trip shall be generated by the RPS in the event of a trip of both Main Feedwater Pump Turbines (MFWPTs). This trip limits the extent of overheating of the Reactor Coolant System, which could occur following a loss of both Main Feedwater Pumps.

The trip is required to be automatically armed at $\geq$ 2% RTP (allowable value); actual trip enabling setpoint is 1.75% RTP for conservatism. The trip is automatically blocked when RTP is $\leq$ 0.5% RTP.

The RPS receives contact inputs from the pressure switches that monitor the turbine hydraulic oil pressure of both MFWPTs. The Technical Specifications require that the pressure switches trip at < 75 psig (allowable value). The current plant setpoint for this trip is$\leq$ 85 psig. Each MFWPT has four hydraulic oil pressure switches; one for each RPS channel A, B, C and D, for a total of 8 inputs. The switch inputs from both MFWPTs are arranged so that a Trip of both MFWPTs produces a trip from that RPS channel. When any two or more RPS channels sense loss of hydraulic oil pressure, indicating both MFWPTs are tripped, a Reactor Trip is initiated.

9.2 Description of Functions Related to Existing Trip and Automatic Bypass

The loss of both Main Feedwater Pump Turbines (Hydraulic Oil Pressure) sensed by two or more RPS channels initiates a Reactor Trip at high power levels. The trip provides an early reactor trip in anticipation of the loss of heat sink associated with the loss of main feedwater pumps. This trip was added in accordance with NUREG-0737 following the Three Mile Island Unit 2 accident. This trip provides a reactor trip at high power levels for a loss of both main feedwater pumps to minimize challenges to the Power Operated Relief Valve (PORV).

While most trip functions have separate annunciators for each RPS channel, the Main Feedwater pump turbine trip function uses a common annunciator for all four channels ("FWPT/Reactor Trip P.S. Alert" – P.S. stands for "pressure switch"). This Annunciator is alarmed if either main feedwater pump turbine A AND/OR B is tripped in any channel. This Annunciator is NOT blocked by the Bypass function (NI below 0.5% RTP).

The Main Feedwater Pump Turbine trip function is blocked on power decrease at 0.5% RTP and the "FWPT/Reactor Channel Trip Bypass" annunciator is alarmed. This annunciator is also shared by all four channels. In the current design, this annunciator will alarm when the first channel NI is below 0.5% RTP during a power decrease, however the reactor trip function is not truly disabled at this point, since the other three channels are still capable of performing the required reactor trip function (2/4 logic). Effectively, three channels must be at or below 0.5% RTP during a power decrease for the FWPT reactor trip function to actually be bypassed.

9.3 **Existing Shutdown Bypass Function**

9.3.1 The Loss of Both Main Feedwater Pumps Trip is NOT bypassed when the RPS channel is placed in Shutdown Bypass via the keyswitch. As noted above, this trip is automatically bypassed on decreasing power at 0.5% RTP.

9.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

9.4 **Existing Setpoints for Trip Functions**

9.4.1 The Trip of Both Main Feedwater Pump Turbines are contact inputs from field mounted pressure switches.

9.4.2 The Main Feedwater Pump Trip is automatically enabled when reactor power is at or above 1.75% power.

9.4.3 The Main Feedwater Pump Trip is automatically bypassed when reactor power is decreasing less than or equal to 0.5% power.

9.5 **Existing Algorithm Equations for Channel Trip Functions**

Reactor power (RTP) inputs are shared with RPS Function #1.

Loss of Main Feedwater Pumps Trip

CURRENT ALGORITHM

Channel Trip: [(PS_{MFPTA} = open contact) AND (PS_{MFPTB} = open contact)] AND $\phi m \geq \phi_{SP\ FLUX(ENABLE)}$

Automatic Trip Bypass: $\phi_m \leq \phi_{SP\ FLUX(BYPASS)}$

(a) PS_{MFPTA} = contact input from MFWP turbine A into RPS channel A, B, C and D.

(b) PS_{MFPTB} = contact input from MFWP turbine B into RPS channel A, B, C and D.

(c) ϕ_m = measured total flux (RTP%) in each RPS channel A, B, C and D.

(d) $\phi_{SP\ FLUX(ENABLE)}$ = 1.75% RTP (Adjustable), Enables Reactor Trip function on increasing power.

(e) $\phi_{SP\ FLUX(BYPASS)}$ = 0.5% RTP (Adjustable), Bypasses Reactor Trip function on decreasing power.

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	RESET Value	Unit
PS_{MFPTA}	Contact input from MFWPT A pressure switch to Channel A,B,C,D of the RPS	contact open / contact closed	NA	MFWPT A tripped / not tripped
PS_{MFPTB}	Contact input from MFWPT B pressure switch to Channel A,B,C,D of the RPS	contact open / contact closed	NA	MFWPT B tripped / not tripped
ϕ_m	Measured Total Flux (% Rated Thermal Power)	0 — 125	NA	% RTP
$\phi_{SP\ FLUX(ENABLE)}$	Automatically Enables the reactor Trip function on increasing reactor power (Enabled) when reactor power is at or above the setpoint	1.75	Auto reset once power is at or below 0.5. See below.	% RTP
$\phi_{SP\ FLUX(BYPASS)}$	Automatically Bypasses the reactor Trip function (Blocked) when reactor power decreases to or below the setpoint (This is a reset value)	0.5	Auto reset once power is at or above 1.75. See above.	% RTP

9.6 **New Algorithm Equations for Channel Trip Functions**

Loss of Main Feedwater Pumps Trip

PROPOSED ALGORITHM

Trip: [≥ 2/4 (PS_{MFPTA} = open contact signals) AND ≥ 2/4 (PS_{MFPTB} = open contact signals)] AND $\phi_{m2.Max} \geq \phi_{SP\ FLUX(ENABLE)}$

Automatic Trip Bypass: $\phi_{m2.Max} \leq \phi_{SP\ FLUX(BYPASS)}$

(a) PS_{MFPTA} = contact input signals from MFWP turbine A into RPS channel A, B, C and D.

(b) PS_{MFPTB} = contact input signals from MFWP turbine B into RPS channel A, B, C and D.

(c) $\phi_{m2.Max}$ = total flux (% RTP); 2nd maximum value of Channel A, B, C, D.

(d) $\phi_{SP\ FLUX(ENABLE)}$ = 1.75% RTP (Adjustable); Enables Reactor Trip function on increasing power.

(e) $\phi_{SP\ FLUX(BYPASS)}$ (See OSC-8695 for value) (Adjustable); this is the Reset value of the trip Enable comparator for ϕ SP FLUX (ENABLE). Bypasses the reactor trip function on decreasing power.

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	RESET Value	Units
PS_{MFPTA}	Contact input from MFWPT A pressure switches to Channel A,B,C,D of the RPS	contact open / contact closed	NA	MFWPT A tripped / not tripped
PS_{MFPTB}	Contact input from MFWPT B pressure switches to Channel A,B,C,D of the RPS	contact open / contact closed	NA	MFWPT B tripped / not tripped
$\phi_{m2.Max}$	Second maximum total flux value	0 to 125	NA	% RTP
$\phi_{SP\ FLUX(ENABLE)}$	Automatically enables the reactor Trip function on Increasing Reactor Power at or above the enable value.	1.75	Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value.	% RTP
$\phi_{SP\ FLUX(BYPASS)}$	Automatically bypasses the reactor Trip function on decreasing Reactor Power at or below the value. (This is the reset value for $\phi_{SP\ FLUX(ENABLE)}$).	See OSC-8695 for value.	NA	% RTP

9.7 **New Design Features**

9.7.1 Each RPS instrument channel (A, B, C & D) monitors the associated reactor power (ϕ_m) signal value as well as the reactor power signals from the other three instrument channels. Each RPS instrument channel selects the second maximum (2.Max) measured reactor power value ($\phi_{m2.Max}$) from all four channels. On increasing reactor power, if the value of $\phi_{m2.Max}$ is equal to or greater than $\phi_{SP\ FLUX(ENABLE)}$, the Loss of Both Main Feedwater Pump Turbine Reactor Trip function is enabled in that RPS instrument channel.

9.7.2 Each RPS instrument channel A, B, C & D monitors both MFWPT A and B hydraulic oil pressure switch contact inputs. The status of these eight (8) contact inputs is shared between channels over fiber optic communication links. If the reactor trip function is enabled (as discussed in 9.7.1 above) and both FWPTs are tripped, as indicated by 2/4 FWPT A AND 2/4 FWPT B hydraulic oil pressure switch contacts open, then that RPS instrument channel produces a trip signal. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

9.7.3 On decreasing reactor power, the reactor power comparator using the 2.Max NI signal shall reset whenever the 2.Max signal is at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$ (see OSC-8695 for the reset value). With 4 channels operable, this effectively results in the FWPT trip function being Bypassed when 3 or more channels are at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$. If one channel is in Manual Bypass via the channel bypass switch, the FWPT trip function is effectively bypassed during power decrease whenever 2 of the remaining 3 channels are at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$.

9.7.4 The Main Feedwater pump trip function uses a common annunciator for all four channels ("FWPT/Reactor Trip P.S. Alert", this alarm will be moved from 1SA18 to 1SA5, see Section 22). The annunciator is alarmed when 2/4 pressure switch contacts are open on FWPT 'A' AND/OR when 2/4 pressure switch contacts are open on FWPT 'B'. This alarm is NOT blocked by the Bypass function (2.MAX NI signal at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$).

9.7.5 The "FWPT/Reactor Trip Bypass" annunciator is also shared by all four channels. This annunciator shall alarm whenever the FWPT reactor trip function is NOT enabled, i.e., $\phi_{m2.Max}$ is $\leq \phi_{SP\ FLUX(BYPASS)}$. (Note that the $\phi_{SP\ FLUX(BYPASS)}$ value is simply the Reset value of the $\phi_{SP\ FLUX(ENABLE)}$ comparator.) With all four channels operable, at least three channels must be below the Bypass value before the FWPT/reactor trip function is disabled and the Bypass Annunciator is alarmed. The Bypass alarm will therefore only be received when the trip function is actually bypassed – this is an improvement over the original design (see section 9.2).

9.7.6 Deleted

9.7.7 Deleted

9.7.8 The Loss of Both Main Feedwater Pump Turbine Reactor Trip function is NOT bypassed when the RPS channel is placed in Shutdown bypass via the keyswitch. This trip is automatically bypassed on decreasing power at $\leq \phi_{SP\ FLUX(BYPASS)}$ (same as existing system).

9.7.9 Deleted

9.8 Safety Classification

This function is classified QA Condition 1 (Class 1E).

9.9 **Response Time Requirements**

The response time for the TXS rack/processing equipment will be ≤ 500 msec for Function 9. This time does not include the sensor response time. (Note – No response time is required by the RPS Equipment Specification for this function. The safety analyses do not credit reactor trip on a loss of both Main Feedwater Pumps Trip. The value above is established to provide acceptance criteria for testing of the new system.)

9.10 **Existing / New Input Signals**

(contact inputs wetted by RPS, 120 VAC)

ID Code	Description	Physical Range	Electrical Range
1RPSPS0400	MFWPT A to RPS A	Contact input (MFWPT A tripped / MFWPT A not-tripped)	open contact / closed contact
1RPSPS0401	MFWPT A to RPS B	Contact input (MFWPT A tripped / MFWPT A not-tripped)	open contact / closed contact
1RPSPS0402	MFWPT A to RPS C	Contact input (MFWPT A tripped / MFWPT A not-tripped)	open contact / closed contact
1RPSPS0403	MFWPT A to RPS D	Contact input (MFWPT A tripped / MFWPT A not-tripped)	open contact / closed contact
1RPSPS0404	MFWPT B to RPS A	Contact input (MFWPT B tripped / MFWPT B not-tripped)	open contact / closed contact
1RPSPS0405	MFWPT B to RPS B	Contact input (MFWPT B tripped / MFWPT B not-tripped)	open contact / closed contact
1RPSPS0406	MFWPT B to RPS C	Contact input (MFWPT B tripped / MFWPT B not-tripped)	open contact / closed contact
1RPSPS0407	MFWPT B to RPS D	Contact input (MFWPT B tripped / MFWPT B not-tripped)	open contact / closed contact

9.11 **Existing Output Signals**

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA18-19 (Note 1)	RPS FWPT/Reactor Trip P.S. Alert (Common to all 4 Channels)	Binary	145 VDC	Statalarm
1SA18-20 (Note 1)	RPS FWPT/Reactor Channel Trip Bypass (Common to all 4 Channels)	Binary	145 VDC	Statalarm
ER-383*	R.P. Ch. A MFP Trip	Binary	125 VDC	Event Recorder
ER-385*	R.P. Ch. B MFP Trip	Binary	125 VDC	Event Recorder
ER-387*	R.P. Ch. C MFP Trip	Binary	125 VDC	Event Recorder
ER-389*	R.P. Ch. D MFP Trip	Binary	125 VDC	Event Recorder

Note 1 these existing Statalarms will be moved as indicated in Section 22.

*Contact Input Open to Alarm, also Event Recorder points are automatically bypassed when Main Feedwater Pump Trip is bypassed.

9.12 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2347	FWPT / REACTOR CH A (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2348	FWPT / REACTOR CH B (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2349	FWPT / REACTOR CH C (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2350	FWPT / REACTOR CH D (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2140	FWPT / REACTOR CH A (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2141	FWPT / REACTOR CH B (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2142	FWPT / REACTOR CH C (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2143	FWPT / REACTOR CH D (NOT BYPASS) (BYPASS)	Binary	Gateway

9.13 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

9.14 **References**

See Section 28.

10.0 Main Turbine Trip

10.1 Existing Automatic Trip Function Description

Main Turbine Trip

Reactor power (% RTP) inputs are shared with RPS Function #1.

An Anticipatory Reactor Trip shall be generated by the RPS in the event of a trip of the Main Turbine (loss of Hydraulic Fluid Pressure). This trip is activated at higher power levels. This prevents challenging the High RCS Pressure Trip. The trip is enabled at≥ 30.0% RTP (allowable value); actual setpoint is 29.75 % RTP for conservatism. The trip is automatically inhibited on decreasing reactor power at ≤ 27.75 % RTP.

The RPS receives contact inputs from the pressure switches that monitor the Main Turbine Hydraulic Fluid pressure. The Main Turbine has four hydraulic fluid pressure switches: one for each RPS channel, A, B, C & D. When any two or more RPS channels sense the Main Turbine is tripped, a reactor trip is initiated.

10.2 Description of Functions Related to Existing Trip and Automatic Bypass

10.2.1 The Main Turbine hydraulic fluid pressure switches have Normally Open contacts held closed by the hydraulic fluid system pressure. The switches open on loss of hydraulic fluid pressure on decreasing pressure. The Technical Specification requires a reactor trip at < 800 psig (allowable value). The current plant setpoint for this trip is ≤850 psig.

10.2.2 The trip lowers the probability of an RCS Power Operated Relief Valve (PORV) actuation for turbine trip cases.

10.2.3 While most trip functions have separate annunciators for each RPS channel, the Main Turbine trip function uses a common annunciator for all four channels ("Gen. Turb/Reactor Trip P.S. Alert"). This annunciator is alarmed if the hydraulic fluid pressure switch contact to any channel opens to indicate a main turbine trip. This annunciator is NOT blocked by the Bypass function (NI below 27.75%% RTP).

10.2.4 The Main Turbine Trip/Reactor Trip function is automatically blocked on power decrease at 27.75% RTP and the "Gen. Turb/Reactor Trip Channel Bypass" annunciator is alarmed. This annunciator is also shared by all four channels. In the current design, this annunciator will alarm when the first channel NI is below 27.75% RTP during a power decrease, however the reactor trip function is not truly disabled at this point, since the other three channels are still capable of performing the required reactor trip function (2/4 logic). Effectively, three channels must be at or below 27.75% RTP during a power decrease for the Main Turbine reactor trip function to actually be bypassed.

10.3 **Existing Shutdown Bypass Function**

10.3.1 The Main Turbine Trip is NOT bypassed when the RPS channel is placed in Shutdown Bypass. As noted above, this trip is automatically bypassed on decreasing power at 27.75% RTP.

10.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

10.4 **Existing Setpoints for Trip Functions**

10.4.1 The Anticipatory Reactor Trip on a Main Turbine Trip is a contact input from the field mounted pressure switches.

10.4.2 The Main Turbine Trip is automatically enabled when reactor power is increasing at or above 29.75 % RTP.

10.4.3 The Main Turbine Trip is automatically bypassed when reactor power decreases at or below 27.75% RTP.

10.5 **Existing Algorithm Equations for Channel Trip Functions**

Main Turbine Trip

CURRENT ALGORITHM

Channel Trip: $[(PS_{EHC} = \text{open contact})]$ AND $\phi_m \geq \phi_{SP\ FLUX(ENABLE)}$

Automatic Trip Bypass: $\phi_m \leq \phi_{SP\ FLUX(BYPASS)}$

(a) **PS_{EHC} = contact input from Main Turbine hydraulic fluid Pressure switch in each RPS channel A, B, C, D.**

(b) **ϕ_m = measured reactor power (% RTP) in each RPS channel A, B, C, D.**

(c) **$\phi_{SP\ FLUX\ (ENABLE)}$ = 29.75% RTP (Adjustable); Enables Reactor Trip function on increasing power.**

(d) **$\phi_{SP\ FLUX\ (BYPASS)}$ = 27.75% RTP (Adjustable); Bypasses Reactor Trip function on decreasing power.**

Existing Process Parameters for Current Algorithm

Logical ID	Description	Range / Value	Reset Value	Unit
PS_{EHC}	Contact inputs from EHC oil pressure switches, CH. A, B, C & D	contact open / contact closed	NA	Main Turbine tripped / not tripped
ϕ_m	Measured Total Flux (% Rated Thermal Power)	0 to 125	NA	% RTP
$\phi_{SP\ FLUX(ENABLE)}$	Automatically Enables Trip function on Increasing Reactor Power at or above the setpoint.	29.75	Auto reset once power is below setpoint. See below.	% RTP
$\phi_{SP\ FLUX(BYPASS)}$	Automatically resets Main Turbine Trip Enable at 27.75 decreasing Reactor Power and inhibits the Main Turbine Trip function. (This is a reset value.)	27.75	Automatically enables Trip on increasing reactor power. See above	% RTP

10.6 **New Algorithm Equations for Channel Actuation Functions**

Main Turbine Trip

PROPOSED ALGORITHM

Channel Trip: [(PS_{EHC} ≥ 2/4 open contact signals)] AND

$$\phi_{m2.Max} \geq \phi_{SP\ FLUX\ (ENABLE)}$$

Automatic Trip Bypass: $\phi_{m2.Max} \leq \phi_{SP\ FLUX\ (BYPASS)}$

(a) **PS_{EHC} = contact input signals from Main Turbine hydraulic fluid Pressure switch in each RPS channel A, B, C, D.**

(b) **$\phi_{m2.Max}$ = Total Flux (% RTP); 2nd maximum value of RPS Channel A, B, C, and D.**

(c) **$\phi_{SP\ FLUX\ (ENABLE)}$ = 29.75% RTP (Adjustable); Enables Reactor Trip function on increasing power.**

(d) **$\phi_{SP\ FLUX\ (BYPASS)}$ (See OSC-8695 for value) (Adjustable). This is the Reset value of the trip Enable comparator for $\Phi_{SP\ FLUX\ (ENABLE)}$. Bypasses Reactor Trip function on decreasing power.**

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	RESET Value	Unit
PS_{EHC}	Contact inputs from EHC oil pressure switches to Channel A, B, C & D of the RPS	contact open / contact closed	NA	Main Turbine tripped / not tripped
$\phi_{m2.Max}$	Second maximum total flux value	0 to 125	NA	% RTP
$\phi_{SP\ FLUX(ENABLE)}$	Automatically enables Main Turbine Trip on Increasing Reactor Power at 29.75.	29.75	Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value.	% RTP
$\phi_{SP\ FLUX(BYPASS)}$	Automatically resets Main Turbine Trip Enable on decreasing Reactor Power and inhibits the Main Turbine Trip function. (This is the reset value for $\phi_{SP\ FLUX(ENABLE)}$)	See OSC-8695 for value.	NA	% RTP

10.7 New Design Features

10.7.1 Each RPS instrument channel (A, B, C & D) monitors the associated reactor power (ϕ_m) signal value as well as the reactor power signals from the other three instrument channels. Each RPS channel selects the second maximum (2.Max) measured reactor power value ($\phi_{m2.Max}$) from all four channels. On increasing reactor power, if the value of $\phi_{m2.Max}$ is equal to or greater than $\phi_{SP\ FLUX(ENABLE)}$, the Main Turbine Trip reactor Trip function is enabled in that RPS instrument channel.

10.7.2 Each TXS channel A, B, C & D monitors one of four hydraulic fluid pressure switch contact inputs. The status of these 4 contact inputs is shared between channels over fiber optic communications links. If the reactor Trip function is enabled (as discussed in 10.7.1 above) and 2/4 Main Turbine hydraulic fluid pressure switch contacts are open, then that RPS instrument channel produces a Trip signal. If two or more RPS instrument channels are in the tripped state, a reactor trip is generated via the 2/4 reactor trip relay logic. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

10.7.3 On decreasing reactor power, the reactor power comparator using the 2.Max NI signal shall reset whenever the 2.Max signal is at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$ (see OSC-8695 for the reset value). With 4 channels operable, this effectively results in the Main Turbine reactor trip function being Bypassed when 3 or more channels are at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$. If one channel is in Manual Bypass via the channel bypass switch, the trip function is effectively bypassed during power decrease whenever 2 of the remaining 3 channels are at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$.

10.7.4 The Main Turbine trip function uses a common annunciator for all four channels ("Gen. Turb/Reactor Trip P.S. Alert", this alarm will be moved from 1SA18 to 1SA5, see Section 22). The annunciator shall be alarmed when 1/4 hydraulic fluid pressure switch contacts are open. This alarm is NOT blocked by the Bypass function (2.MAX NI signal at or below the reset value, $\phi_{SP\ FLUX(BYPASS)}$.

10.7.5 The "Gen. Turb/Reactor Trip Bypass" annunciator is also shared by all four channels. This annunciator shall alarm whenever the Main Turbine reactor trip function is NOT enabled, i.e., $\phi_{m2.Max}$ is ≤ the reset value, $\phi_{SP\ FLUX(BYPASS)}$. (Note that the reset value, $\phi_{SP\ FLUX(BYPASS)}$ is simply the Reset value of the $\phi_{SP\ FLUX(ENABLE)}$ comparator.) With all four channels operable, at least three channels must be below the Bypass value before the Main Turbine/reactor trip function is disabled and the Bypass Annunciator is alarmed. The Bypass alarm will therefore only be received when the trip function is actually bypassed – this is an improvement over the original design (see Section 10.2).

10.7.6 The Main Turbine Trip/Reactor Trip function is NOT bypassed when the RPS channel is placed in Shutdown bypass via the keyswitch. This trip function is automatically bypassed on decreasing power at the reset value, $\phi_{SP\ FLUX(BYPASS)}$ (same as existing system).

10.7.7 Deleted

10.7.8 Deleted

10.7.9 Deleted

10.8 **Safety Classification**

This function is classified QA Condition 1 (Class 1E).

10.9 **Response Time Requirements**

The response time for the TXS rack/processing equipment will be ≤ 500 msec for Function 10.

This time does not include the sensor response time. (Note – No response time is required by the RPS Equipment Specification for this function. The safety analyses do not credit reactor trip on a Main Turbine Trip. The value above is established to provide acceptance criteria for testing of the new system.)

10.10 **Existing / New Input Signals**

(contact inputs wetted by RPS, 120 VAC)

ID Code	Description	Physical Range	Electrical Range
1RPSPS0408	RPS Gen Turbine EHC Oil Pressure (to RPS A) (NO Contact, OPENS to trip)	Contact input (Main Turbine Tripped / Not Tripped)	open contact / closed contact
1RPSPS0409	RPS Gen Turbine EHC Oil Pressure (to RPS B) (NO Contact, OPENS to trip)	Contact input (Main Turbine Tripped / Not Tripped)	open contact / closed contact
1RPSPS0410	RPS Gen Turbine EHC Oil Pressure (to RPS C) (NO Contact, OPENS to trip)	Contact input (Main Turbine Tripped / Not Tripped)	open contact / closed contact
1RPSPS0411	RPS Gen Turbine EHC Oil Pressure (to RPS D) (NO Contact, OPENS to trip)	Contact input (Main Turbine Tripped / Not Tripped)	open contact / closed contact

10.11 **Existing Output Signals**

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA18-25 (Note 1)	RPS Gen. Turb/React Trip P.S. Alert (Common to all 4 Channels)	Binary	145 VDC	Statalarm
1SA18-26 (Note 1)	RPS Gen. Turb /React Channel Trip Bypass (Common to all 4 Channels)	Binary	145 VDC	Statalarm
ER-384*	R.P. Ch. A Gen. Turb. Trip	Binary	125 VDC	Event Recorder
ER-386*	R.P. Ch. B Gen. Turb. Trip	Binary	125 VDC	Event Recorder
ER-388*	R.P. Ch. C Gen. Turb. Trip	Binary	125 VDC	Event Recorder
ER-390*	R.P. Ch. D Gen. Turb. Trip	Binary	125 VDC	Event Recorder

Note 1 these existing Statalarms will be moved as indicated in Section 22.

*Contact Input Open to Alarm also Event Recorder points are automatically bypassed when Main Turbine Trip is bypassed.

10.12 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2150	TURB / REACTOR CH A (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2151	TURB / REACTOR CH B (NOT TRIPPED) (TRIPPED)	Binary	Gateway

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2152	TURB / REACTOR CH C (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2153	TURB / REACTOR CH D (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D2154	TURB / REACTOR CH A (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2155	TURB / REACTOR CH B (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2156	TURB / REACTOR CH C (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2157	TURB / REACTOR CH D (NOT BYPASS) (BYPASS)	Binary	Gateway

10.13 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

10.14 **References**

See Section 28.

11.0 Reactor Coolant Pump Power/Flux Trip

11.1 Existing Automatic Trip Function Description

Reactor Coolant Pump Power Monitor/Flux Trip

Reactor power (% RTP) analog signal inputs are shared with RPS Function #1.
The Reactor Coolant Pump Power/Flux Trip shall generate a reactor trip signal if fewer than 3 reactor coolant pumps are operating AND reactor power is greater than 2% RTP (allowable value); actual RPS Trip setpoint is enabled at 1.5% RTP increasing for conservatism.

Each reactor coolant pump has a Reactor Coolant Pump Power Monitor (RCPPM) that monitors the power and breaker status of the pump motor to determine if the pump is running. Each RCPPM provides contact outputs to all four RPS channels.

11.2 Description of Functions Related to Existing Trip

This trip function is credited in the safety analysis for accidents in which there is a loss of electrical power to the reactor coolant pumps (pump coast-down events). The Reactor Coolant Pump Power/Flux Trip provides protection against power operation with less than three (3) reactor coolant pumps in operation. This trip provides protection against DNB by initiating a reactor trip shortly after loss of power to the reactor coolant pumps. The Power/Imbalance/Flow Trip provides a backup trip function for this trip. The RCPPM output relays also provide contact signals to the Steam Generator Level Control system for control functions.

11.3 Existing Shutdown Bypass Function

11.3.1 The Reactor Coolant Pump Power Monitor/Flux Trip is bypassed when the Shutdown Bypass switch is placed to Bypass.

11.3.2 See Section 14 for information on existing bypass functions and keyswitches and Section 23 for new TXS bypass functions and keyswitch functions.

11.4 Existing Setpoints for Trip Functions

Per Tech Specs, if reactor power is above 2% RTP, RPS will trip the reactor if two Reactor Coolant Pumps are lost. The actual setpoint is 1.5%.

11.5 Existing Hardware Description

The Reactor Coolant Pump Power Monitor (RCPPM) is a solid-state detection, relay output, four channel power monitor system. Each of the four (4) reactor coolant pump motors has a separate RCPPM to detect a sustained reduction of Reactor Coolant Pump power consumption:

1. RCP Monitor A1
2. RCP Monitor A2
3. RCP Monitor B1
4. RCP Monitor B2

Upon reduction of power to any pump motor, the associated monitor channel will provide a trip signal to each of the four (4) reactor protection system channels. The system also monitors the position of the RCP motor circuit breaker and, upon opening of the breaker, will also produce an output signal to the RPS within a nominal 100 to 550 milliseconds (adjustable) after loss or reduction of power to the RCP motors. The RCPPM system cabinet contains all four (4) channels with physical metal barrier compartments between each channel and between each output relay within each channel.

The existing RCPPM utilizes a single watt transducer for each pump. The watt transducer provides an analog signal to a bistable trip device, which on a loss of power to the pump, de-energizes the coils of four relays wired in parallel. These relays provide contacts to the RPS for the Pump Power/Flux Trip function and contacts to the Steam Generator Level Control system. For each pump, the four output relays provide an isolated contact to the four RPS channels. A single failure of the watt transducer could prevent the detection of a loss of power to a pump; therefore the present design does not allow credit to be taken for this trip function for a double pump coast-down event in the Safety Analysis.

Each RCPPM channel contains the following components:

1. One (1) AC watt transducer
2. One (1) electronic trip module
3. One (1) time delay relay for producing a delayed output adjustable from 100 to 550 milliseconds.
4. Four (4) auxiliary relays, each with electrically separate output contacts. These relays are continuously energized as long as power is available to the RCP motors, and the pump requires power in excess of the preset trip setting
5. A test switch and relay for testing
6. Indicating lights

11.6 RCPPM Modification Hardware Description

The RCPPM will be modified as part of the ONS RPS/ES modification. The existing RCPPM circuitry does not have the needed redundancy to allow Safety Analysis to credit the pump

monitors during RCP coast-down events. Therefore, the existing RCPPM equipment will be replaced with equipment that has the desired redundancy and will be qualified via testing and/or analysis. Each Reactor Coolant Pump Power Monitor will be modified to include the following new redundant components:

1. Two (2) new AC watt transducers
2. Two (2) new electronic trip modules
3. Two (2) new time delay relays (adjustable)

The existing output/isolation relays in each RCPPM will be used to provide inputs to the TXS RPS.

11.7 **Existing Algorithm for Channel Trip Functions**

CURRENT ALGORITHM

Reactor Coolant Pump Power/Flux Trip

Trip: < 3 RCPs running & ϕ_m > 1.5% RTP

ϕ_m = Measured Reactor Power (Flux)

Note: With Shutdown Bypass enabled, the RC Pump Power/Flux Trip is bypassed

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	RESET Value	Unit
ϕ_m	Measured Total Flux (sum of upper & lower chamber)	0 - 125	NA	% RTP

11.8 **New Algorithm for Channel Trip Functions**

NEW ALGORITHM

Reactor Coolant Pump Power/Flux Trip

Trip: **< 3 RCPs running & $\phi_{m2.Max} \geq \phi_{SP}$**

(a) **$\phi_{m2.Max}$ = Total Flux (% RTP); 2nd maximum value of RPS Channels A, B, C and D.**

(b) **$\phi_{SP\ FLUX\ (trip)}$ = 1.5% RTP; Total Flux Setpoint for Pump/Flux Trip.**

(c) **$\phi_{SP\ FLUX\ (reset)}$ (See OSC-8695 for value). Total Flux Reset value for Pump/Flux Trip.**

Note: With Shutdown Bypass enabled, the RC Pump Power/Flux Trip is bypassed.

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	RESET Value	Unit
$\phi_{m2.Max}$	Second maximum Reactor Power (flux). (Shared inputs with Function 1, see that section for details of inputs)	0 to 125	NA	% RTP
$\phi_{SP\ FLUX(trip)}$	Reactor Power (flux) Setpoint for Pump/Flux Trip	1.5	Trip comparator auto-resets once power is below the auto-reset value; see OSC-8695 for the auto-reset value.	% RTP
$\phi_{SP\ FLUX(reset)}$	Reactor Power (flux) (Reset for Pump/Flux Trip, $\phi_{SP\ FLUX(trip)}$)	See OSC-8695 for value.	NA	% RTP

11.9 **New Design Features**

11.9.1 The RCPPM Trip is enabled above 1.5%. The TXS RPS system uses a 2 out of 4 pumps tripped logic scheme for the RCPPM Trip, with each channel receiving contact inputs from each of the four RC pumps. In the new design, with the interchannel communication between the four RPS channels, the CRD trip relays are not de-energized until 2/4 RPS channels receive the 2/4 RC pumps tripped signal. Once 2/4 RPS channels receive the 2/4 RC pumps tripped signal, all four channels' CRD trip relays will de-energize causing a Reactor trip. Following a reactor trip, the reactor trip breakers must be reset by the operator prior to restarting the unit.

11.9.2 The Reactor Coolant Pump Power Monitor/Flux Trip is bypassed when the Shutdown Bypass switch is placed to Bypass.

11.10 **Safety Classification**

This function is classified QA Condition 1 (Class 1E).

11.11 **Response Time Requirements**

11.11.1 The response time for each redundant RCPPM instrument string is set to a nominal 500 msec by adjustment of the time delay relay per procedures (IP/0/A/305-1A, 1B, 1C, 1D) (480 - 520 msec). Safety Analysis assumes up to a 525 msec sensor delay for pump power supply loss.

11.11.2 Each redundant RCPPM instrument string consists of a watt transducer, comparator, and a time delay relay. Either redundant instrument string can de-energize the four (4) output relays (1 per RPS channel) which provide electrically separate output contacts to the RPS. Time response for the string is set to a nominal 500 msec by adjustment of the time delay relay, and includes the time from a simulated loss of PT signal to the time the output relays to RPS actuate. The RCPPM instrument string time response does not include the TXS rack time response requirements (provided separately below).

11.11.3 The response time for the TXS rack/processing equipment shall be for ≤ 141 msec. (Power Supply Loss portion of Function 11.)

11.11.4 The response time for the TXS rack/processing equipment shall be for ≤ 186 msec. (Flux Change portion of Function 11.)

11.12 Failure Discussion

The modified RCPPM design protects against loss of function due to a single component failure as follows:

11.12.1 A loss of control power to the reactor coolant pump power monitoring circuit will cause the four normally energized output relays to de-energize, resulting in a "loss of pump power" trip signals to the RPS (fail-safe). A single failure to the de-energized state of the trip comparator, time delay relay, or a single output relay will result in a "loss of pump power" trip signal (fail-safe).

11.12.2 A single failure of a trip comparator or time delay relay would not prevent detection of a loss of pump power since there is a redundant string.

11.12.3 A single failure of a watt transducer to the high output state will not prevent the other watt transducer string from functioning to detect a loss of pump power.

11.12.4 A single failure of a watt transducer to the low output state will result in a "loss of pump power" trip signal to the RPS.

11.12.5 The existing pump PTs and CTs are shared by the redundant watt transducers. The failure mode of a CT is low, which would result in "loss of pump power" trip signals to RPS. A PT failure low (shorted output windings) would yield the same result. A PT failure high (shorted turns in the PT primary) would not prevent circuit operation, since during an actual loss of pump power condition, both primary and secondary PT voltage would go to zero, resulting in a "loss of pump power" trip signal to RPS.

11.13 Existing/New Input Signals

Note: Nuclear Power Range total power (flux) inputs for this function are shared with Function 1 and are listed in that section.

ID Code	Description	Physical Range	Electrical Range
1RC_RL1A	Reactor Coolant Pump 1A1 Monitor Relay 1A	Binary	(relay contact, open to trip)
1RC_RL1B	Reactor Coolant Pump 1A1 Monitor Relay 1B	Binary	(relay contact, open to trip)
1RC_RL1C	Reactor Coolant Pump 1A1 Monitor Relay 1C	Binary	(relay contact, open to trip)
1RC_RL1D	Reactor Coolant Pump 1A1 Monitor Relay 1D	Binary	(relay contact, open to trip)
1RC_RL2A	Reactor Coolant Pump 1A2 Monitor Relay 2A	Binary	(relay contact, open to trip)
1RC_RL2B	Reactor Coolant Pump 1A2 Monitor Relay 2B	Binary	(relay contact, open to trip)
1RC_RL2C	Reactor Coolant Pump 1A2 Monitor Relay 2C	Binary	(relay contact, open to trip)
1RC_RL2D	Reactor Coolant Pump 1A2 Monitor Relay 2D	Binary	(relay contact, open to trip)

ID Code	Description	Physical Range	Electrical Range
1RC_RL3A	Reactor Coolant Pump 1B1 Monitor Relay 3A	Binary	(relay contact, open to trip)
1RC_RL3B	Reactor Coolant Pump 1B1 Monitor Relay 3B	Binary	(relay contact, open to trip)
1RC_RL3C	Reactor Coolant Pump 1B1 Monitor Relay 3C	Binary	(relay contact, open to trip)
1RC_RL3D	Reactor Coolant Pump 1B1 Monitor Relay 3D	Binary	(relay contact, open to trip)
1RC_RL4A	Reactor Coolant Pump 1B2 Monitor Relay 4A	Binary	(relay contact, open to trip)
1RC_RL4B	Reactor Coolant Pump 1B2 Monitor Relay 4B	Binary	(relay contact, open to trip)
1RC_RL4C	Reactor Coolant Pump 1B2 Monitor Relay 4C	Binary	(relay contact, open to trip)
1RC_RL4D	Reactor Coolant Pump 1B2 Monitor Relay 4D	Binary	(relay contact, open to trip)

11.14 Existing/New Output Signals

The following existing Statalarms will be spared out (no longer used) since they alarmed the contact power from the existing Bailey contact monitor. This function is replaced by the TXS systems contact power/breaker monitoring (alarmed to Trouble Annunciator, OAC via gateway, etc.)

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range	Destination
1SA5-4	RP Channel A RC Pump Monitor PS Failure	Binary	N/A	Statalarm
1SA5-16	RP Channel B RC Pump Monitor PS Failure	Binary	N/A	Statalarm
1SA5-28	RP Channel C RC Pump Monitor PS Failure	Binary	N/A	Statalarm
1SA5-40	RP Channel D RC Pump Monitor PS Failure	Binary	N/A	Statalarm

The following existing RPS system outputs are to be provided by the new TXS system except as noted in the table:

ID Code	Description	Physical Range	Electrical Range	Destination
1SA1-7	RP Channel A RCP/Flux Trip	Binary	N/A	Statalarm
1SA1-19	RP Channel B RCP/Flux Trip	Binary	N/A	Statalarm
1SA1-31	RP Channel C RCP/Flux Trip	Binary	N/A	Statalarm
1SA1-43	RP Channel D RCP/Flux Trip	Binary	N/A	Statalarm
1SA7-34	RC Pump Monitor Sys. Chan. #1 Trip (Moved from 1SA7-33) Not connected to TXS	Binary	N/A	Statalarm
1SA7-09	RC Pump Monitor Sys. Chan. #1 Test (Moved from 1SA7-34) Not connected to TXS	Binary	N/A	Statalarm
1SA7-35	RC Pump Monitor Sys. Chan. #2 Trip (Moved from 1SA7-39) Not connected to TXS	Binary	N/A	Statalarm

ID Code	Description	Physical Range	Electrical Range	Destination
1SA7-18	RC Pump Monitor Sys. Chan. #2 Test (Moved from 1SA7-40) Not connected to TXS	Binary	N/A	Statalarm
1SA7-43	RC Pump Monitor Sys. Chan. #3 Trip (Moved from 1SA7-41) Not connected to TXS	Binary	N/A	Statalarm
1SA7-27	RC Pump Monitor Sys. Chan. #3 Test (Moved from 1SA7-42) Not connected to TXS	Binary	N/A	Statalarm
1SA7-44	RC Pump Monitor Sys. Chan. #4 Trip (Moved from 1SA7-43) Not connected to TXS	Binary	N/A	Statalarm
1SA7-36	RC Pump Monitor Sys. Chan. #4 Test (Moved from 1SA7-44) Not connected to TXS	Binary	N/A	Statalarm
O1D2360 (Info Only)	RCP 1A1 POWER MONITOR CH (NOT TRIP) (TRIP)(Info Only -located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC
O1D2361 (Info Only)	RCP 1A2 POWER MONITOR CH (NOT TRIP) (TRIP) (Info Only – located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC
O1D2362 (Info Only)	RCP 1B1 POWER MONITOR CH (NOT TRIP) (TRIP) (Info Only – located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC
O1D2363 (Info Only)	RCP 1B2 POWER MONITOR CH (NOT TRIP) (TRIP) (Info Only – located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC
O1D2381	RPS CH B RCP/FLUX (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D2382	RPS CH A RCP/FLUX (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D2383	RPS CH C RCP/FLUX (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D2384	RPS CH D RCP/FLUX (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D2412	RPS CH A PUMP MONITOR (NOT IN TEST) (IN TEST)	Binary	N/A	To be Deleted
O1D2413	RPS CH B PUMP MONITOR (NOT IN TEST) (IN TEST)	Binary	N/A	To be Deleted
O1D2414	RPS CH C PUMP MONITOR (NOT IN TEST) (IN TEST)	Binary	N/A	To be Deleted
O1D2415	RPS CH D PUMP MONITOR (NOT IN TEST) (IN TEST)	Binary	N/A	To be Deleted
O1D1859	RCP 1A1 POWER MONITOR (NOT IN TEST) (IN TEST) (Info Only – located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC
O1D1860	RCP 1A2 POWER MONITOR (NOT IN TEST) (IN TEST) (Info Only – located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC

ID Code	Description	Physical Range	Electrical Range	Destination
O1D1949	RCP 1B1 POWER MONITOR (NOT IN TEST) (IN TEST) (Info Only – located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC
O1D2274	RCP 1B2 POWER MONITOR (NOT IN TEST) (IN TEST) (Info Only – located in RCP Power Monitor Cabinet & not RPS)	Binary	N/A	OAC
O1A0876	RPS CH A RCP CONTACT SIGNAL	0 – 162.5%	N/A	To be Deleted
O1A1419	RPS CH B RCP CONTACT SIGNAL	0 – 162.5%	N/A	To be Deleted
O1A1423	RPS CH C RCP CONTACT SIGNAL	0 – 162.5%	N/A	To be Deleted
O1A1567	RPS CH D RCP CONTACT SIGNAL	0 – 162.5%	N/A	To be Deleted
ER-162*	R.P. Channel A RCP/Flux Ratio Trip	Binary	N/A	Event Recorder
ER-171*	R.P. Channel B RCP/Flux Ratio Trip	Binary	N/A	Event Recorder
ER-180*	R.P. Channel C RCP/Flux Ratio Trip	Binary	N/A	Event Recorder
ER-190*	R.P. Channel D RCP/Flux Ratio Trip	Binary	N/A	Event Recorder
O1A1696 (Info Only)	RP Ch. A Contact Monitor Aux PS	-300 to 0 VDC	N/A	To be Deleted
O1A1700 (Info Only)	RP Ch. B Contact Monitor Aux PS	-300 to 0 VDC	N/A	To be Deleted
O1A1702 (Info Only)	RP Ch. C Contact Monitor Aux PS	-300 to 0 VDC	N/A	To be Deleted
O1A1705 (Info Only)	RP Ch. D Contact Monitor Aux PS	-300 to 0 VDC	N/A	To be Deleted

*Contact Input Open to Alarm, also Event Recorder is automatically bypassed when Trip is bypassed.

11.15 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

11.16 **References**

See Section 28.

12.0 Reserved

This RPS function number has been reserved for possible future use. This section previously included a functional description for a future RCS Delta Temperature Trip. This description has been deleted since the function will not be implemented with this modification.

13.0 RPS / ESFAS Overview, NI Replacements, RPS Channel E

13.1 Nuclear Instrumentation (NI) Replacement Hardware and Design Features

13.1.1 New Nuclear Instrumentation equipment supplied for RPS channels A, B, C and D:

13.1.1.1 Bipolar Power Supply Module

13.1.1.2 High Voltage Control Module

13.1.1.3 Power Range Test Module and Line Filter

13.1.1.4 2 Linear Amplifiers (one each for upper and lower detectors, input scaling: 10^{-5} – 10^{-2} Amps, voltage output range: 0 – 11.52 volts, equivalent to 0 – 72% reactor power)

13.1.1.5 Summing amplifier (input scaling 0 – 10.0 volts from each linear amp, equivalent to 0 – 62.5% reactor power, output scaling: 4 – 20 mA equivalent to 0 – 125% reactor power)

13.1.1.6 Detector High Voltage Power Supply

13.1.2 The equipment above is being replaced in the RPS system and will be installed in the TXS cabinets. Existing field cabling and connectors will be reused. Special care to assure the lengths of cables reach the equipment in new cabinet locations is required.

13.1.3 For RPS Channels A, B, C and D, the High Voltage Power Supplies and the NI ±15 VDC Power Supplies will be monitored by TXS. Calculation OSC-8695, "Unit 1 Software Parameters for TXS Plant Protection System" shall establish high and low limits for each NI power supply input. Exceeding these limits for a channel shall result in an alarm to annunciators 1SA5-6, 18, 30 and 42. The TXS shall also provide individual alarm signals to the OAC for any power supply that exceeds its limits.

13.1.4 The existing Wide Range Nuclear Instrumentation (WRNI) monitors (Gamma-Metrics) will be relocated from cabinets RPS-A1/B1/C1/D1 to cabinets 1PPSCA002/4/6/8. This will provide separation of the WRNI from the TXS logic processor. Cabinets 1PPSCA002/4/6/8 will contain WRNI, power supply, input/output and interposing equipment. Existing field cables and interconnection cables will be reused.

13.1.5 This is an installation and cabinet layout note. The existing WRNI uses double fuses to isolate safety related (1E) 120VAC power for indicators and relays. New fuse blocks and fuses will be installed in the new TXS cabinets 1PPSCA002/4/6/8 by the modification to the cabinets on site. Space should be reserved for these fuse blocks in each cabinet.

13.2 Other Existing RPS Design Functions

13.2.1 Each channel of the existing system contains a Manual Bypass feature that is required in the new design. Reference Section 14.3 for a description of the existing Manual Bypass feature and Section 23.4 for a description of the new Manual Bypass feature.

13.2.2 Two Banana plugs are available for testing of the CRD Under-Voltage Relays in each RPS channel in the Bailey design. This feature of the existing RPS is not required in the new system.

13.3 **New RPS/ESFAS TXS Design Features**

Each RPS/ESFAS cabinet will have the capability of being tested (via the TXS maintenance test machine, if desired). When the TXS maintenance test machine is plugged into an analog or digital input card, the cabinet will provide an annunciator alarm for the operator (excluding RPS Channel E, which will only alarm to the OAC). The channel in test alarm will also be transmitted to the OAC via the gateway.

13.4 **New RPS OAC Points**

ID Code	Description	Physical Range	Electrical Range	Destination
O1X4646	RPS Channel A in Test	Binary	N/A	Gateway
O1X4647	RPS Channel B in Test	Binary	N/A	Gateway
O1X4648	RPS Channel C in Test	Binary	N/A	Gateway
O1X4649	RPS Channel D in Test	Binary	N/A	Gateway
O1X4650	RPS Channel E in Test	Binary	N/A	Gateway

13.5 **Other Existing RPS/ ESFAS Design Functions**

13.5.1 Other functions include the ES interface for the HPI and LPI Bypass Permit alarm, LPI valve LP1 interlock and WR Pressure recording. The ESFAS only sends one signal to the Integrated Control System (ICS) cabinets for the HPI and LPI Bypass Permit alarm, LP1 interlock, and WR Pressure recording interface. The signal comes from ESFAS Cabinet 1, Row 9, Terminal Board 3, Terminations 1 and 2. That signal can be originated from the RCS wide range pressure transmitter from either Channel A or B, depending on the position of an amphenol connector which is located in Channel A. The Channel B RCS wide range signal is hard wired from ESFAS Cabinet 2, Row 9, Terminal Board 3, Terminations 4 and 5 to ESFAS Cabinet 1, Row 9, Terminal Board 3, Terminations 4 and 5. The existing plug connections that change which signal goes to the ICS cabinet is shown on drawing OM 201.J-0004 001.

13.5.2 Reference Sections 15.8.2, 15.4, and 20.7 for a description of the HPI Bypass Permit, Sections 16.8.2, 16.4, and 20.7 for a description of the LPI Bypass Permit, and Section 20.8 for details of the new TXS design for switching the WR pressure signals to the ICS cabinet and the LP1 interlock.

13.5.3 The wetting voltage for status inputs (dry contacts) on the OAC is 24 VDC. The input cards sense current. When a contact is closed, the cards limit the current to roughly 5 mA. When the contact is open, the current goes to 0 mA.

13.6 **Cabinet Paint**

The TXS RPS and ESFAS Cabinets shall be an ANSI 61 color.

13.7 **Trip Logic Discussion**

The RPS Trip Logic shall meet the intent of the 2 out of 4 Boolean Logic shown below:

A = Channel A B = Channel B C = Channel C D = Channel D

A trip will occur in the RPS when any combination of 2 Channels in trip occurs:

TRIP = AB + BD + AC + BC + AD + CD (Where "+" means "OR").

13.8 **Analog Lead / Lag / Filter**

Analog Lead / Lag / Filters shall be provided downstream of A-MRC block to allow for future filtering of noise if necessary. The Analog Lead / Lag / Filter function is designed to allow a delay, which shall be set to zero (0) unless otherwise specified by OSC-8695, Unit 1 Software Parameters for TXS Plant Protection System.

13.9 **RPS/ESFAS Cabinet Tag Numbers**

ONS Unit	Equipment System	Equipment Type	New Equipment Suffix	Old Equipment Suffix
1	PPS	CA	0001	RPS-A1
1	PPS	CA	0002	RPS-A2
1	PPS	CA	0003	RPS-B1
1	PPS	CA	0004	RPS-B2
1	PPS	CA	0005	RPS-C1
1	PPS	CA	0006	RPS-C2
1	PPS	CA	0007	RPS-D1
1	PPS	CA	0008	RPS-D2
1	PPS	CA	0009	ESF-1
1	PPS	CA	0010	ESF-2
1	PPS	CA	0011	ESF-3
1	PPS	CA	0012	ESF-4
1	PPS	CA	0013	ESF-5
1	PPS	CA	0014	ESF-6
1	PPS	CA	0015	ESF-7
1	PPS	CA	0016	RPS-E
1	PPS	CA	0017	ESF-8
1	PPS	CA	0018	ESF-9

13.10 Manual Reactor Trip

13.10.1 Manual Reactor Trip Switch

The manual reactor trip switch is located on 1UB1.

13.11 RPS Channel E

The RPS Channel E functions are classified Non-1E

13.11.1 Reactor Power

NI-9 was originally used for control functions to ICS. Recent Duke modifications have changed the original scheme such that NI-7 & NI-8 have replaced the NI-9 functions, and will come off of isolated, spare outputs of Channels C & D (See Duke Modification OD101542, which deletes NI-9 from the system, for more information). As a result, cables 1IS-575 & -576 will need to be re-connected from Channels C & D for the ICS.

13.11.2 Reactor Coolant Pressure

1RCPT166P (1700 - 2500 psig) is used for control functions to ICS.

13.11.3 Reactor Coolant Flow (DP)

1RCFT0014P and 1RCFT0015P monitor reactor coolant flow and provide signals to ICS.

13.11.4 Channel E Input Signals

ID Code	Description	Physical Range	Electrical Range
1RCFT0014P	RC14A-DPT5 RC Flow Channel E	0 to 43.3 psid	4 - 20 mADC
1RCFT0015P	RC14B-DPT5 RC Flow Channel E	0 to 43.3 psid	4 - 20 mADC
1RCPT0166P	RC3B-PT4 RP Reactor Coolant System Pressure - Loop B Output to ICS	1700 - 2500 psig	4 - 20 mADC

13.11.5 Channel E Output Signals

ID Code	Description	Physical Range	Electrical Range	Destination
O1D2299	NI PR RECORDER FLUX (NOT HI) (HI) (Point to be supplied from new recorder, This is NOT a TXS RPS output.)	Binary	N/A	Hardwired OAC point
1SA5-53	1E RPS TROUBLE (new descriptor)	Binary	145 VDC	Statalarm
1SA5-54	SPARE	Binary	145 VDC	delete
1SA5-55	SPARE (Not a TXS output, now a spare. Used to be NI Power Range 9 Power Supply Failure)	Binary	145 VDC	delete
1RCPT0166P	Narrow Range RCS Pressure - Loop B Output to ICS	1700 - 2500 psig	0 - 10 VDC	ICS
1RCFT0014P	RP Reactor Coolant System differential pressure - Loop A Output to ICS	0 to 43.3 psid	0 - 10 VDC	ICS
1RCFT0015P	RP Reactor Coolant System differential pressure - Loop B Output to ICS	0 to 43.3 psid	0 – 10 VDC	ICS

13.12 New Statalarm Panel Changes

Statalarm Panel changes are shown in Section 22.

13.13 References

See Section 28.

14.0 RPS BYPASS SWITCHES & FUNCTIONS

14.1 Existing RPS Bypasses

The existing RPS is designed with three types of bypasses: Dummy Bistable, Manual Bypass and Shutdown Bypass. The bypass functions and switches for the new TXS system are detailed in Section 23.

14.2 Existing Dummy Bistable

The dummy bistable is used to bypass one or more functions (bistable trips) associated with one RPS Channel. The STAR Module uses jumpers to jumper out the trip contact. The jumpers fall under the same administrative controls as dummy bistables.

A dummy bistable is used if a bistable in an RPS channel fails tripped. Dummy bistables may be used in only one RPS channel at a time (by procedure and per Tech Specs) and use of the dummy bistable makes that protective function inoperable for that channel.

If an RPS channel is in Manual Bypass, no other RPS channel may contain a dummy bistable (by procedure and per Tech Specs). Inserting a dummy bistable in the place of a failed (tripped) bistable allows that RPS channel to be reset, thus allowing the remainder of the functions in that RPS channel to be returned to service. This is more conservative than manually bypassing the entire RPS channel. For an RPS channel with a dummy bistable installed, only the affected function(s) is inoperable. The installation of the STAR hardware in the nuclear overpower flux/flow imbalance trip string requires the use of jumpers to bypass the trip string. The installation of these jumpers does not require the removal of the STAR processor module. Therefore, the protective channel is not forced into a tripped condition. 1SA5, window 49 (-50, -51, -52) alarms "RP Channel A (B, C, D) Dummy Bistable Inserted".

14.3 Existing Manual Bypass

The existing RPS has a Manual Bypass feature which allows operations to take an entire RPS channel out of service for maintenance and/or testing. A Manual Bypass keyswitch located in each RPS cabinet (A2, B2, C2, and D2) on the Reactor Trip Module, bypasses all automatic trip functions associated with that channel. With an RPS channel in Manual Bypass, all RPS functional trips are reduced to two-out-of-three trip logic. More than one RPS channel could physically be placed in Manual Bypass at a time, however administrative controls allow only one RPS channel to be placed in Manual Bypass at a time. There is only one key for each unit for this function and the units have different keys.

14.4 Existing Shutdown Bypass

The existing RPS has a Shutdown Bypass feature which allows certain RPS protective functions for a channel to be bypassed with a keyswitch located in that channel's RPS cabinet (A2, B2, C2, or D2). The Shutdown Bypass function provides the capability to perform CRD testing, zero power physics testing, and startup procedures.

Placing the Shutdown Bypass keyswitch to "Bypass" does the following:

14.4.1 bypasses the Low Pressure Trip,

14.4.2 bypasses the Variable Low Pressure Trip,

14.4.3 bypasses the Flux/Flow/Imbalance Trip,

14.4.4 bypasses the RC Pump Power Monitor Trip,

14.4.5 enables a high RCS pressure trip set point of 1710 psig (Tech. Spec. allowable value of ≤ 1720 psig).

The normal high pressure trip of 2345 psig (Tech. Spec. allowable value of ≤ 2355 psig) is not bypassed, but is nonfunctional because RPS will trip before the higher setpoint can be reached.

14.4.6 Existing Hardwired Computer Points

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D1251	RPS CH A SD BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1252	RPS CH B SD BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1253	RPS CH C SD BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1254	RPS CH D SD BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway

14.5 Existing High Flux Trip Setpoint Reduction During Reactor Shutdown

The High Flux Trip setpoint is recalibrated by procedure to ≤ 4% RTP (Tech. Spec. allowable value of 5%), once the RPS is in Shutdown Bypass.

14.6 New RPS Bypass Switch Functions

See Section 23.

ENGINEERED SAFETY FEATURES ACTUATION SYSYTEM

This system is described in the UFSAR and Technical Specifications as the Engineered Safeguards Protective System (ESPS). Each of the four existing ESFAS Actuation functions are discussed in the following sections. The Oconee Technical Specifications (TS) and TS Bases, the ESFAS Design Basis Document, existing ESFAS operating and calibration procedures and other references (see Section 27) have been used to develop this System Functional Requirements Description document.

15.0 RCS Pressure Low

(High Pressure Injection, Reactor Building (RB) Non-Essential Isolation, Keowee Start, Load Shed and Standby Breaker Input, and Keowee Standby Bus Feeder Breaker Input - Existing Digital Logic Channels 1 & 2)

15.1 Existing Automatic Trip Function Description

Reactor Coolant System Pressure – Low

Reactor Coolant System Pressure inputs are shared with ESFAS Functional Trip #2.

Reactor Coolant System (RCS) pressure transmitters 1RCPT0021P, 23P and 22P (0 to 2500 psig range) provide inputs to the ESFAS protective channels A, B and C respectively. When any of these signals reach the RCS Pressure Low Setpoint, the associated protective channel bistable is tripped. If two or more protective channel bistables are in the tripped state, a Channel 1 and Channel 2 ESFAS Actuation is generated.

Tech Specs require that the RCS Pressure - Low actuation be enabled at or above 1750 psig. Actual ESFAS BYPASS is automatically removed at 1740 psig for conservatism, see 15.4 below. Tech Specs also require that the RCS Pressure - Low actuation (on decreasing pressure) occur before 1590 psig, (allowable value); actual ESFAS actuation setpoint is 1600 psig for conservatism.

Reactor Building (RB) Pressure – High

A High Reactor Building Pressure signal (ESFAS Function #3) shall also provide an actuation signal to ESFAS Actuation Channels 1 and 2.

15.2 Description of Functions Related to Existing Actuation

The purpose of High Pressure Injection (HPI) System initiation is to assure that sufficient water from the borated water storage tank (BWST) flows into the Reactor Coolant System (RCS) to control reactor coolant inventory and to provide core cooling during certain loss-of-coolant-accidents (LOCAs). HPI System initiation also helps to control core reactivity through the injection of boron into the RCS. Also, the HPI System is required following a steam line break (SLB) to assure core reactivity control. Initiation of HPI also actuates the starting of the emergency power system (Keowee Hydro Station) to assure the availability of power to operate the required safety equipment in the event of a Loss of Offsite Power (LOOP).

15.3 Existing Manual Actuation Function

A manual actuation of the High Pressure Injection and Reactor Building Non-Essential Isolation (Channels 1 and 2) shall be capable of being initiated from the main control board TRIP/RESET pushbutton switches. This manual actuation is independent of the automatic ESFAS Channel 1 and 2 automatic actuation system and shall be capable of actuating all channel related field components regardless of any failures of the automatic system. The TRIP latching logic is internal in the ES system.

15.4 **Existing HPI BYPASS (INHIBIT)**

The HPI BYPASS (INHIBIT) permissive bistables (monitoring analog pressure inputs A, B & C) allow manual bypass of the HPI TRIP function on decreasing reactor coolant pressure below the HPI BYPASS setpoint.

The HPI BYPASS (INHIBIT) is required to be automatically removed on increasing reactor coolant pressure at the HPI BYPASS REMOVAL setpoint of 1750 psig, (allowable value). Actual HPI BYPASS REMOVAL setpoint is 1740 psig for conservatism.

Once the HPI BYPASS (INHIBIT) has been automatically removed, the operator must again manually bypass HPI on decreasing pressure. This bypass does not prevent actuation of the High Pressure Injection on High Reactor Building pressure. Bypassing is under administrative control. Since the ESFAS has three analog input channels, there are three High Pressure Injection BYPASS switches. Two of the three switches must be operated to initiate a bypass. Once a bypass has been initiated, the condition is indicated by the plant annunciator system and by lamps associated with the bypass switches.

15.5 **Existing Associated Actuation Functions**

A High Reactor Building Pressure signal (ESFAS Function #3) shall also provide an actuation signal to ESFAS Actuation Channels 1 and 2.

15.6 **Existing Algorithm Equations for Channel Actuation Functions**

RCS Pressure Low

CURRENT ALGORITHM

Channel Trip: $P_m \leq P_{SP\ PRESS}$ **OR** $TRIP_{RBHP}$

Remove HPI Trip BYPASS: $P_m \geq P_{SP\ PRESS\ RBYP}$

Allow HPI Trip BYPASS: $P_m \leq P_{SP\ PRESS\ BYP}$

(a) P_m = measured RCS pressure in each ESFAS channel A, B and C.
(b) $P_{SP\ PRESS}$ = HPI Trip; setpoint 1600 psig, decreasing.
(c) $P_{SP\ PRESS\ RBYP}$ = Remove HPI BYPASS; setpoint 1740 psig, increasing.
(d) $P_{SP\ PRESS\ BYP}$ = Allow Manual HPI BYPASS; setpoint 1740 psig, decreasing.
(e) $TRIP_{RBHP}$ = Reactor Building HIGH pressure actuation; see ESFAS Function #3 in Section 17.
(f) 2 out of 3 channels tripped = ESFAS Channels 1 & 2 Actuation

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	Reset Value	Units
P_m	Measured Reactor Coolant System Pressure in each ESFAS channel.	0 – 2500	N/A	psig
$P_{SP\ PRESS}$	ESFAS Actuation Trip setpoint on decreasing pressure. Tech Spec Allowable Value is 1590 psig.	1600 Automatically Trip on decreasing pressure	manual reset once pressure is above setpoint	psig
$P_{SP\ PRESS\ RBYP}$	Remove HPI Trip Bypass on increasing pressure. Tech Spec Allowable Value is ≥ 1750.	1740 Automatically remove bypass on increasing pressure	<1740 manual bypass	psig
$P_{SP\ PRESS\ BYP}$	Allow HPI Trip Bypass on decreasing pressure.	< 1740 manual bypass	1740 Automatically remove bypass on increasing pressure	psig
$TRIP_{RBHP}$	Logical Trip Function on Reactor Building HIGH pressure actuation. (See ESFAS Function #3 in Section 17).	N/A	N/A	N/A

15.7 **New Algorithm Equations for Channel Actuation Functions**

RCS Pressure Low

PROPOSED ALGORITHM

Channel Trip: $P_{m2.Min} \leq P_{SP\ PRESS}$ OR $TRIP_{RBHP}$

Remove HPI Trip BYPASS: $P_{m2.Min} \geq P_{SP\ PRESS\ RBYP}$

Allow HPI Trip BYPASS: $P_{m2.Min} \leq P_{SP\ PRESS\ BYP}$

(a) **$P_{m2.Min}$ = RC pressure, 2nd minimum value of pressure from ESFAS channel A, B and C.**
(b) **$P_{SP\ PRESS}$ = HPI Trip; setpoint 1600 psig, decreasing.**
(c) **$P_{SP\ PRESS\ RBYP}$ = Remove HPI BYPASS; setpoint 1740 psig, increasing.**
(d) **$P_{SP\ PRESS\ BYP}$ = Allow Manual HPI BYPASS; (See OSC-8695 for value), decreasing.**
(e) **$TRIP_{RBHP}$ = Reactor Building HIGH pressure actuation; see ESFAS Function #3 in Section 17.**
(f) **2 out of 3 channels tripped = ESFAS Channels 1 & 2 Actuation**

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$P_{m2.Min}$	RCS pressure, second minimum of all channels A, B & C	0 – 2500	N/A	psig
$P_{SP\ PRESS}$	ESFAS Actuation Trip setpoint on decreasing pressure. Tech Spec Allowable Value is ≥1590 psig.	1600 Automatically Trip on decreasing pressure	Trip comparator auto-resets once pressure is above the auto-reset value; see OSC-8695 for the auto-reset value. (See 15.8.3.)	psig
$P_{SP\ PRESS\ RBYP}$	Remove HPI Trip Bypass on increasing pressure. Tech Spec Allowable Value is ≥ 1750.	1740 Automatically remove bypass on increasing pressure	Allow manual bypass on decreasing pressure. Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value.	psig
$P_{SP\ PRESS\ BYP}$	Allow HPI Trip Bypass on decreasing pressure. (This is the reset for the automatic removal of HPI Trip Bypass, $P_{SP\ PRESS\ RBYP}$)	See OSC-8695 for value	NA	psig

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$TRIP_{RBHP}$	Logical Trip Function on Reactor Building HIGH pressure actuation. (See ESFAS Function 3 in Section 17).	N/A	N/A	N/A

15.8 **New Design Features**

15.8.1 Second Maximum / Second Minimum Function

Each ESFAS instrument channel (A, B & C) processes the associated Reactor Coolant System (RCS) pressure signal value as well as the RCS pressure signal values from the other two ESFAS instrument channels. For the RCS Pressure Low Trip, each ESFAS channel selects the second minimum (2.Min) measured RCS pressure value ($P_{m2.Min}$) from all three channels. If the value of $P_{m2.Min}$ falls below the RCS Pressure Low Trip setpoint ($P_{SP\ PRESS}$), the channel generates a trip signal. If two or more ESFAS instrument channels are in the tripped state, an actuation is generated for ESFAS channel 1 and 2 components.

15.8.2 HPI BYPASS Function

As described above, each TXS instrument channel (A, B & C) processes the associated Reactor Coolant System (RCS) pressure signal value as well as the RCS pressure signal values from the other two ESFAS instrument channels. For the HPI BYPASS Function, on decreasing RCS pressure, each ESFAS instrument channel selects the second minimum (2.Min) measured RCS pressure value ($P_{m2.Min}$) from all three channels (A, B & C). If the value of $P_{m2.Min}$ is below the HPI BYPASS setpoint, the system allows the operator to manually BYPASS the RCS Low Pressure trip function in that ESFAS instrument channel. Bypassing the trip function in 2/3 of the ESFAS instrument channels will result in the bypass of ESFAS actuation channels 1 and 2 for this trip function. On increasing RCS pressure, if the value of $P_{m2.Min}$ is above the HPI BYPASS REMOVAL setpoint ($P_{SP\ PRESS\ RBYP}$), the HPI BYPASS is required to be automatically removed. Following an ESFAS actuation, to allow resetting ESFAS actuation channels 1 and 2, the TXS RCS Low Pressure comparators may be bypassed by depressing the HPI BYPASS pushbutton for each channel.

15.8.3 TRIP/RESET Function

Depressing the manual TRIP pushbutton will initiate a TRIP signal to the associated ESFAS Channel 1 or 2 directly to the associated Channel output relays bypassing the TXS. Following an actuation, the manual or automatic Channel 1 and/or 2 TRIP signal can be reset by depressing the associated channel RESET button (HPI analog channels must first be bypassed - see discussion below). The existing pushbuttons will be replaced (see Section 20. 7).

The concept of operation for a reset of HPI Channel 1 (2) following an automatic trip on ESFAS Function #1 (RCS Pressure Low) is as follows:

1. To reset the HPI channel 1 (2) following an automatic or manual ESFAS actuation ESFAS Function #3 (RB Pressure High) must not be tripped.
2. If ESFAS Function #1 (RCS Pressure Low) is tripped, ESFAS Function #1 (RCS Pressure Low) trip logic must be manually bypassed with the HPI BYPASS pushbuttons (BYPASS light will come on).
3. HPI Channel 1 (2) may be removed from automatic operation by placing ODD (EVEN) HPI channel in manual by pushing the Channel 1 (2) MANUAL pushbutton and the Load Shed 1 (2) MANUAL pushbutton. At the AUTO/MANUAL switch, the AUTO lights will go out, the MANUAL lights will come on. At this point the Channel 1 (2) ESFAS R_O contacts will drop out and the operator has manual control of all Channel 1 (2) devices.
4. Channel 1 (2) may then be reset with the Channel 1 (2) RESET pushbutton. When the RESET pushbutton is pushed, the TRIP light for Channel 1 (2) will go out and the Channel 1 (2) MANUAL light will go out.
5. If required, the operator may re-actuate ESFAS Channel 1 (2) with the Channel 1 (2) TRIP pushbutton.

15.8.4 RZ Module Replacement

The RZ Module indicating function for Channel 1 & 2 ESFAS components will be replaced with lamp boxes that will have indicating LEDs for the status of each device actuated by the ES system arranged by channel (See Section 20). In addition, the "Operate Here" functions for certain ODD and EVEN devices will be replaced with control switches and indicating LEDs on 1VB2 and 1UB2 as shown in Section 20.

15.8.5 AUTO/MANUAL Function

The existing ESFAS AUTO/MANUAL function is used to remove the ES actuation signal to each ESFAS actuated component. The existing individual component AUTO/MANUAL function will be replaced with a new Logic Channel level AUTO/MANUAL function (see Section 20.6).

15.8.6 New ODD/EVEN Field Device Status

ODD/EVEN device status (check back) from HPI Pump 1B will be provided from ESTC3. The signal will be sent to ESFAS cabinets (1PPSCA0017 and 1PPSCA0018) for lighting the associated device status LEDs on the lamp box and providing device status signals to the TXS and OAC.

15.8.7 ESFAS Outputs

All new ESFAS output contacts (R_O) shall have an adjustable software time delay on closure (0 to 15 minutes); all time delays will be set to zero (0) seconds.

15.8.8 Emergency Override Switches

See Section 21 discussion.

15.8.9 Analog Signal Monitoring discussion, see Section 25.4.

15.8.10 CHANNEL CHECK discussion, see Section 25.1.

15.9 **Safety Classification**

This function is classified QA Condition 1 (Class 1E).

15.10 **Response Time Requirements**

The response time for the TXS rack/processing equipment shall be < 500 ms. The channel response time does not include the sensor response time or the time required for the field devices to go to the ES position from the Non-ES position.

15.11 **Existing Input Signals**

The RC pressure inputs are shared with ESFAS Function #2 and the Diverse Low Pressure Injection Actuation System (DLPIAS - see Section 30) as well as the Diverse High Pressure Injection Actuation System (DHPIAS – See Section 31). Transmitter loops are powered from ESFAS. Pushbuttons are wetted from ESFAS. (*HPI Pushbuttons in Sections 15.11 are located on UB1 instead of UB2, See PIP O-2008-5867 for further resolution and tracking.)

ID Code	Description	Physical Range	Electrical Range
1RCPT0021P	RC Pressure analog CH.A	0 - 2500 psig	4 - 20 mADC
1RCPT0023P	RC Pressure analog CH B	0 - 2500 psig	4 - 20 mADC
1RCPT0022P	RC Pressure analog CH C	0 - 2500 psig	4 - 20 mADC
1ESPB00ESCH1	CH 1 TRIP pushbutton	Binary	Contact input
1ESPB00ESCH2	CH 2 TRIP pushbutton	Binary	Contact input
1ESPB00ESCH1	CH 1 RESET pushbutton	Binary	Contact input
1ESPB00ESCH2	CH 2 RESET pushbutton	Binary	Contact input
1HPIPB0299UB1*	CH A HPI BYPASS pushbutton	Binary	Contact input
1HPIPB0301UB1*	CH B HPI BYPASS pushbutton	Binary	Contact input
1HPIPB0303UB1*	CH C HPI BYPASS pushbutton	Binary	Contact input

15.12 **Existing Output Signals**

(lights are powered from ESFAS; statalarms provide 145 VDC to output contacts in ESFAS. (*HPI Pushbuttons in Sections 15.12 are located on UB1 instead of UB2, See PIP O-2008-5867 for further resolution and tracking.)

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range
1ESPB00ESCH1	CH 1 TRIPPED indicating light on pushbutton	Binary	24 VAC
1ESPB00ESCH2	CH 2 TRIPPED indicating light on pushbutton	Binary	24 VAC
1HPIPB0299UB1*	CH A HPI BYPASS indicating light on pushbutton	Binary	24 VAC
1HPIPB0301UB1*	CH B HPI BYPASS indicating light on pushbutton	Binary	24 VAC
1HPIPB0303UB1*	CH C HPI BYPASS indicating light on pushbutton	Binary	24 VAC
1SA7-1	ES HP Injection Channel A Trip	Binary	145 VDC
1SA7-10	ES HP Injection Channel B Trip	Binary	145 VDC
1SA7-19	ES HP Injection Channel C Trip	Binary	145 VDC
1SA7-6	ES HP Channel A Bypassed	Binary	145 VDC
1SA7-15	ES HP Channel B Bypassed	Binary	145 VDC
1SA7-24	ES HP Channel C Bypassed	Binary	145 VDC
1SA1-10	ES Channel 1 Trip	Binary	145 VDC
1SA1-22	ES Channel 2 Trip	Binary	145 VDC

15.13 **New Input Signals**

(all new and existing contact inputs are wetted by TXS)

ID Code	Description	Physical Range	Electrical Range
CH 1 MANUAL 1PPSPB0052UB2	CH 1 MANUAL pushbutton	Binary	Contact input
CH 1 AUTO 1PPSPB0052UB2	CH 1 AUTO pushbutton	Binary	Contact Input
CH 1 LOAD SHED MANUAL 1PPSPB0070UB2	CH 1 LOAD SHED MANUAL pushbutton	Binary	Contact input
CH 1 LOAD SHED AUTO 1PPSPB0070UB2	CH 1 LOAD SHED AUTO pushbutton	Binary	Contact input
CH 2 MANUAL 1PPSPB0053UB2	CH 2 MANUAL pushbutton	Binary	Contact input
CH 2 AUTO 1PPSPB0053UB2	CH 2 AUTO pushbutton	Binary	Contact Input
CH 2 LOAD SHED MANUAL 1PPSPB0071UB2	CH 2 LOAD SHED MANUAL pushbutton	Binary	Contact input
CH 2 LOAD SHED AUTO 1PPSPB0071UB2	CH 2 LOAD SHED AUTO pushbutton	Binary	Contact input

15.14 **New Output Signals**

(all new and existing indicating lights are powered from TXS)

ID Code	Description	Physical Range	Electrical Range
CH 1 AUTO 1PPSPB0052UB2	CH 1 AUTO indicating light on pushbutton	Binary	24 VDC
CH 1 MANUAL 1PPSPB0052UB2	CH 1 MANUAL indicating light on pushbutton	Binary	24 VDC
CH 2 AUTO 1PPSPB0053UB2	CH 2 AUTO indicating light on pushbutton	Binary	24 VDC
CH 2 MANUAL 1PPSPB0053UB2	CH 2 MANUAL indicating light on pushbutton	Binary	24 VDC
CH 1 LOAD SHED AUTO 1PPSPB0070UB2	CH 1 LOAD SHED AUTO indicating light on pushbutton	Binary	24 VDC
CH 1 LOAD SHED MANUAL 1PPSPB0070UB2	CH 1 LOAD SHED MANUAL indicating light on pushbutton	Binary	24 VDC
CH 2 LOAD SHED AUTO 1PPSPB0071UB2	CH 2 LOAD SHED AUTO indicating light on pushbutton	Binary	24 VDC
CH 2 LOAD SHED MANUAL 1PPSPB0071UB2	CH 2 LOAD SHED MANUAL indicating light on pushbutton	Binary	24 VDC
RC Pressure Wide Range to ICS/NNI	RC Pressure Wide Range to ICS /NNI (see Section 20.8)	0 – 2500 psig	0 to 10 VDC
1SA7-33	ES HPI BYP PERMIT	Binary	145 VDC
Isolated Output (to DLPIAS section 30)	RC Pressure analog CH A	0 - 2500 psig	0 - 20 mADC
Isolated Output (to DLPIAS section 30)	RC Pressure analog CH B	0 - 2500 psig	0 - 20 mADC
Isolated Output (to DLPIAS section 30)	RC Pressure analog CH C	0 - 2500 psig	0 - 20 mADC
Isolated Output (to DHPIAS section 31)	RC Pressure analog CH A	0 - 2500 psig	0 - 20 mADC
Isolated Output (to DHPIAS section 31)	RC Pressure analog CH B	0 - 2500 psig	0 - 20 mADC
Isolated Output (to DHPIAS section 31)	RC Pressure analog CH C	0 - 2500 psig	0 - 20 mADC

15.15 **Existing Actuated Field Devices (via existing R_O contacts)**

Channel 1	Channel 2
1EL RLKA (Keowee Start - CH A) (ES Position On)	1EL RLKB (Keowee Start - CH B) (ES Position On)
1EL RLESG1X (Load Shed & Standby Breaker 1 Initiate) (Load Shed ES Position Complete; BKR ES Position Closed - see Note 1)	1EL RLESG2X (Load Shed & Standby Breaker 2 Initiate) (Load Shed ES Position Complete; BKR ES Position Closed - see Note 1)
1EL RLESG1X1 (Load Shed & Standby Breaker 1 Initiate – second R_O contact, see Note 2) (Load Shed ES Position Complete ; BKR ES Position Closed)	N/A
0EL RL1RX1 (Keowee Standby Bus 1 Feeder Breaker) (ES Position Closed)	0EL RLRX2 (Keowee Standby Bus 2 Feeder Breaker) (ES Position Closed)
1CS VA0005 (1CS-5) (ES Position Closed)	1CS VA0006 (1CS-6) (ES Position Closed)

1FDWVA0105 (1FDW-105) (ES Position Closed)	1FDWVA0103 (1FDW-103) (ES Position Closed)
1FDWVA0107 (1FDW-107) (ES Position Closed)	1FDWVA0104 (1FDW-104) (ES Position Closed)
1GWDVA0012 (1GWD-12) (ES Position Closed)	1FDWVA0106 (1FDW-106) (ES Position Closed)
1HPIPU0001 (HPI-P1A) (ES Position Run)	1FDWVA0108 (1FDW-108) (ES Position Closed)
HPIPU0002 (HPI-P1B) (ES Position Run)	1GWDVA0013 (1GWD-13) (ES Position Closed)
1HP VA0003 (1HP-3) (ES Position Closed)	1HPIPU0002 (HPI-P1B) (ES Position Run)
1HP VA0004 (1HP-4) (ES Position Closed)	1HPIPU0003 (HPI-P1C) (ES Position Run)
1HP VA0020 (1HP-20) (ES Position Closed)	1HP VA0005 (1HP-5) (ES Position Closed)
1HP VA0024 (1HP-24) (ES Position Open)	1HP VA0021 (1HP-21) (ES Position Closed)
1HP VA0026 (1HP-26) (ES Position Open)	1HP VA0025 (1HP-25) (ES Position Open)
1LWDVA0001 (1LWD-1) (ES Position Closed)	1HP VA0027 (1HP-27) (ES Position Open)
1PR VA0001 (1PR-1) (ES Position Closed)	1LWDVA0002 (1LWD-2) (ES Position Closed)
1PR VA0006 (1PR-6) (ES Position Closed)	1PR VA0002 (1PR-2) (ES Position Closed)
1PR VA0007 (1PR-7) (ES Position Closed)	1PR VA0003 (1PR-3) (ES Position Closed)
1PR VA0009 (1PR-9) (ES Position Closed)	1PR VA0004 (1PR-4) (ES Position Closed)
1RC VA0005 (1RC-5) (ES Position Closed)	1PR VA0005 (1PR-5) (ES Position Closed)
1RC VA0006 (1RC-6 (Note 3) (ES Position Closed)	1PR VA0008 (1PR-8) (ES Position Closed)
	1PR VA0010 (1PR-10) (ES Position Closed)
	1RC VA0007 (1RC-7) (ES Position Closed)

Note 1 – LOCA Load Shed, Trains A and B, is actuated by spare contacts on auxiliary relays 1EL_RLESG1X and 1EL_RLESG2X, respectively, located in the Emergency Power Switching Logic Panel. These new functions do not require additional outputs from the ESFAS voters.

Note 2– Channel 1 requires that two control relays be picked up by the R_O relay. A second set of R_O outputs were added to Channel 1 in order to split the current load. Channel 2 has only one control relay and does not require a second R_O.

Note 3 New system feature – provide separate 24 VDC signals to control station LEDs to replace "operate here" indication function.

15.16 Normal Control and Device Status Indication

ODD devices (Cabinet 8)	EVEN devices (Cabinet 9)
1ELRLLSCA (LOAD SHED – NORMAL/COMPLETE) (ES Position Complete)	1ELRLLSCB (LOAD SHED – NORMAL/COMPLETE) (ES Position Complete)
0ELBKB1T05 (STBY BUS FDR BKR 1 – OPEN/CLOSED) (ES Position Closed)	0ELBKB2T09 (STBY BUS FDR BKR 2 – OPEN/CLOSED) (ES Position Closed)
1ELRL11GR (KEOWEE START CH A – UNIT 1 ON/OFF) (ES Position On)	1ELRL11GR (KEOWEE START CH B – UNIT 1 ON/OFF) (ES Position On)
2ELRL11GR (KEOWEE START CH A – UNIT 2 ON/OFF) (ES Position On)	2ELRL11GR (KEOWEE START CH B – UNIT 2 ON/OFF) (ES Position On)
1ELBKB1T06 (STBY BKR 1 OPEN/CLOSED) (ES Position Closed)	1ELBKB2T08 (STBY BKR 2 OPEN/CLOSED) (ES Position Closed)
1CS VA0005 (1CS-5) (ES Position Closed)	1CS VA0006 (1CS-6) (ES Position Closed)
1FDWVA0105 (1FDW-105)(Note 3)(ES Position Closed)	1FDWVA0103 (1FDW-103) (ES Position Closed)
1FDWVA0107 (1FDW-107)(Note 3)(ES Position Closed)	1FDWVA0104 (1FDW-104) (ES Position Closed)
1GWDVA0012 (1GWD-12) (ES Position Closed)	1FDWVA0106 (1FDW-106) (Note 3) (ES Position Closed)
1HPIPU0001 (HPI-P1A) (ES Position Run)	1FDWVA0108 (1FDW-108) (Note 3) (ES Position Closed)
1HP VA0003 (1HP-3) (ES Position Closed)	1GWDVA0013 (1GWD-13) (ES Position Closed)
1HP VA0004 (1HP-4) (ES Position Closed)	1HPIPU0003 (HPI-P1C) (ES Position Run)
1HP VA0020 (1HP-20) (ES Position Closed)	1HP VA0005 (1HP-5) (ES Position Closed)
1HP VA0024 (1HP-24) (ES Position Open)	1HP VA0021 (1HP-21) (Note 3) (ES Position Closed)
1HP VA0026 (1HP-26) (ES Position Open)	1HP VA0025 (1HP-25) (ES Position Open)
1LWDVA0001 (1LWD-1) (ES Position Closed)	1HP VA0027 (1HP-27) (ES Position Open)
1PR VA0001 (1PR-1) (ES Position Closed)	1LWDVA0002 (1LWD-2) (ES Position Closed)
1PR VA0006 (1PR-6) (ES Position Closed)	1PR VA0002 (1PR-2) (ES Position Closed)
1PR VA0007 (1PR-7) (Note 3) (ES Position Closed)	1PR VA0003 (1PR-3) (Note 3) (ES Position Closed)
1PR VA0009 (1PR-9) (Note 3) (ES Position Closed)	1PR VA0004 (1PR-4) (ES Position Closed)
1RC VA0005 (1RC-5) (Note 3) (ES Position Closed)	1PR VA0005 (1PR-5) (ES Position Closed)
1RC VA0006 (1RC-6 (Note 3) (ES Position Closed)	1PR VA0008 (1PR-8) (Note 3) (ES Position Closed)
1HPIPU0002 (HPI-P1B) (Note 2) (ES Position Run)	1PR VA0010 (1PR-10) (Note 3) (ES Position Closed)
	1RC VA0007 (1RC-7) (Note 3) (ES Position Closed)
	1HPIPU0002 (HPI-P1B) (Note 2) (ES Position Run)

Note 1 Keowee Start - CH A and CH B indication comes from cabinets KOICA and KOICB respectively.
Note 2 New system feature - checkback signals from ODD/EVEN field component go to both ODD and EVEN cabinets.
Note 3 New system feature – provide separate 24 VDC signals to control station LEDs to replace "operate here" indication function.

15.17 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design. [Note that O1A1416 & O1A1417 remain hardwired (HW), in support of the station Core Thermal Power (CTP) calculation requirements and will also be available on the Gateway.]

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D1872	ES HP INJECTION CH A (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1873	ES HP INJECTION CH B (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1874	ES HP INJECTION CH C (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1875	ES HP CH A (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1876	ES HP CH B (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1877	ES HP CH C (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1890	ES CH 1 (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1891	ES CH 2 (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1A1416	RC LOOP A WR PRESS 1	0 to 2500 psig*	Gateway/HW
O1A1417	RC LOOP B WR PRESS 1	0 to 2500 psig*	Gateway/HW
O1A1418	RC LOOP A WR PRESS 2	0 to 2500 psig	Gateway

* The hardwired input signal to the OAC is 0 to 10 VDC, representing 0 to 2500 psig.

15.18 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

15.19 **References**

See Section 27

16.0 RCS Pressure Low Low
(Low Pressure Injection and LPSW Actuation - Existing Digital Logic Channels 3 & 4)

16.1 Existing Automatic Trip Functions

Reactor Coolant Pressure Low Low

Reactor Coolant System Pressure inputs are shared with ESFAS Functional Trip #1.

When any of these signals reach the RCS Pressure Low Low Setpoint, the associated protective channel bistable is tripped. If two or more protective channel bistables are in the tripped state, a Channel 3 and Channel 4 ESFAS Actuation is generated.

Tech Specs require that the RCS Pressure – Low Low actuation be enabled at or above 900 psig. Actual ESFAS bypass is automatically removed at 890 psig for conservatism (see 16.4 below). Tech Specs also require that the RCS Pressure – Low Low actuation (decreasing pressure) occur before 500 psig (allowable value); actual ESFAS actuation setpoint is 550 psig for conservatism.

Reactor Building (RB) Pressure – High

A High Reactor Building Pressure signal (ESFAS Function #3) shall also provide an actuation signal to ESFAS Actuation Channels 3 and 4.

16.2 Description of Functions Related to Existing Trip

The purpose of Low Pressure Injection (LPI) System initiation is to assure that adequate flow into the Reactor Coolant System (RCS) is maintained following LOCAs resulting from break sizes above a certain minimum. The LPI System (along with the HPI System and core flood tanks) provides enough water to cool the core and to ensure the ability to establish recirculation from the Reactor Building sump and provide long term cooling after a LOCA.

16.3 Existing Manual Actuation Function

A manual actuation of the Low Pressure Injection and LPSW Actuation (Channels 3 and 4) shall be capable of being initiated from the main control board TRIP/RESET pushbutton switches. This manual actuation is independent of the automatic ESFAS Channel 3 and 4 automatic actuation system and shall be capable of actuating all channel related field components regardless of any failures of the automatic system. The TRIP latching logic is internal in the ES system.

16.4 Existing LPI BYPASS (INHIBIT)

The LPI BYPASS (INHIBIT) permissive bistables (monitoring analog pressure inputs A, B & C) allow manual bypass of the LPI TRIP function on decreasing reactor coolant pressure below the LPI BYPASS setpoint (890 psig).

The LPI BYPASS (INHIBIT) is required to be automatically removed on increasing reactor coolant pressure at the LPI BYPASS REMOVAL setpoint of 900 psig (allowable value). Actual LPI BYPASS REMOVAL setpoint is 890 psig for conservatism.

Once the LPI BYPASS (INHIBIT) has been automatically removed, the operator must again manually bypass LPI on decreasing pressure. This bypass does not prevent actuation of the Low Pressure Injection on High Reactor Building pressure. Bypassing is under administrative control. Since the ESFAS has three analog input channels, there are three Low Pressure Injection BYPASS switches. Two of the three switches must be operated to initiate a bypass. Once a bypass has been initiated, the condition is indicated by the plant annunciator system and by lamps associated with the bypass switches.

16.5 **Existing Associated Actuation Functions**

A High Reactor Building Pressure signal (ESFAS Function #3) shall also provide an actuation signal to ESFAS Actuation Channels 3 and 4.

16.6 **Existing Algorithm Equations for Channel Actuation Functions**

RCS Pressure Low Low

CURRENT ALGORITHM

Channel Trip: $P_m \leq P_{SP\ PRESS}$ **OR** $TRIP_{RBHP}$

Remove LPI Trip BYPASS: $P_m \geq P_{SP\ PRESS\ RBYP}$

Allow LPI Trip BYPASS: $P_m \leq P_{SP\ PRESS\ BYP}$

(a) P_m = measured RCS pressure in each ESFAS channel A, B and C.
(b) $P_{SP\ PRESS}$ = LPI Trip; setpoint 550 psig, decreasing.
(c) $P_{SP\ PRESS\ RBYP}$ = Remove LPI BYPASS; setpoint 890 psig, increasing.
(d) $P_{SP\ PRESS\ BYP}$ = Allow Manual LPI BYPASS; setpoint 890 psig, decreasing.
(e) $TRIP_{RBHP}$ = Reactor Building HIGH pressure TRIP; see ESFAS Function 3 in Section 17.
(f) 2 out of 3 channels tripped = ESFAS Channels 3 & 4 Actuation

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	Reset Value	Units
P_m	Measured Reactor Coolant System Pressure in each ESFAS channel.	0 – 2500	N/A	psig
$P_{SP\ PRESS}$	ESFAS LPI Actuation Trip setpoint on decreasing pressure. Tech Spec Allowable Value is ≥ 500 psig.	550 Automatically Trip on decreasing pressure	manual reset once pressure is above setpoint	psig
$P_{SP\ PRESS\ RBYP}$	Remove LPI Trip Bypass on increasing pressure. Tech Spec Allowable Value is ≥ 900.	890 Automatically remove bypass on increasing pressure	< 890 manual bypass	psig
$P_{SP\ PRESS\ BYP}$	Allow LPI Trip Bypass on decreasing pressure.	< 890 manual bypass	890 Automatically remove bypass on increasing pressure	psig
$TRIP_{RBHP}$	Reactor Building HIGH pressure TRIP. (See ESFAS Function 3 in Section 17).	N/A	N/A	N/A

16.7 **New Algorithm Equations for Channel Actuation Functions**

RCS Pressure Low Low

PROPOSED ALGORITHM

Channel Trip: $P_{m2.Min} \leq P_{SP\ PRESS}$ OR $TRIP_{RBHP}$

Remove LPI Trip BYPASS: $P_{m2.Min} \geq P_{SP\ PRESS\ RBYP}$

Allow LPI Trip BYPASS: $P_{m2.Min} \leq P_{SP\ PRESS\ BYP}$

(a) $P_{m2.Min}$ = RC pressure, 2nd minimum value of pressure from ESFAS channel A, B and C.

(b) $P_{SP\ PRESS}$ = LPI Trip; setpoint 550 psig, decreasing.

(c) $P_{SP\ PRESS\ RBYP}$ = Remove LPI BYPASS; setpoint 890 psig, increasing.

(d) $P_{SP\ PRESS\ BYP}$ = Allow Manual LPI BYPASS; (See OSC-8695 for value), decreasing.

(e) $TRIP_{RBHP}$ = Reactor Building HIGH pressure TRIP; see ESFAS Function 3 in Section 17.

(f) 2 out of 3 channels tripped = ESFAS Channels 3 & 4 Actuation

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$P_{m2.Min}$	RCS pressure, second minimum of all channels A, B & C	0 – 2500	N/A	psig
$P_{SP\ PRESS}$	RC Low Low Pressure Actuation Trip setpoint on decreasing pressure. Tech Spec Allowable Value is ≥ 500 psig.	550 Automatically Trip on decreasing pressure	Trip comparator auto-resets once pressure is above the auto-reset value; see OSC-8695 for the auto-reset value. (See 16.8.3.)	psig
$P_{SP\ PRESS\ RBYP}$	Remove LPI Trip Bypass on increasing pressure. Tech Spec Allowable Value is ≥ 900.	890 Automatically remove bypass on increasing pressure	Trip comparator auto-resets once pressure is below the auto-reset value, to allow manual bypass on decreasing pressure. See OSC-8695 for the auto-reset value.	psig
$P_{SP\ PRESS\ BYP}$	Allow LPI Trip Bypass on decreasing pressure. (This is the reset for the Automatic Removal of LPI Trip Bypass, $P_{SP\ PRESS\ RBYP}$)	See OSC-8695 for value.	NA	psig
$TRIP_{RBHP}$	Reactor Building HIGH pressure TRIP. (See ESFAS Function 3 in Section 17).	N/A	N/A	N/A

16.8 New Design Features

16.8.1 Second Maximum / Second Minimum Function

Each ESFAS instrument channel (A, B & C) processes the associated Reactor Coolant System (RCS) pressure signal value as well as the RCS pressure signal values from the other two ESFAS instrument channels. For the RCS Pressure Low Low Trip, each ESFAS channel selects the second minimum (2.Min) measured RCS pressure value ($P_{m2.Min}$) from all three channels. If the value of $P_{m2.Min}$ falls below the RCS Pressure Low

Low Trip setpoint ($P_{SP\ PRESS}$), the channel generates a trip signal. If two or more ESFAS instrument channels are in the tripped state, an actuation is generated for ESFAS channel 3 and 4 components.

16.8.2 LPI BYPASS Function

As described above, each ESFAS instrument channel (A, B & C) processes the associated Reactor Coolant System (RCS) pressure signal value as well as the RCS pressure signal values from the other two ESFAS instrument channels. For the LPI BYPASS Function, on decreasing RC pressure, each ESFAS instrument channel selects the second minimum (2.Min) measured RCS pressure value ($P_{m2.Min}$) from all three channels (A, B & C). If the value of $P_{m2.Min}$ is below the LPI BYPASS setpoint, the system allows the operator to manually BYPASS the RCS Low-Low Pressure function in that ESFAS instrument channel. Bypassing the trip function in 2/3 of the ESFAS instrument channels will result in the bypass of ESFAS actuation channels 3 and 4 for this trip function. On increasing RCS pressure, if the value of $P_{m2.Min}$ is above the LPI BYPASS REMOVAL setpoint ($P_{SP\ PRESS\ RBYP}$), the LPI BYPASS is required to be automatically removed. Following an ESFAS actuation, to allow resetting ESFAS actuation channels 3 and 4, the TXS RCS Low-Low Pressure comparators (old analog channel bistable) may be bypassed by depressing the LPI BYPASS pushbutton for each channel.

16.8.3 TRIP/RESET Function

Depressing the manual TRIP pushbutton will initiate a TRIP signal to the associated ESFAS Channel 3 or 4 directly to the associated Channel output relays bypassing the TXS. Following an actuation, the manual or automatic Channel 3 and/or 4 TRIP signal can be reset by depressing the associated Channel RESET button (LPI analog channels must first be bypassed - see discussion below). The existing pushbuttons will be replaced (see Section 20. 7).

The concept of operation for a reset of LPI Channel 3 (4) following an automatic trip on ESFAS Function #2 (RCS Pressure Low Low) is as follows:

1. To reset the LPI Channel 3 (4) following an automatic or manual ESFAS actuation ESFAS Function #3 (RB Pressure High) must not be tripped.
2. If ESFAS Function #2 (RCS Pressure Low Low) is tripped, ESFAS Function #2 (RCS Pressure Low Low) trip logic must be manually bypassed with the LPI BYPASS pushbuttons (BYPASS light will come on).
3. LPI Channel 3 (4) may be removed from automatic operation by placing ODD (EVEN) LPI channel in manual by pushing the Channel 3 (4) MANUAL pushbutton. At the AUTO/MANUAL switch, the AUTO lights will go out, the MANUAL lights will come on. At this point the Channel 3 (4) ESFAS R_O contacts will drop out and the operator has manual control of all Channel 3 (4) devices.

4. Channel 3 (4) may then be reset with the Channel 3 (4) RESET pushbutton. When the RESET pushbutton is pushed, the TRIP light for Channel 3 (4) will go out and the Channel 3 (4) MANUAL light will go out.
5. If required, the operator may re-actuate ESFAS channel 3 (4) with the Channel 3 (4) TRIP pushbutton.

16.8.4 RZ Module Replacement

The RZ Module indicating function for Channel 3 & 4 ESFAS components will be replaced with lamp boxes that will have indicating LEDs for the status of each device actuated by the ES system arranged by channel (see Section 20). In addition, the "Operate Here" functions for certain ODD and EVEN devices will be replaced with control switches and indicating LEDs on 1VB2 and 1UB2 as shown in Section 20.

16.8.5 AUTO/MANUAL Function

The existing ESFAS AUTO/MANUAL function is used to remove the ES actuation signal to each ESFAS actuated component. The existing individual component AUTO/MANUAL function will be replaced with a new Logic Channel level AUTO/MANUAL function (see Section 20.6).

16.8.6 New ODD/EVEN Field Device Status

ODD/EVEN device status (check back) from LPSW Pump C will be provided from ESTC3. The signal will be sent to ESFAS cabinets (1PPSCA0017 and 1PPSCA0018) for lighting the associated device status LEDs on the lamp box and providing device status signals to the TXS and OAC.

16.8.7 ESFAS Outputs

All new ESFAS output contacts (R_O) shall have an adjustable software time delay on closure (0 to 15 minutes). All time delays will be set to zero (0) seconds.

16.8.8 Emergency Override Switches, See Section 21 discussion.

16.8.9 Analog Signal Monitoring discussion, see Section 25.4.

16.8.10 CHANNEL CHECK discussion, see Section 25.1.

16.9 Safety Classification

This function is classified QA Condition 1 (Class 1E).

16.10 Response Time Requirements

The response time for the TXS rack/processing equipment shall be < 500 ms. The channel response time does not include the sensor response time or the time required for the field devices to go to the ES position from the Non-ES position.

16.11 Existing Input Signals

The RC pressure inputs are shared with ESFAS Function 1, Diverse Low Pressure Injection Actuation System (DLPIAS - see Section 30) and Diverse High Pressure Injection Actuation System (DHPIAS – see Section 31). Pushbuttons are wetted from ESFAS.

ID Code	Description	Physical Range	Electrical Range
1ESPB00ESCH3	CH 3 TRIP/RESET pushbutton	Binary	Contact input
1ESPB00ESCH4	CH 4 TRIP/RESET pushbutton	Binary	Contact input
1LPIPB0300UB2	CH A LPI BYPASS pushbutton	Binary	Contact input
1LPIPB0302UB2	CH B LPI BYPASS pushbutton	Binary	Contact input
1LPIPB0304UB2	CH C LPI BYPASS pushbutton	Binary	Contact input

16.12 Existing Output Signals

(lights are powered from ESFAS; statalarms provide 145 VDC to output contacts in ESFAS)

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range
1ESPB00ESCH3	CH 3 TRIPPED indicating light on pushbutton	Binary	24 VAC
1ESPB00ESCH4	CH 4 TRIPPED indicating light on pushbutton	Binary	24 VAC
1LPIPB0300UB2	CH A LPI BYPASS indicating light on pushbutton	Binary	24 VAC
1LPIPB0302UB2	CH B LPI BYPASS indicating light on pushbutton	Binary	24 VAC
1LPIPB0304UB2	CH C LPI BYPASS indicating light on pushbutton	Binary	24 VAC
1SA7-2	ES LP Injection Channel A TRIP	Binary	145 VDC
1SA7-11	ES LP Injection Channel B TRIP	Binary	145 VDC
1SA7-20	ES LP Injection Channel C TRIP	Binary	145 VDC
1SA7-7	ES LP Channel A BYPASS	Binary	145 VDC
1SA7-16	ES LP Channel B BYPASS	Binary	145 VDC
1SA7-25	ES LP Channel C BYPASS	Binary	145 VDC
1SA1-34	ES Channel 3 TRIP	Binary	145 VDC
1SA1-46	ES Channel 4 TRIP	Binary	145 VDC

16.13 New Input Signals

(all new and existing contact inputs are wetted by TXS)

ID Code	Description	Physical Range	Electrical Range
CH 3 AUTO 1PPSPB0054UB2	CH 3 AUTO pushbutton	Binary	Contact input
CH 3 MANUAL 1PPSPB0054UB2	CH 3 MANUAL pushbutton	Binary	Contact input
CH 4 AUTO 1PPSPB0055UB2	CH 4 AUTO pushbutton	Binary	Contact input
CH 4 MANUAL 1PPSPB0055UB2	CH 4 MANUAL pushbutton	Binary	Contact input

16.14 **New Output Signals**

(all new and existing indicating lights are powered from TXS)

ID Code	Description	Physical Range	Electrical Range
CH 3 AUTO 1PPSPB0054UB2	CH 3 AUTO indicating light on pushbutton	Binary	24 VDC
CH 3 MANUAL 1PPSPB0054UB2	CH 3 MANUAL indicating light on pushbutton	Binary	24 VDC
CH 4 AUTO 1PPSPB0055UB2	CH 4 AUTO indicating light on pushbutton	Binary	24 VDC
CH 4 MANUAL 1PPSPB0055UB2	CH 4 MANUAL indicating light on pushbutton	Binary	24 VDC
1LPVA0001 OPEN interlock	1LPVA0001 OPEN Interlock permissive (on decreasing RC pressure less than 400 psig). See Section 20.8 for additional information.	Binary	120 VAC (supplied from 1LPVA0001 control circuit, MCC 1XS1, compartment F4D)
1SA7-42	ES LPI BYP PERMIT	Binary	145 VDC

16.15 **Existing Actuated Field Devices (via existing R_O contacts)**

Channel 3	Channel 4
1LPIPU0001 (LPI-P1A) (ES Position Run)	1LPIPU0002 (LPI-P1B) (ES Position Run)
1LP VA0017 (1LP-17) (ES Position Open)	1LP VA0018 (1LP-18) (ES Position Open)
0LPSPU000A (A LPSW PUMP) (ES Position Run)	0LPSPU000B (B LPSW PUMP) (ES Position Run)
0LPSPU000C (C LPSW PUMP) (ES Position Run)	0LPSPU000C (C LPSW PUMP) (ES Position Run)

16.16 **Normal Control and Device Status Indication**

ODD devices (Cabinet 8)	EVEN devices (Cabinet 9)
1LPIPU0001 (LPI-P1A) (ES Position Run)	1LPIPU0002 (LPI-P1B) (ES Position Run)
1LP VA0017 (1LP-17) (ES Position Open)	1LP VA0018 (LP-18) (ES Position Open)
0LPSPU000A (A LPSW PUMP) (ES Position Run)	0LPSPU000B (B LPSW PUMP) (ES Position Run)
0LPSPU000C (C LPSW PUMP) (ES Position Run) (Note 1)	0LPSPU000C (C LPSW PUMP) (ES Position Run) (Note 1)

(Note 1 New system feature - Checkback signals from ODD/EVEN field component go to both ODD and EVEN cabinets.)

16.17 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D1878	ES LP INJECTION CH A (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1879	ES LP INJECTION CH B (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1880	ES LP INJECTION CH C (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1881	ES LP CH A (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1882	ES LP CH B (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1883	ES LP CH C (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D1892	ES CH 3 (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1893	ES CH 4 (NOT TRIPPED) (TRIPPED)	Binary	Gateway

16.18 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

16.19 **References**

See Section 27.

17.0 Reactor Building Pressure High
(Reactor Building (RB) Cooling and RB Essential Isolation and Penetration Room Ventilation Actuation - Existing Digital Logic Channels 5 & 6)

17.1 Existing Automatic Trip Function

Reactor Building Pressure High

Reactor Building (RB) pressure transmitters 1BSPT0004P, 05P and 06P (-15 to +15 psig range) provide inputs to the ESFAS protective channels A, B and C respectively. When any of these signals reaches the RB Pressure High Setpoint, the associated protective channel bistable is tripped. If two or more protective channel bistables are in the tripped state, a Channel 5 and Channel 6 ESFAS Actuation is generated.

Tech Specs require that the RB Pressure High actuation (increasing pressure) occurs before 4 psig, (allowable value); actual ESFAS actuation setpoint is 3 psig for conservatism.

17.2 Description of Functions Related to Existing Trip

The purpose of Reactor Building Cooling (RBC) System initiation is to assure that sufficient cooling of the reactor building is provided following high-energy line breaks or pressurizer quench tank releases that occur which result in an increase in reactor building pressure.

17.3 Existing Manual Trip Function

A manual actuation of the RB Cooling, RB Essential Isolation and Penetration Room Ventilation Actuation (Channels 5 and 6) shall be capable of being initiated from the main control board TRIP/RESET pushbutton switches. This manual actuation is independent of the automatic ESFAS Channel 5 and 6 automatic actuation system and shall be capable of actuating all channel related field components regardless of any failures of the automatic system.

17.4 Existing BYPASS (INHIBIT)

There is no BYPASS (INHIBIT) permissive for this function.

17.5 Existing Associated Actuation Functions

As stated in Sections 15.5 and 16.5 a High Reactor Building Pressure signal (ESFAS Function #3) shall also provide an actuation signal to ESFAS Actuation Channels 1, 2, 3 and 4. Additionally, a contact input to ICS is provided from the ESFAS Channel A cabinet for a degraded containment condition. This signal shall remain in the new system. See tables in Sections 17.12 and 17.14.

17.6 **Existing Algorithm Equations for Channel Actuation Functions**

RB Pressure High

CURRENT ALGORITHM
Channel Trip: $P_m \geq P_{SP\ PRESS}$

(a) **P_m = measured RB pressure in each ESFAS channel A, B and C.**
(b) **$P_{SP\ PRESS}$ = Reactor Building HIGH pressure Trip; setpoint 3 psig increasing.**
(c) **$TRIP_{RBHP}$ = Reactor Building HIGH pressure TRIP signal to ESFAS Channels 1 & 2 and 3 & 4; see ESFAS Functions #1 and #2 in Sections 15 and 16.**
(d) **2 out of 3 channels tripped = ESFAS Channels 5 & 6 Actuation**

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	Reset Value	Units
P_m	Measured Reactor Building Pressure in each ESFAS channel.	-15 to +15	N/A	psig
$P_{SP\ PRESS}$	ESFAS Actuation Trip setpoint on increasing pressure Tech Spec Allowable Value is ≤ 4 psig.	3 Automatically Trip on increasing pressure	manual reset once pressure is below setpoint	psig
$TRIP_{RBHP}$	Logical Trip Function to ESFAS Functions #1 & #2 in Sections 15 & 16.	N/A	N/A	N/A

17.7 **New Algorithm Equations for Channel Actuation Functions**

RB Pressure High

PROPOSED ALGORITHM
Channel Trip: $P_{m2.Max} \geq P_{SP\ PRESS}$ PSIG

(a) **$P_{m2.Max}$ = 2nd max value of RB pressure from ESFAS channel A, B and C.**
(b) **$P_{SP\ PRESS}$ = Reactor Building HIGH pressure Trip; setpoint 3 psig increasing.**
(c) **$TRIP_{RBHP}$ = Reactor Building HIGH pressure TRIP signal to ESFAS Channels 1 & 2 and 3 & 4; see ESFAS Functions #1 and #2 in Sections 15 and 16.**
(d) **2 out of 3 channels tripped = ESFAS Channels 5 & 6 Actuation**

Process Parameters for New Algorithm

Setpoints, coefficients, reset values, and algorithm variables shall be adjustable utilizing software using the TXS Service Unit. When an adjustable parameter can be entered from a GSM screen the GSM screen shall enforce the range limits on the entered value. The stated range limits on calculated values in the table below are the expected ranges of the calculated value and are not meant to imply limits unless otherwise specified.

Logical ID	Description	Range / Value	Reset Value	Units
$P_{m2.Max}$	Reactor Building pressure, second maximum of all channels A, B & C	-15 to +15	N/A	psig
$P_{SP\ PRESS}$	RB High Pressure Actuation Trip setpoint on increasing pressure. Tech Spec Allowable Value is ≤ 4 psig.	3 Automatically Trip on increasing pressure	Trip comparator auto-resets once pressure is below the auto-reset value; see OSC-8695 for the auto-reset value.	psig
$TRIP_{RBHP}$	Logical Trip Function on Reactor Building HIGH pressure actuation sent to ESFAS Functions #1 and #2. (See ESFAS Functions #1 & 2 in Sections 15 & 16.)	N/A	N/A	N/A

17.8 **New Design Features**

17.8.1 Second Maximum / Second Minimum Function

Each ESFAS instrument channel (A, B & C) processes the associated Reactor Building (RB) pressure signal value as well as the RB pressure signal values from the other two ESFAS instrument channels. For the Reactor Building Pressure High Trip, each ESFAS channel selects the second maximum (2.Max) measured RB pressure value ($P_{m2.Max}$) from all three channels. If the value of $P_{m2.Max}$ increases above the RB Pressure High Trip setpoint ($P_{SP\ PRESS}$), the channel generates a Trip signal. If two or more ESFAS instrument channels are in the tripped state, an Actuation is generated for ESFAS channels 5 & 6 components.

17.8.2 TRIP/RESET Function

Depressing the manual TRIP pushbutton will initiate a TRIP signal to the associated ESFAS Channel 5 or 6 directly to the associated Channel output relays bypassing the TXS. Following an actuation, the manual or automatic Channel 5 and/or 6 TRIP signal can be reset by depressing the associated Channel RESET button. The existing pushbuttons will be replaced (see Section 20. 7).

The concept of operation for a reset of Channel 5 (6) Reactor Building Cooling, Penetration Room Ventilation, and Essential Reactor Building Isolation is as follows:

1. Channel 5 (6) may be removed from automatic operation by placing ODD (EVEN) RB Cooling, PR Ventilation and Essential RB Isolation channel in manual by pushing the Channel 5 (6) MANUAL pushbutton. At the AUTO/MANUAL switch, the AUTO lights will go out, the MANUAL lights will come on. At this point the channel 5 (6) ESFAS R_O contacts will drop out and the operator has manual control of all Channel 5 (6) devices.
2. The RB Cooling, PR Ventilation and Essential RB Isolation logic will automatically reset once the RB pressure transmitters signals decrease below the trip setpoints (2^{nd} max).
3. Channel 5 (6) may then be reset with the Channel 5 (6) RESET pushbutton. When the RESET pushbutton is pushed, the TRIP light for channel 5 (6) will go out and the channel 5 (6) MANUAL light will go out.
4. If required, the operator may re-actuate ESFAS channel 5 (6) with the channel 5 (6) TRIP pushbutton.

17.8.3 RZ Module Replacement

The RZ Module indicating function for Channel 5 & 6 ESFAS components will be replaced with lamp boxes that will have indicating LEDs for the status of each device actuated by the ES system arranged by channel (see Section 20). In addition, the "Operate Here" functions for certain ODD and EVEN devices will be replaced with control switches and indicating LEDs on 1VB2 and 1UB2 as shown in Section 20.

17.8.4 AUTO/MANUAL Function

The existing ESFAS AUTO/MANUAL function is used to remove the ES actuation signal to each ESFAS actuated component. The existing individual component AUTO/MANUAL function will be replaced with a new Logic Channel level AUTO/MANUAL function (see Section 20.6).

17.8.5 New ODD/EVEN Field Device Status

ODD/EVEN device status (check back) from RBCU-1B, LPSW-6, 15 and 21 will be provided from 1ESTC3. The signal will be sent to ESFAS cabinets (1PPSCA0017 and 1PPSCA0018) for lighting the associated device status LEDs on the lamp box, lighting new indication LEDs on 1UB2 (LPSW-6 and 15 only) and providing device status signals to the TXS and OAC.

17.8.6 ESFAS Outputs

All new ESFAS output contacts (R_O) shall have an adjustable software time delay on closure (0 to 15 minutes). All time delays will be set to zero (0) seconds.

17.8.7 Emergency Override Switches

See Section 21 discussion.

17.8.8 Analog Signal Monitoring discussion, see Section 25.4.

17.8.9 CHANNEL CHECK discussion, see Section 25.1.

17.9 Safety Classification

This function is classified QA Condition 1 (Class 1E).

17.10 Response Time Requirements

The TXS total channel response time must be < 500 ms. The channel response time does not include the sensor response time or the time required for the field devices to go to the ES position from the Non-ES position.

17.11 **Existing Input Signals**

Transmitter loops are powered from ESFAS. Pushbuttons are wetted from ESFAS.

ID Code	Description	Physical Range	Electrical Range
1BS PT0004P	RB Pressure Ch. A	-15 to +15 psig	4 – 20 mA
1BS PT0005P	RB Pressure Ch. B	-15 to +15 psig	4 – 20 mA
1BS PT0006P	RB Pressure Ch. C	-15 to +15 psig	4 – 20 mA
1ESPB00ESCH5	CH 5 TRIP pushbutton	Binary	Contact input
1ESPB00ESCH6	CH 6 TRIP pushbutton	Binary	Contact input
1ESPB00ESCH5	CH 5 RESET pushbutton	Binary	Contact input
1ESPB00ESCH6	CH 6 RESET pushbutton	Binary	Contact input

17.12 **Existing Output Signals**

(Lights are powered from ESFAS; statalarms provide 145 VDC to output contacts in ESFAS)

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range
1ESPB00ESCH5	CH 5 TRIPPED indicating light on pushbutton	Binary	24 VAC
1ESPB00ESCH6	CH 6 TRIPPED indicating light on pushbutton	Binary	24 VAC
1SA7-3	ES RB Isolation Channel A TRIP	Binary	145 VDC
1SA7-12	ES RB Isolation Channel B TRIP	Binary	145 VDC
1SA7-21	ES RB Isolation Channel C TRIP	Binary	145 VDC
1SA1-11	ES Channel 5 TRIP	Binary	145 VDC
1SA1-23	ES Channel 6 TRIP	Binary	145 VDC
CH A Tripped (RB Pressure ≥ 3 psig)	CH A Tripped to ICS Cab 4 for degraded containment. (contact output)	Binary	ICS provides 118 VAC to wet contact

17.13 **New Input Signals**

(All new and existing contact inputs are wetted by TXS.)

ID Code	Description	Physical Range	Electrical Range
CH 5 AUTO 1PPSPB0056UB2	CH 5 AUTO pushbutton	Binary	Contact input
CH 5 MANUAL 1PPSPB0056UB2	CH 5 MANUAL pushbutton	Binary	Contact Input
CH 6 AUTO 1PPSPB0057UB2	CH 6 AUTO pushbutton	Binary	Contact input
CH 6 MANUAL 1PPSPB0057UB2	CH 6 MANUAL pushbutton	Binary	Contact input

17.14 **New Output Signals**

(All new and existing indicating lights are powered from TXS.)

ID Code	Description	Physical Range	Electrical Range
CH 5 AUTO 1PPSPB0056UB2	CH 5 AUTO indicating light on pushbutton	Binary	24 VDC
CH 5 MANUAL 1PPSPB0056UB2	CH 5 MANUAL indicating light on pushbutton	Binary	24 VDC
CH 6 AUTO 1PPSPB0057UB2	CH 6 AUTO indicating light on pushbutton	Binary	24 VDC
CH 6 MANUAL 1PPSPB0057UB2	CH 6 MANUAL indicating light on pushbutton	Binary	24 VDC
CH A Tripped (RB Pressure ≥ 3 psig)	CH A Tripped to ICS Cab 4 for degraded containment. (contact output)	Binary	ICS provides 118 VAC to wet contact

17.15 **Existing Actuated Field Devices (via existing R_O contacts)**

Channel 5	Channel 6
1RBCAH0020A (RBCU-1A) (ES Position Low Speed)	1RBCAH0020B (RBCU-1B) (ES Position Low Speed)
1RBCAH0020B (RBCU-1B) (ES Position Low Speed)	1CC VA0008 (1CC-8) (ES Position Closed)
1CC VA0007 (1CC-7) (ES Position Closed)	1RBCAH0020C (RBCU-1C) (ES Position Low Speed)
1LPSVA0018 (1LPSW-18) (ES Position Full Open)	1LPSVA0024 (1LPSW-24) (ES Position Full Open)
1LPSVA0006 (1LPSW-6) (ES Position Closed)	1LPSVA0006 (1LPSW-6) (ES Position Closed)
1LPSVA0015 (1LPSW-15) (ES Position Closed)	1LPSVA0015 (1LPSW-15) (ES Position Closed)
1LPSVA0021 (1LPSW-21) (ES Position Full Open)	1LPSVA0021 (1LPSW-21) (ES Position Full Open)
1LPSVA1055 (ES Position Closed)	1LPSVA1054 (ES Position Closed)
1LPSVA1061 (ES Position Closed)	1LPSVA1062 (ES Position Closed)
1PR BW000A (PR FAN 1A) (ES Position Run)	1PR BW000B (PR FAN 1B) (ES Position Run)

17.16 **Existing Normal Control and Device Status Indication**

ODD devices (Cabinet 8)	EVEN devices (Cabinet 9)
1RBCAH0020A (RBCU-1A) (ES Position Low Speed)	1RBCAH0020C (RBCU-1C) (ES Position Low Speed)
1CC VA0007 (1CC-7) (ES Position Closed) (Note 2)	1CC VA0008 (1CC-8) (Note 2)
1LPSVA0018 (1LPSW-18) (ES Position Full Open)	1LPSVA0024 (1LPSW-24) (ES Position Full Open)
1PR BW000A (PR FAN 1A) (ES Position Run) (Note 2)	1PR BW000B (PR FAN 1B) (ES Position Run) (Note 2)
1RBCAH0020B (RBCU-1B) (ES Position Low Speed) (Note 1)	1RBCAH0020B (RBCU-1B) (ES Position Low Speed) (Note 1)
1LPSVA1055 (ES Position Closed)	1LPSVA1054 (ES Position Closed)
1LPSVA1061 (ES Position Closed)	1LPSVA1062 (ES Position Closed)

ODD devices (Cabinet 8)	EVEN devices (Cabinet 9)
1LPSVA0006 (1LPSW-6) (ES Position Closed) (Note 1)	1LPSVA0006 (1LPSW-6) (ES Position Closed) (Note 1)
1LPSVA0015 (1LPSW-15) (ES Position Closed) (Note 1)	1LPSVA0015 (1LPSW-15) (ES Position Closed) (Note 1)
1LPSVA0021 (1LPSW-21) (ES Position Full Open) (Note 1)	1LPSVA0021 (1LPSW-21) (ES Position Full Open) (Note 1)

Note 1 New system feature - Checkback signals from ODD/EVEN field components go to both ODD and EVEN cabinets.

Note 2 New system feature – provide separate 24 VDC signals to control station LEDs to replace "operate here" indication function.

17.17 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D1950	ES RB ISOLATION CH A (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1951	ES RB ISOLATION CH B (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1952	ES RB ISOLATION CH C (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1894	ES CH 5 (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1D1896	ES CH 6 (NOT TRIPPED) (TRIPPED)	Binary	Gateway
O1A1566	RB NR PRESS 1	-15 to +15 psig	Gateway
O1A1286	RB NR PRESS 2	-15 to +15 psig	Gateway
O1A1287	RB NR PRESS 3	-15 to +15 psig	Gateway

17.18 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

17.19 **References**

See Section 27.

18.0 Reactor Building Pressure High High
(Reactor Building Spray - Existing Digital Logic Channels 7 & 8)

18.1 Existing Automatic Trip Function

RB Spray Actuation on High-High RB Pressure

The Reactor Building High-High pressure is monitored by six Reactor Building pressure sensing switches, with two pressure switches in each analog channel A, B and C. One pressure switch in each analog channel provides inputs to logic Channel 7 and the other pressure switch provides inputs to logic Channel 8. Contact buffer modules provide the isolating interface between the 3 channels of analog pressure switch inputs (A, B and C) and the 2 ESFAS logic channels (7 and 8). The outputs from the contact buffer modules provide inputs to the two-out-of-three logic (trip logic modules) in the digital logic subsystem, which actuate the Channel 7 and 8 Engineered Safeguards (ES) components (see Section 18.9). RB Pressure Switches are wired to the normally open contact and close on increasing pressure (BSPS-0018, BSPS-0020, and BSPS-0022 are inputs to Channel 7; BSPS-0019, BSPS-0021, and BSPS-0023 are inputs to Channel 8).

Tech Specs requires that the RB Pressure High High actuation (increasing pressure) occurs before 15 psig, (allowable value); actual ESFAS actuation setpoint is 10 psig for conservatism.

18.2 Description of Functions Related to Existing Trip

The purpose of the Reactor Building Spray initiation is to cool the Reactor Building atmosphere to maintain equipment Environmental Qualification and scrub post-LOCA activity to reduce offsite dose.

18.3 Existing Manual Actuation Function

A manual actuation of the Reactor Building Spray (Channels 7 and 8) shall be capable of being initiated from the main control board TRIP/RESET pushbutton switches. This manual actuation is independent of the automatic ESFAS Channel 7 and 8 automatic actuation system and shall be capable of actuating all channel related field components regardless of any failures of the automatic system.

18.4 Existing BYPASS (INHIBIT)

There is no BYPASS (INHIBIT) permissive for this function.

18.5 Existing Associated Actuation Functions

None

18.6 **Existing Algorithm Equations for Channel Actuation Functions**

RB Pressure High High

CURRENT ALGORITHM

Channel Trip: $PS_{RB\ PRESS}$ = closed contact

(a) **$PS_{RB\ PRESS}$ = closed contact from Reactor Building Pressure Switches in each ESFAS channel A, B & C.**

(b) **Logic Channels 7 (BSPS-0018, 20 and 22) & 8 (BSPS-0019, 21 and 23) each receive buffered contact inputs from RB pressure switches.**

(c) **2 out of 3 channels tripped = ESFAS Channels 7 & 8 Actuation**

Existing Process Parameters for Current Algorithm

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$PS_{RB\ PRESS}$	Reactor Building Pressure switch (contact closed / open)	Trip / Not Tripped	N/A	N/A

18.7 **New Algorithm Equations for Channel Actuation Functions**

RB Pressure High High

PROPOSED ALGORITHM

Channel Trip: $P_{SRB\ PRESS()} \geq$ 2 out of 3 closed contact signals

(a) **$PS_{RB\ PRESS}$ = closed contact signals from Reactor Building Pressure Switches in each ESFAS channel A, B & C.**

(b) **2 out of 3 channels tripped = ESFAS Channels 7 (BSPS-0018, 20 and 22) & 8 (BSPS-0019, 21 and 23) Actuation**

Process Parameters for New Algorithm

Logical ID	Description	Parameter Range or Value	Reset Value	Units
$PS_{RB\ PRESS}$	Reactor Building Pressure switch (contact closed / open)	Tripped / Not Tripped	N/A	N/A

18.8 New Design Features

18.8.1 TRIP/RESET Function

Depressing the manual TRIP pushbutton will initiate a TRIP signal to the associated ESFAS Channel 7 or 8 directly to the associated Channel output relays bypassing the TXS. The manual or automatic TRIP signal can be reset by depressing the associated Channel RESET button. The existing pushbuttons will be replaced (see Section 20. 7).

The concept of operation for a reset of Reactor Building Spray actuation on Channel 7 (8) following either an automatic or manual ESFAS actuation is:

1. Channel 7 (8) may be removed from automatic operation by placing ODD (EVEN) RB Spray channel in manual by pushing the Channel 7 (8) MANUAL pushbutton. At the AUTO/MANUAL switch, the AUTO lights will go out, the MANUAL lights will come on. At this point the Channel 7 (8) ESFAS R_O contacts will drop out and the operator has manual control of all Channel 7 (8) devices.
2. The RB Spray logic will automatically reset once the RB pressure switch inputs are cleared (2-out-of-3).
3. Channel 7 (8) may then be reset with the Channel 7 (8) RESET pushbutton. When the RESET pushbutton is pushed, the TRIP light for Channel 7 (8) will go out and the Channel 7 (8) MANUAL light will go out.
4. If required, the operator may re-actuate ESFAS Channel 7 (8) with the Channel 7 (8) TRIP pushbutton.

18.8.2 RZ Module Replacement

The RZ Module indicating function for Channel 7 and 8 ESFAS components will be replaced with lamp boxes that will have indicating LEDs for the status of each device actuated by the ES system arranged by channel (see Section 20). In addition, the "Operate Here" functions for certain ODD and EVEN devices will be replaced with control switches and indicating LEDs on 1VB2 and 1UB2 as shown in Section 20.

18.8.3 AUTO/MANUAL Function

The existing ESFAS AUTO/MANUAL function is used to remove the ES actuation signal to each ESFAS actuated component. The existing individual component AUTO/MANUAL function will be replaced with a new Logic Channel level AUTO/MANUAL function (see Section 20.6).

18.8.4 ESFAS Outputs

All new ESFAS output contacts (R_O) shall have an adjustable software time delay on closure (0 to 15 minutes). All time delays will be set to zero (0) seconds.

18.8.5 Emergency Override Switches

See Section 21 discussion.

18.9 **Safety Classification**

This function is classified QA Condition 1 (Class 1E).

18.10 **Response Time Requirements**

The TXS total channel response time shall be < 500 ms. The channel response time does not include the sensor response time or the time required for the field devices to go to the ES position from the Non-ES position.

18.11 **Existing Input Signals**

Pressure switches and pushbuttons are wetted from ESFAS.

ID Code	Description	Physical Range	Electrical Range
1BS PS0018	RB Pressure Ch. A to CH 7 (normally open contact, close to Trip)	Binary	Contact input
1BS PS0019	RB Pressure Ch. A to CH 8 (normally open contact, close to Trip)	Binary	Contact input
1BS PS0020	RB Pressure Ch. B to CH 7 (normally open contact, close to Trip)	Binary	Contact input
1BS PS0021	RB Pressure Ch. B to CH 8 (normally open contact, close to Trip)	Binary	Contact input
1BS PS0022	RB Pressure Ch. C to CH 7 (normally open contact, close to Trip)	Binary	Contact input
1BS PS0023	RB Pressure Ch. C to CH 8 (normally open contact, close to Trip)	Binary	Contact input
1ESPB00ESCH7	CH 7 TRIP pushbutton	Binary	Contact input
1ESPB00ESCH8	CH 8 TRIP pushbutton	Binary	Contact input
1ESPB00ESCH7	CH 7 RESET pushbutton	Binary	Contact input
1ESPB00ESCH8	CH 8 RESET pushbutton	Binary	Contact input

18.12 **Existing Output Signals**

(lights are powered from ESFAS; statalarms provide 145 VDC to output contacts in ESFAS)

ID Code	Existing Description	Existing Physical Range	Existing Electrical Range
1ESPB00ESCH7	CH 7 TRIPPED indicating light on pushbutton	Binary	24 VAC
1ESPB00ESCH8	CH 8 TRIPPED indicating light on pushbutton	Binary	24 VAC
1SA7-4	ES RB Spray Channel A TRIP	Binary	145 VDC
1SA7-13	ES RB Spray Channel B TRIP	Binary	145 VDC
1SA7-22	ES RB Spray Channel C TRIP	Binary	145 VDC
1SA1-35	ES Channel 7 TRIP	Binary	145 VDC
1SA1-47	ES Channel 8 TRIP	Binary	145 VDC

18.13 **New Input Signals**

(all new and existing contact inputs are wetted by TXS)

ID Code	Description	Physical Range	Electrical Range
CH 7 MANUAL 1PPSPB0058UB2	CH 7 MANUAL pushbutton	Binary	Contact input
CH 7 AUTO 1PPSPB0058UB2	CH 7 AUTO pushbutton	Binary	Contact input
CH 8 MANUAL 1PPSPB0059UB2	CH 8 MANUAL pushbutton	Binary	Contact input
CH 8 AUTO 1PPSPB0059UB2	CH 8 AUTO pushbutton	Binary	Contact input

18.14 **New Output Signals**

(all new and existing indicating lights are powered from TXS)

New EDB Tag	Description	Physical Range	Electrical Range
CH 7 MANUAL 1PPSPB0058UB2	CH 7 MANUAL indicating light on pushbutton	Binary	24 VDC
CH 7 AUTO 1PPSPB0058UB2	CH 7 AUTO indicating light on pushbutton	Binary	24 VDC
CH 8 MANUAL 1PPSPB0059UB2	CH 8 MANUAL indicating light on pushbutton	Binary	24 VDC
CH 8 AUTO 1PPSPB0059UB2	CH 8 AUTO indicating light on pushbutton	Binary	24 VDC

18.15 **Existing Actuated Field Devices (via existing R_O contacts)**

Channel 7	Channel 8
1BS PU0001 (RBS-P1A) (ES Position Run)	1BS PU0002 (RBS-P1B) (ES Position Run)
1BS VA0001 (1BS-1) (ES Position Open)	1BS VA0002 (1BS-2) (ES Position Open)

18.16 **Existing Normal Control and Device Status Indication**

ODD Devices (Cabinet 8)	EVEN Devices (Cabinet 9)
1BS PU0001 (RBS-P1A) (ES Position Run) (Note 1)	1BS PU0002 (RBS-P1B) (ES Position Run) (Note 1)
1BS VA0001 (1BS-1) (ES Position Open) (Note 1)	1BS VA0002 (1BS-2) (ES Position Open) (Note 1)

Note 1 New system feature – provide separate 24 VDC signals to control station LEDs to replace "operate here" indication function.

18.17 **Existing Hardwired Computer Points**

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	Existing Electrical Range	New Destination
O1D1953	ES BS CH A1 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D1954	ES BS CH A2 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D1955	ES BS CH B1 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D1956	ES BS CH B2 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D1957	ES BS CH C1 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D1958	ES BS CH C2 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D1897	ES CH 7 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway
O1D1898	ES CH 8 (NOT TRIPPED) (TRIPPED)	Binary	N/A	Gateway

18.18 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

18.19 **References**

See Section 27.

19.0 ESFAS Existing Computer Alarms

19.1 Existing Miscellaneous ESFAS Computer Points

Existing hardwired computer inputs coming into ESFAS cabinets 1 through 9 will be deleted and new computer point IDs and descriptions (including status state for binary points) will be assigned for old points which will be sent to the OAC gateway. The following is a list of other existing ESFAS computer points.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Physical Range	New Destination
O1D1342	ES CH A POWER SUPPLY (NOT FAIL) (FAIL)	Binary	To be deleted
O1D2640	ES CH B POWER SUPPLY (NOT FAIL) (FAIL)	Binary	To be deleted
O1D2641	ES CH C POWER SUPPLY (NOT FAIL) (FAIL)	Binary	To be deleted
O1D1887	ES CH A (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1888	ES CH B (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1889	ES CH C (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1272	ES CAB 1 COOLING FAN (NORMAL) (FAIL)	Binary	To be deleted
O1D1329	ES CAB 2 COOLING FAN (NORMAL) (FAIL)	Binary	To be deleted
O1D2560	ES CAB 3 COOLING FAN (NORMAL) (FAIL)	Binary	To be deleted
O1D1339	ES CAB 4 COOLING FAN (NORMAL) (FAIL)	Binary	To be deleted
O1D2586	ES CAB 5 COOLING FAN (NORMAL) (FAIL)	Binary	To be deleted
O1D1340	ES CAB 6 COOLING FAN (NORMAL) (FAIL)	Binary	To be deleted
O1D1341	ES CAB 7 COOLING FAN (NORMAL) (FAIL)	Binary	To be deleted
O1D1963	ES CH 1 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1964	ES CH 2 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1965	ES CH 3 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1966	ES CH 4 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1968	ES CH 5 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1969	ES CH 6 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1970	ES CH 7 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1971	ES CH 8 (NOT IN TEST) (IN TEST)	Binary	Gateway
O1D1870	ES ODD LOGICALS (FALSE) (TRUE)	Binary	To be deleted
O1D1869	ES EVEN LOGICALS (FALSE) (TRUE)	Binary	To be deleted
O1D0832	1LPSW-21 RBCU 1B OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D0833	1LPSW-21 RBCU 1B OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0794	1LPSW-6 RCP COOLER SUPPLY (NOT OPEN) (OPEN)	Binary	Gateway
O1D0795	1LPSW-6 RCP COOLER SUPPLY (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0796	1LPSW-15 RCP COOLER OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D0797	1LPSW-15 RCP COOLER OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D2127	HPI PUMP 1B (OFF) (ON)	Binary	Gateway

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Physical Range	New Destination
O1D2223	LPSW PUMP C (OFF) (ON)	Binary	Gateway

19.2 **Existing Normal Control Cabinet 8 Computer Points**

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Physical Range	Destination
O1D2125	HPI PUMP 1A (OFF) (ON)	Binary	Gateway
O1D0624	1HP-24 1A HPI HDR BWST SUCTION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0625	1HP-24 1A HPI HDR BWST SUCTION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0634	1HP-26 RC LOOP 1A INJECTION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0635	1HP-26 RC LOOP 1A INJECTION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0580	1HP-3 LETDOWN COOLER 1A OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D0581	1HP-3 LETDOWN COOLER 1A OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0582	1HP-4 LETDOWN COOLER 1B OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D0583	1HP-4 LETDOWN COOLER 1B OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0660	1HP-20 RCP SEAL RETURN (INSIDE) (NOT OPEN) (OPEN)	Binary	Gateway
O1D0661	1HP-20 RCP SEAL RETURN (INSIDE) (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0432	1GWD-12 QUENCH TANK VENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D0433	1GWD-12 QUENCH TANK VENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0846	1LWD-1 RB NORMAL SUMP PENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D0847	1LWD-1 RB NORMAL SUMP PENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0250	1CS-5 COMP DRAIN HDR INSIDE ISOLATION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0251	1CS-5 COMP DRAIN HDR INSIDE ISOLATION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1014	1PR-1 RB PURGE OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1015	1PR-1 RB PURGE OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1012	1PR-6 RB PURGE INLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1013	1PR-6 RB PURGE INLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1020	1PR-7 RB RAD MONITOR INLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1021	1PR-7 RB RAD MONITOR INLET (NOT CLOSED) (CLOSED)	Binary	Gateway

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Physical Range	Destination
O1D1024	1PR-9 RB RAD MONITOR OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1025	1PR-9 RB RAD MONITOR OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1050	1RC-5 PZR STEAM SAMPLE (NOT OPEN) (OPEN)	Binary	Gateway
O1D1051	1RC-5 PZR STEAM SAMPLE (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1056	1RC-6 PZR WATER SAMPLE (NOT OPEN) (OPEN)	Binary	Gateway
O1D1057	1RC-6 PZR WATER SAMPLE (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0404	1FDW-105 SG 1A SAMPLE PENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D0405	1FDW-105 SG 1A SAMPLE PENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1138	1FDW-107 SG 1B SAMPLE PENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D1139	1FDW-107 SG 1B SAMPLE PENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D2214	LPI PUMP 1A (OFF) (ON)	Binary	Gateway
O1D0754	1LP-17 LOOP A INJECTION ISOLATION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0755	1LP-17 LOOP A INJECTION ISOLATION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D2221	LPSW PUMP A (OFF) (ON)	Binary	Gateway
O1D1348	BUILDING SPRAY PUMP 1A (OFF) (ON)	Binary	Gateway
O1D0084	1BS-1 HDR A RB ISOLATION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0085	1BS-1 HDR A RB ISOLATION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0124	1CC-7 CC RETURN INSIDE BLOCK (NOT OPEN) (OPEN)	Binary	Gateway
O1D0125	1CC-7 CC RETURN INSIDE BLOCK (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0826	1LPSW-18 RBCU 1A OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D0827	1LPSW-18 RBCU 1A OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D2301	PR FAN 1A (OFF) (ON)	Binary	Gateway

19.3 Existing Normal Control Cabinet 9 Computer Points

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Physical Range	Destination
O1D2129	HPI PUMP 1C (OFF) (ON)	Binary	Gateway
O1D0626	1HP-25 1B HPI HDR BWST SUCTION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0627	1HP-25 1B HPI HDR BWST SUCTION (NOT CLOSED) (CLOSED)	Binary	Gateway

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Physical Range	Destination
O1D0632	1HP-27 RC LOOP 1B INJECTION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0633	1HP-27 RC LOOP 1B INJECTION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0434	1GWD-13 QUENCH TANK VENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D0435	1GWD-13 QUENCH TANK VENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0848	1LWD-2 RB NORMAL SUMP PENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D0849	1LWD-2 RB NORMAL SUMP PENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0252	1CS-6 COMP DRAIN HDR OUTSIDE ISOLATION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0253	1CS-6 COMP DRAIN HDR OUTSIDE ISOLATION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1016	1PR-2 RB PURGE OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1017	1PR-2 RB PURGE OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1018	1PR-3 RB PURGE CONTROL (NOT OPEN) (OPEN)	Binary	Gateway
O1D1019	1PR-3 RB PURGE CONTROL (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1008	1PR-4 RB PURGE INLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1009	1PR-4 RB PURGE INLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1010	1PR-5 RB PURGE INLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1011	1PR-5 RB PURGE INLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1052	1RC-7 PZR SAMPLE OUTSIDE ISOLATION VALVE (NOT OPEN) (OPEN)	Binary	Gateway
O1D1053	1RC-7 PZR SAMPLE OUTSIDE ISOLATION VALVE (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1132	1FDW-106 SG 1A SAMPLE PENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D1133	1FDW-106 SG 1A SAMPLE PENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0408	1FDW-108 SG 1B SAMPLE PENT (NOT OPEN) (OPEN)	Binary	Gateway
O1D0409	1FDW-108 SG 1B SAMPLE PENT (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0396	1FDW-103 SG 1A DRAIN (NOT OPEN) (OPEN)	Binary	Gateway
O1D0397	1FDW-103 SG 1A DRAIN (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0398	1FDW-104 SG 1B DRAIN (NOT OPEN) (OPEN)	Binary	Gateway

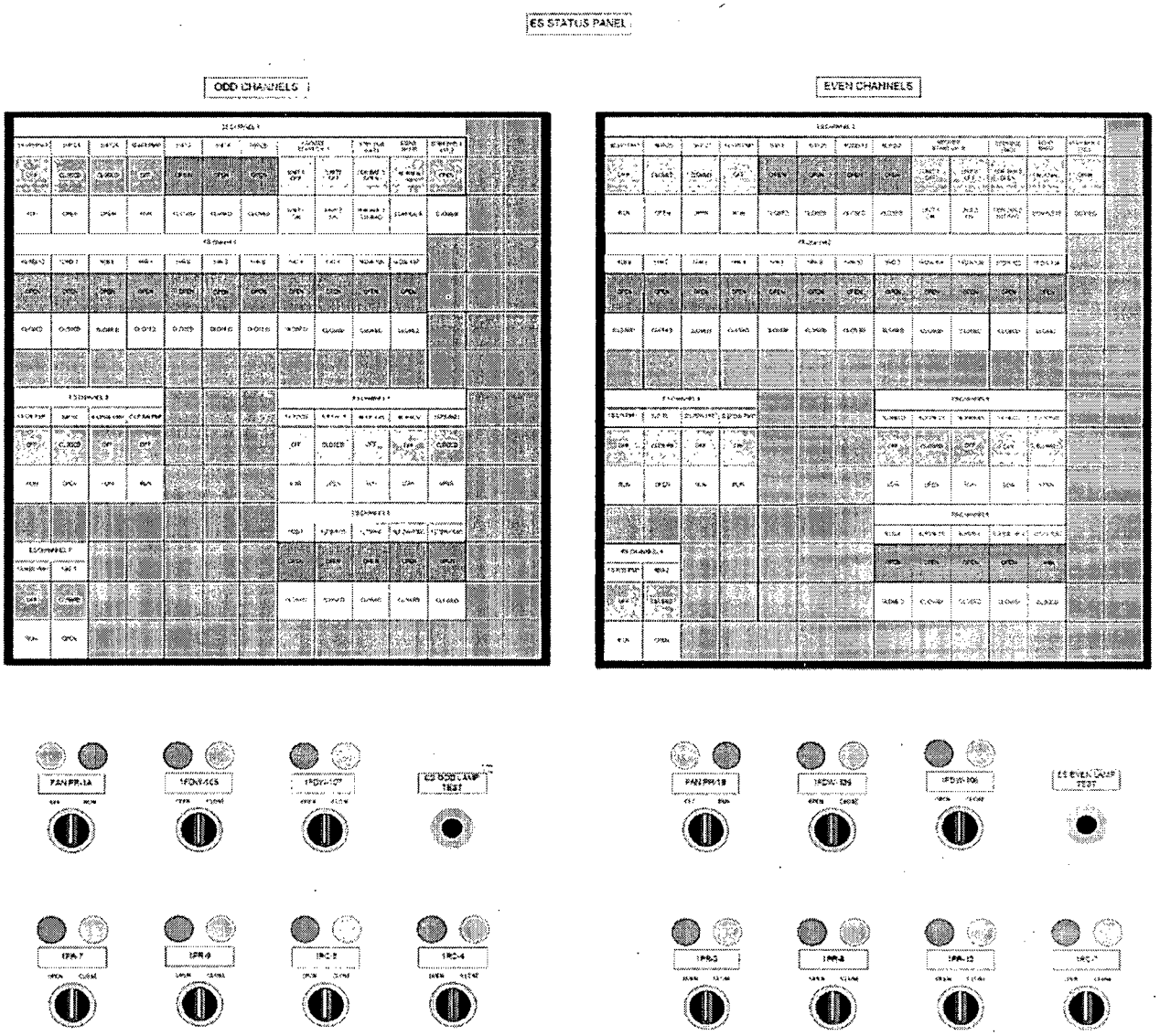
Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Physical Range	Destination
O1D0399	1FDW-104 SG 1B DRAIN (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D2215	LPI PUMP 1B (OFF) (ON)	Binary	Gateway
O1D0756	1LP-18 LOOP B INJECTION ISOLATION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0757	1LP-18 LOOP B INJECTION ISOLATION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D2222	LPSW PUMP B (OFF) (ON)	Binary	Gateway
O1D1349	BUILDING SPRAY PUMP 1B (OFF) (ON)	Binary	Gateway
O1D0086	1BS-2 HDR B RB ISOLATION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0087	1BS-2 HDR B RB ISOLATION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0840	1LPSW-24 RBCU 1C OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D0841	1LPSW-24 RBCU 1C OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D2302	PR FAN 1B (OFF) (ON)	Binary	Gateway
O1D0570	1HP-5 LETDOWN LINE ISOLATION (NOT OPEN) (OPEN)	Binary	Gateway
O1D0571	1HP-5 LETDOWN LINE ISOLATION (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0662	1HP-21 RCP SEAL RETURN BLOCK (OUTSIDE) (NOT OPEN) (OPEN)	Binary	Gateway
O1D0663	1HP-21 RCP SEAL RETURN BLOCK (OUTSIDE) (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D0126	1CC-8 CC RETURN OUTSIDE BLOCK (NOT OPEN) (OPEN)	Binary	Gateway
O1D0127	1CC-8 CC RETURN OUTSIDE BLOCK (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1022	1PR-8 RB RAD MONITOR INLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1023	1PR-8 RB RAD MONITOR INLET (NOT CLOSED) (CLOSED)	Binary	Gateway
O1D1026	1PR-10 RB RAD MONITOR OUTLET (NOT OPEN) (OPEN)	Binary	Gateway
O1D1027	1PR-10 RB RAD MONITOR OUTLET (NOT CLOSED) (CLOSED)	Binary	Gateway

20.0 ESFAS RZ Module Indication and Controls Replacement

20.1 New Components and Arrangements on 1VB2

The RZ Module indicating function will be replaced with new Hathaway status panels that will indicate the status of each device actuated by the ESFAS system, arranged by channel. The new status panels shall use LEDs that are powered from the TXS system (24 VDC). When a logic channel of ESFAS is actuated, either automatically or with the TRIP pushbutton switch, the associated ES position light for the device on the status panel will begin to flash ON and OFF. Once the device has reached its ES position, the light will stop flashing and stay ON. The new status panel will have an external push button that will be used to test all the lamps on the status panel. Pushing the test push button will provide a 24 VDC signal to each of the status panel LEDs from the TXS equipment.

The entire arrangement for both ODD and EVEN channels as well as the new "Operate Here" controls for certain devices are shown on the next page. Enlarged arrangement drawings follow for clarity.



Note: Figure contains non-essential information. Figure included for general layout only. For legible figures see Sections 20.2, 20.3, 20.4, and 20.5.

20.2 ODD Device Status Panel arrangement on 1VB2

(Shown enlarged for clarity, new EDB Tag 1PPSAM0001VB2)

ES CHANNEL 1											
1A HPI PMP	1HP-24	1HP-26	1B HPI PMP	1HP-3	1HP-4	1HP-20	KEOWEE START CH. A		STBY BUS (SK1)	LOAD SHED	STBY BKR 1 (SI_1)
OFF	CLOSED	CLOSED	OFF	OPEN	OPEN	OPEN	UNIT 1 OFF	UNIT2 OFF	FDR BKR 1 OPEN	NORMAL	OPEN
RUN	OPEN	OPEN	RUN	CLOSED	CLOSED	CLOSED	UNIT 1 ON	UNIT 2 ON	FDR BKR 1 CLOSED	COMPLETE	CLOSED

ES Channel 1										
1GWD-12	1LWD-1	1CS-5	1PR-1	1PR-6	1PR-7	1PR-9	1RC-5	1RC-6	1FDW-105	1FDW-107
OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED

ES CHANNEL 3				ES CHANNEL 5				
1A LPI PMP	1LP-17	A LPSW PMP	C LPSW PMP	1A RBCU	1LPSW-18	1A PR FAN	1B RBCU	1LPSW-21
OFF	CLOSED	OFF	OFF	OFF/HI	CLOSED	OFF	OFF/HI	CLOSED
RUN	OPEN	RUN	RUN	LOW	OPEN	RUN	LOW	OPEN

ES CHANNEL 5				
1CC-7	1LPSW-15	1LPSW-6	1LPSW-1055	1LPSW-1061
OPEN	OPEN	OPEN	OPEN	OPEN
CLOSED	CLOSED	CLOSED	CLOSED	CLOSED

ES CHANNNEL 7	
1A RBS PMP	1BS-1
OFF	CLOSED
RUN	OPEN

20.3 EVEN Device Status Panel arrangement on 1VB2

(Shown enlarged for clarity, new EDB tag 1PPSAM0002VB2)

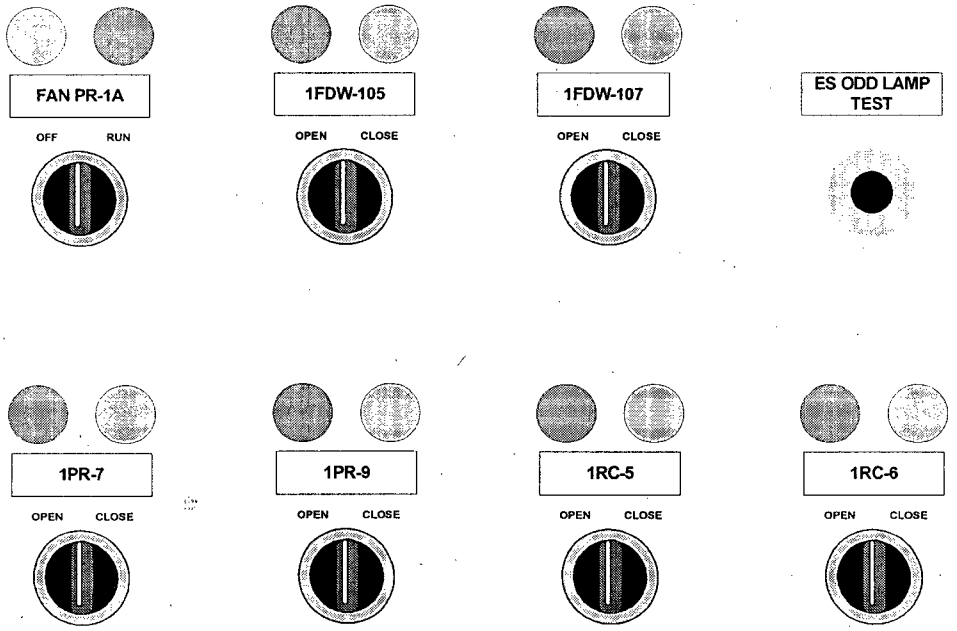
ES CHANNEL 2												
1C HPI PMP	1HP-25	1HP-27	1B HPI PMP	1HP-5	1HP-21	1GWD-13	1LWD-2	KEOWEE START CH. B		STBY BUS (5K2)	LOAD SHED	STBY BKR 2 (52_1)	
OFF	CLOSED	CLOSED	OFF	OPEN	OPEN	OPEN	OPEN	UNIT 1 OFF	UNIT 2 OFF	FDR BKR 2 OPEN	NORMAL	OPEN	
RUN	OPEN	OPEN	RUN	CLOSED	CLOSED	CLOSED	CLOSED	UNIT 1 ON	UNIT 2 ON	FDR BKR 2 CLOSED	COMPLETE	CLOSED	
ES Channel 2													
1CS-6	1PR-2	1PR-3	1PR-4	1PR-5	1PR-8	1PR-10	1RC-7	1FDW-106	1FDW-108	1FDW-103	1FDW-104		
OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN		
CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED		
ES CHANNEL 4							ES CHANNEL 6						
1B LPI PMP	1LP-18	B LPSW PMP	C LPSW PMP				1C RBCU	1LPSW-24	1B PR FAN	1B RBCU	1LPSW-21		
OFF	CLOSED	OFF	OFF				OFF/HI	CLOSED	OFF	OFF/HI	CLOSED		
RUN	OPEN	RUN	RUN				LOW	OPEN	RUN	LOW	OPEN		
							ES CHANNEL 6						
							1CC-8	1LPSW-15	1LPSW-6	1LPSW-1054	1LPSW-1062		
ES CHANNNEL 8							OPEN	OPEN	OPEN	OPEN	OPEN		
1B RBS PMP	1BS-2												
OFF	CLOSED						CLOSED	CLOSED	CLOSED	CLOSED	CLOSED		
RUN	OPEN												

20.4 ODD Device Pushbutton and Control Switch Arrangements on 1VB2

For those ESFAS devices which had "Operate Here" controls on the RZ modules, new control switches and indicating LEDs will be provided. The new device controls will be mounted on 1VB2 or on 1UB2 (see Section 20.6 for 1UB2 arrangements). The following ODD devices will have new control switches and indicating LEDs installed on the 1VB2 board below the new ESFAS ODD channel status panel. The enlarged arrangement is shown below for clarity.

first row: PR-1A, FDW-105, FDW-107, ODD Status panel Lamp test pushbutton

second row: PR-7, PR-9, RC-5, RC-6

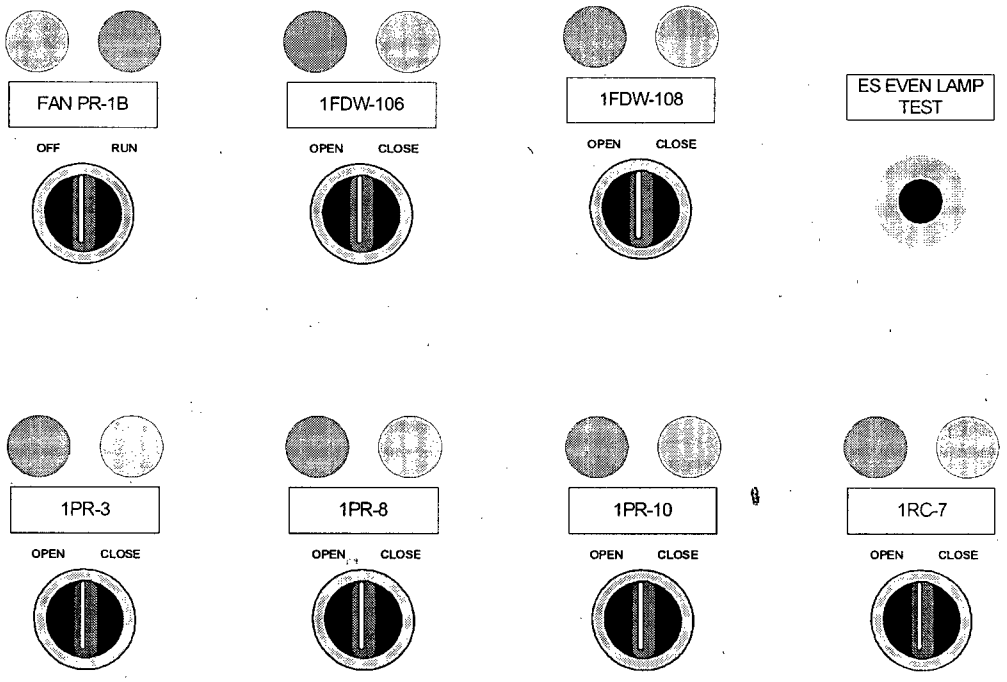


20.5 EVEN Device Pushbutton and Control Switch Arrangements on 1VB2

The following EVEN devices will have new control switches and indicating LEDs installed on the 1VB2 board below the new ESFAS EVEN channel status panel. The enlarged arrangement is shown below for clarity.

first row: PR-1B, FDW-106, FDW-108, EVEN Status panel Lamp test pushbutton

second row: PR-3, PR-8, PR-10, RC-7



20.6 New Pushbutton and Control Switch Arrangements on 1UB2

New AUTO/MANUAL Function

The existing ESFAS AUTO/MANUAL function is used to remove the ES actuation signal to each ESFAS actuated component. Selecting MANUAL causes the R_O contact for each actuated component in the associated digital logic channels (Channels 1 through 8) to go OPEN, thus allowing operator manual control of the individual components from the normal component control switch. The existing individual component function will be replaced with a new ESFAS individual Logic Channel "level" AUTO/MANUAL function. Each of the eight ESFAS logic channels will have an individual AUTO/MANUAL pushbutton selector switch.

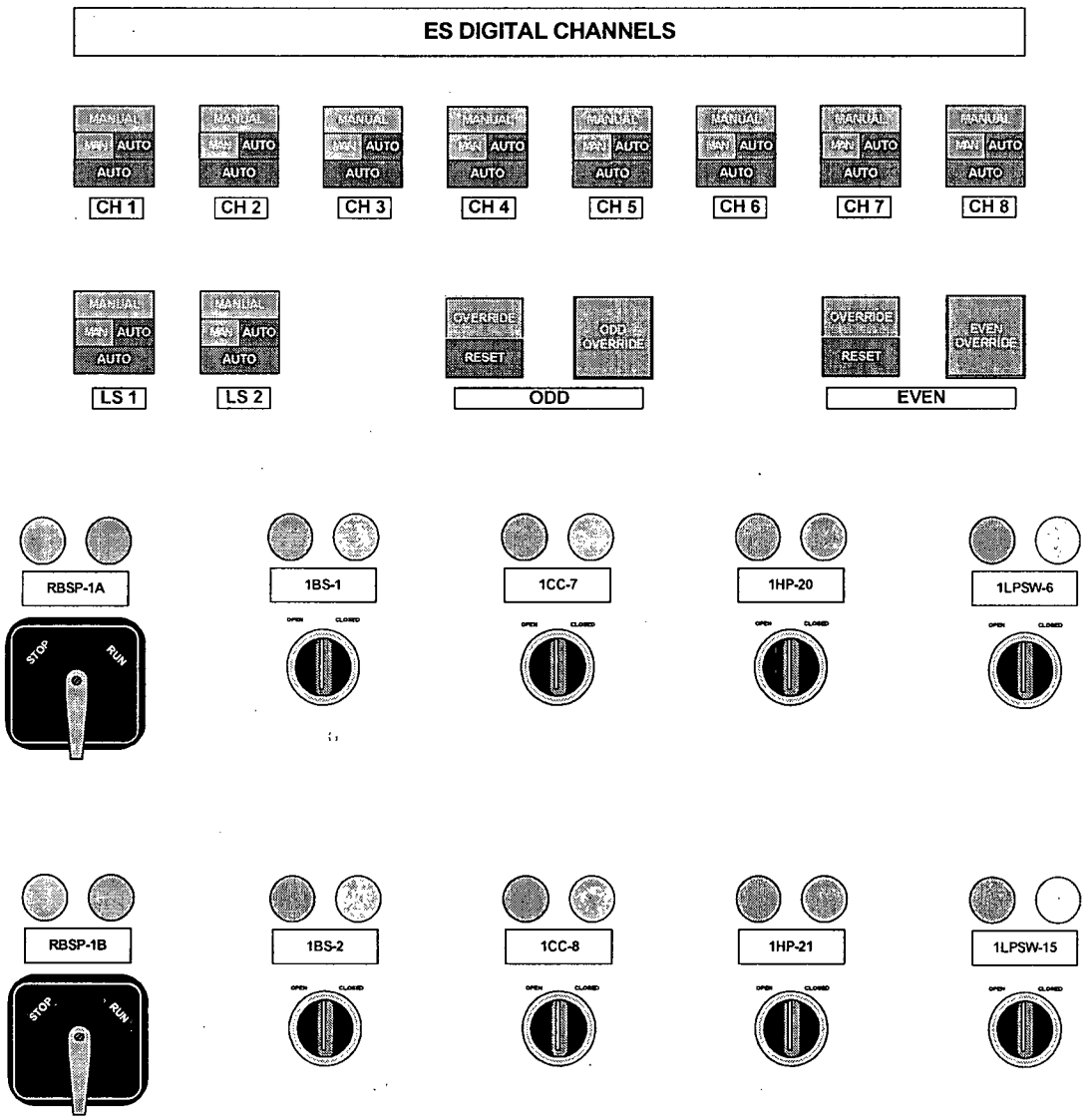
Each of the individual ESFAS channel AUTO/MANUAL pushbutton selector switches includes distinct indicating LEDs indicating either the AUTO or MANUAL selected control mode. Prior to the ESFAS system receiving either an automatic or manual initiation signal, the AUTO/MANUAL indicating LEDs will be "OFF" and the AUTO/MANUAL pushbutton switches have no control function. Once an ESFAS system actuation signal is initiated, either from an automatic system demand actuation or by operator manual initiation actuation, the AUTO light will be illuminated and the AUTO/MANUAL pushbutton functions may then be selected from this control point. With the AUTO/MANUAL pushbutton in AUTO, the ESFAS system operates in the safeguards control mode. However, if it is desired to take manual control of the ES channel or the individual associated actuated components for that channel, the MANUAL mode may be selected. When the MANUAL mode is selected, the individual actuation components in that associated channel may then be operated from the normal component control switch. ESFAS actuation logic Channels 1 and 2 initiate the Load Shed logic. The Load Shed logic Channels 1 and 2 will have a separate AUTO/MANUAL pushbutton selector switch. These selector switches will allow the Load Shed permissive logic to remain enabled even if the operator places the ESFAS Channels 1 or 2 AUTO/MANUAL switches in the MANUAL mode.

If manual has been selected and the operator wishes to place the channel components back in the ES position, the operator can push the AUTO pushbutton and the channel components will go to the ES position. Once an ESFAS channel has been reset using the RESET pushbutton on 1UB1 (see sections 15.8.3, 16.8.3, 17.8.2 & 18.8.1 for discussion), the AUTO/MANUAL LEDs for that channel will go out and the AUTO/MANUAL pushbuttons will no longer respond.

The following devices will have new control switches and indicating LEDs installed on the 1UB2 board where the GE Turbine Electro Hydraulic Controls (EHC) were previously located.

first row: Channel 1 through 8 Auto/Manual selector switches
second row: Load Shed Channel 1 & 2; ODD & EVEN Voter Emergency Override switches and indicator lights
third row: RBSP-1A, BS-1, LPSW-6, CC-7, HP-20
fourth row: RBSP-1B, BS-2, LPSW-15, CC-8, HP-21

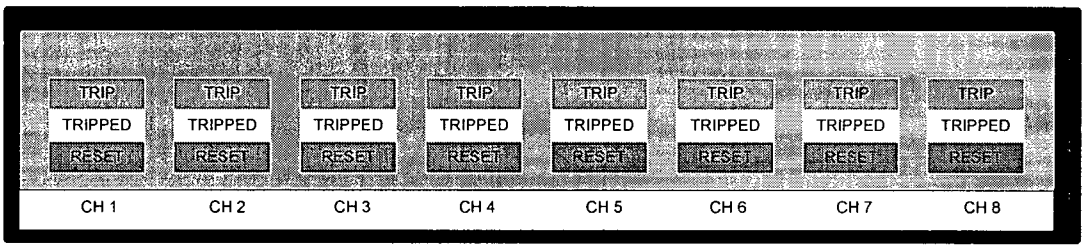
Control switch and indicating lights for HP-20 will be moved from existing location on 1UB1 to new location on 1UB2. The new ODD & EVEN Voter Emergency Override push buttons are discussed in Section 21. Device Tags are shown for reference only.



20.7 HPI & LPI BYPASS and ESFAS TRIP/RESET Pushbuttons

(For additional information, see AREVA Project Change Order 2004-03.)

Replace existing HPI & LPI BYPASS (Trip Inhibit) pushbutton switches and ESFAS TRIP/RESET pushbutton switches with new devices using LEDs that will be powered from the TXS system (24 VDC). The existing pushbutton switches are a momentary, two button set with indicating light made by Cutler Hammer. No changes have been made to the BYPASS button/lens sets.



Contact outputs to statalarms 1SA7-33 (ES HP Injection Bypass Permit) and 1SA7-42 (ES LP Injection Bypass Permit) will be routed to 1VB2 from field terminations in ESFAS cabinet 1PPSCA0009. Redundant (parallel) statalarm contact outputs are supplied from 1PPSCA0002 to 1PPSCA0009.

The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	Existing Electrical Range	New Destination
O1D1867	ES HPI BYPASS (NOT PERMIT) (PERMIT)	Binary	N/A	Gateway
O1D1868	ES LPI BYPASS (NOT PERMIT) (PERMIT)	Binary	N/A	Gateway

20.8 **Wide Range RC Pressure Signal and 1LP1 Interlock**

(For additional information, see AREVA Project Change Order 2004-02.)

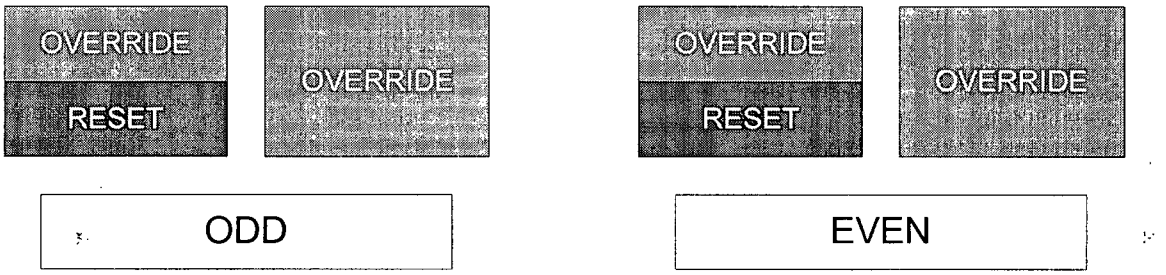
Incorporate ESFAS RC WR Pressure Analog Outputs and Digital Relay Contact Outputs (1LP1 interlock, analog WR pressure signal to the ICS cabinet, recorder and annunciators) into the ONS TXS PPS system design. Delete existing signal monitors and 1LP1 interlock from the ICS cabinet. Provide redundant outputs in order to maintain output functionality in the event a channel is powered down.

Wide range analog RC pressure signal from ESFAS channel A will be supplied to ICS cabinet 9 from field terminations in ESFAS cabinet 1PPSCA0009. Redundant wide range analog RC pressure signal from ESFAS channel B is provided from 1PPSCA0010. The WR analog signal will be routed to the Transient Monitoring system and recorder 1RCCR0045 via existing circuits from the ICS cabinet. If Channel A fails, the redundant signal from Channel B will automatically be aligned to the ICS cabinet via a transfer relay. In addition, the alternate Channel B signal can be selected via software to be aligned to the ICS cabinet via the transfer relay.

The OPEN interlock permissive to 1LPVA0001, on decreasing RC pressure below 400 psig will be supplied to the field from contact outputs in 1PPSCA0013. The contact outputs will be wetted by 120 VAC supplied from the 1LPVA0001 control circuit (MCC 1XS1, compartment F4D). Note that in order to prevent overpressurization of the Low Pressure Injection System, caused by premature opening of the valve, the actual setpoint for the permissive is below 400 psig to ensure that the permissive is removed automatically (via reset) at 400 psig. (See OSC-8695 for the permissive setpoint value.)

21.0 ESFAS EMERGENCY OVERRIDE PUSHBUTTONS

The new ESFAS Emergency Override feature ensures that the operator is capable of taking control of all ESFAS activation devices should there be an inadvertent ESFAS actuation resulting from a failure of the TXS system (e.g. common mode software failure). Two new Emergency Override pushbuttons (one ODD and one EVEN) will be installed on 1UB2 near the new ESFAS AUTO/MANUAL pushbuttons. These pushbuttons will utilize flip or slide covers to prevent inadvertent operation. Actuation of the ESFAS Emergency Override switch will interrupt power to the S451 binary output boards which will de-energize the R_O relays and allow manual control of all ESFAS actuated field devices from the control switches on the control boards. A RESET pushbutton is also provided to allow that Voter's S451 binary output boards to be re-energized following return of the TXS ESFAS to normal operation. EDB Tag number for ODD Override Pushbutton is 1PPSPB0072UB2, EDB Tag number for EVEN Override Pushbutton is 1PPSPB0073UB2.



22.0 RPS / ESFAS OUTPUTS TO STATALARM PANELS

22.1 TXS Reflash of Statalarms

Status Panel windows in the lists below with "**REFLASH**" noted shall have outputs from TXS that reflash upon receiving additional alarm(s). When a Statalarm window noted as "**REFLASH**" is already in alarm, upon receiving another alarm signal, the TXS binary output to the Statalarm window shall momentarily clear (non-alarm state) for approximately 1 second (adjustable time delay), and then come back into the alarm state.

22.2 1SA1 PANEL

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (New)
1SA1-01 **REFLASH**	RP Channel A Trip	1A RPS TRIP	Open	Open
1SA1-02	RP Channel A Low Press Trip	1A LO PRESS TRIP	Open	Closed
1SA1-03	RP Channel A Flux/Imb/Flow Trip	1A FLUX/FLOW/IMB TRIP	Open	Closed
1SA1-04	RP Channel A High Temp Trip	1A HI TEMP TRIP	Open	Closed
1SA1-05	RP Channel A Press/Temp Trip	1A VAR LO PRESS TRIP	Open	Closed
1SA1-06	RP Channel A High Press Trip	1A HI PRESS TRIP	Open	Closed
1SA1-07	RP Channel A RCP/Flux Trip	1A RCP/FLUX TRIP	Open	Closed
1SA1-08	RP NI-5 High Flux Trip	1NI-5 HI FLUX TRIP	Open	Closed
1SA1-09	RP Channel A RB High Press Trip	1A RB HI PRESS TRIP	Open	Closed
1SA1-10	ES Channel 1 Trip	ES 1 TRIP	Closed	Closed
1SA1-11	ES Channel 5 Trip	ES 5 TRIP	Closed	Closed
1SA1-13 **REFLASH**	RP Channel B Trip	1B RPS TRIP	Open	Open
1SA1-14	RP Channel B Low Pressure Trip	1B LO PRESS TRIP	Open	Closed
1SA1-15	RP Channel B Flux/Imb/Flow Trip	1B FLUX/FLOW/IMB TRIP	Open	Closed
1SA1-16	RP Channel B High Temp Trip	1B HI TEMP TRIP	Open	Closed
1SA1-17	RP Channel B Press/Temp Trip	1B VAR LO PRESS TRIP	Open	Closed
1SA1-18	RP Channel B High Press Trip	1B HI PRESS TRIP	Open	Closed
1SA1-19	RP Channel B RCP/Flux Trip	1B RCP/FLUX TRIP	Open	Closed
1SA1-20	RP NI-6 High Flux Trip	1NI-6 HI FLUX TRIP	Open	Closed
1SA1-21	RP Channel B RB High Press Trip	1B RB HI PRESS TRIP	Open	Closed

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (New)
1SA1-22	ES Channel 2 Trip	ES 2 TRIP	Closed	Closed
1SA1-23	ES Channel 6 Trip	ES 6 TRIP	Closed	Closed
1SA1-24	ICS Auto/Hand Power Fuse Blown	ICS H/A PWR FUSE BLOWN	No change	NA
1SA1-25 **REFLASH**	RP Channel C Trip	1C RPS TRIP	Open	Open
1SA1-26	RP Channel C Low Press Trip	1C LO PRESS TRIP	Open	Closed
1SA1-27	RP Channel C Flux/Imb/Flow Trip	1C FLUX/FLOW/IMB TRIP	Open	Closed
1SA1-28	RP Channel C High Temp Trip	1C HI TEMP TRIP	Open	Closed
1SA1-29	RP Channel C Press/Temp Trip	1C VAR LO PRESS TRIP	Open	Closed
1SA1-30	RP Channel C High Press Trip	1C HI PRESS TRIP	Open	Closed
1SA1-31	RP Channel C RCP/Flux Trip	1C RCP/FLUX TRIP	Open	Closed
1SA1-32	RP NI-7 High Flux Trip	1NI-7 HI FLUX TRIP	Open	Closed
1SA1-33	RP Channel C RB High Press Trip	1C RB HI PRESS TRIP	Open	Closed
1SA1-34	ES Channel 3 Trip	ES 3 TRIP	Closed	Closed
1SA1-35	ES Channel 7 Trip	ES 7 TRIP	Closed	Closed
1SA1-37 **REFLASH**	RP Channel D Trip	1D RPS TRIP	Open	Open
1SA1-38	RP Channel D Low Press Trip	1D LO PRESS TRIP	Open	Closed
1SA1-39	RP Channel D Flux/Imb/Flow Trip	1D FLUX/FLOW/IMB TRIP	Open	Closed
1SA1-40	RP Channel D High Temp Trip	1D HI TEMP TRIP	Open	Closed
1SA1-41	RP Channel D Press/Temp Trip	1D VAR LO PRESS TRIP	Open	Closed
1SA1-42	RP Channel D High Press Trip	1D HI PRESS TRIP	Open	Closed
1SA1-43	RP Channel D RCP/Flux Trip	1D RCP/FLUX TRIP	Open	Closed
1SA1-44	RP NI-8 High Flux Trip	1NI-8 HI FLUX TRIP	Open	Closed
1SA1-45	RP Channel D RB High Press Trip	1D RB HI PRESS TRIP	Open	Closed
1SA1-46	ES Channel 4 Trip	ES 4 TRIP	Closed	Closed
1SA1-47	ES Channel 8 Trip	ES 8 TRIP	Closed	Closed

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (New)
1SA1-56	RC PUMP 1A1 OIL TANK LEVEL HIGH	DIVERSE HPI BYP	Closed	Closed
1SA1-57	RC PUMP 1A2 OIL TANK LEVEL HIGH	DIVERSE HPI TRIP	Closed	Closed
1SA1-58	RC PUMP 1B1 OIL TANK LEVEL HIGH	DIVERSE LPI BYP	Closed	Closed
1SA1-59	RC PUMP 1B2 OIL TANK LEVEL HIGH	DIVERSE LPI TRIP	Closed	Closed

22.3 **1SA2 PANEL**

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (New)
1SA2-06	NI Source Range Flux High	SR FLUX HI	Closed	Closed
1SA2-07	NI-1 Rod Withdrawal Inhibit	1NI-1 OUT INHIBIT	Open	Open
1SA2-18	NI Wide Range Flux High	WR FLUX HI	Closed	Closed
1SA2-19	NI-2 Rod Withdrawal Inhibit	1NI-2 OUT INHIBIT	Open	Open
1SA2-30	NI Power Range Flux High	PR FLUX HI	Closed	Closed
1SA2-31	NI-3 Rod Withdrawal Inhibit	1NI-3 OUT INHIBIT	Open	Open
1SA2-43	NI-4 Rod Withdrawal Inhibit	1NI-4 OUT INHIBIT	Open	Open

22.4 **1SA5 PANEL**

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (New)
1SA5-01 **REFLASH**	RP Channel A Trip Bypass	1A RPS MAN BYP	Open	Closed
1SA5-02	RP Channel A On Test	1A RPS TEST	Open	Closed
1SA5-03	RP Channel A Shutdown Bypass	1A RPS SD BYP	Open	Closed
1SA5-04	RP Channel A Pump Monitor PS Failure	SPARE	Open	Spare
1SA5-05 **REFLASH**	RP Channel A DC PS Failure	1A RPS TROUBLE	Open	Open
1SA5-06 **REFLASH**	RP Cabinet A Cooling Fan Failure	1NI-5 PWR FAIL	Open	Open
1SA5-07	NI Power Range 5 Power Supply Failure	1NI-1 TEST / FAIL	Closed	Open
1SA5-08	NI-1 Test/Fail	1A1 RCP OIL OVERFLOW HI	Open	Closed
1SA5-13 **REFLASH**	RP Channel B Trip Bypass	1B RPS MAN BYP	Open	Closed
1SA5-14	RP Channel B On Test	1B RPS TEST	Open	Closed
1SA5-15	RP Channel B Shutdown Bypass	1B RPS SD BYP	Open	Closed
1SA5-16	RP Channel B Pump Monitor PS Failure	SPARE	Open	Spare

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (New)
1SA5-17 **REFLASH**	RP Channel B DC PS Failure	1B RPS TROUBLE	Open	Open
1SA5-18 **REFLASH**	RP Cabinet B Cooling Fan Failure	1NI-6 PWR FAIL	Open	Open
1SA5-19	NI Power Range 6 Power Supply Fail	1NI-2 TEST / FAIL	Closed	Open
1SA5-20	NI-2 Test/Fail	1A2 RCP OIL OVERFLOW HI	Open	Closed
1SA5-25 **REFLASH**	RP Channel C Trip Bypass	1C RPS MAN BYP	Open	Closed
1SA5-26	RP Channel C On Test	1C RPS TEST	Open	Closed
1SA5-27	RP Channel C Shutdown Bypass	1C RPS SD BYP	Open	Closed
1SA5-28	RP Channel C Pump Monitor PS Failure	SPARE	Open	Spare
1SA5-29 **REFLASH**	RP Channel C DC PS Failure	1C RPS TROUBLE	Open	Open
1SA5-30 **REFLASH**	RP Cabinet C Cooling Fan Failure	1NI-7 PWR FAIL	Open	Open
1SA5-31	NI Power Range 7 Power Supply Fail	1NI-3 TEST / FAIL	Closed	Open
1SA5-32	NI-3 Test/Fail	1B1 RCP OIL OVERFLOW HI	Open	Closed
1SA5-37 **REFLASH**	RP Channel D Trip Bypass	1D RPS MAN BYP	Open	Closed
1SA5-38	RP Channel D On Test	1D RPS TEST	Open	Closed
1SA5-39	RP Channel D Shutdown Bypass	1D RPS SD BYP	Open	Closed
1SA5-40	RP Channel D Pump Monitor PS Failure	SPARE	Open	Spare
1SA5-41 **REFLASH**	RP Channel D DC PS Failure	1D RPS TROUBLE	Open	Open
1SA5-42 **REFLASH**	RP Cabinet D Cooling Fan Failure	1NI-8 PWR FAIL	Open	Open
1SA5-43	NI Power Range 8 Power Supply Fail	1NI-4 TEST / FAIL	Closed	Open
1SA5-44	NI-4 Test/Fail	1B2 RCP OIL OVERFLOW HI	Open	Closed
1SA5-49	RP Channel A Dummy Bistable Inserted	FWPT/RX TRIP ALERT	Open	Open
1SA5-50	RP Channel B Dummy Bistable Inserted	FWPT/RX TRIP BYP	Open	Open
1SA5-51	RP Channel C Dummy Bistable Inserted	TURB/RX TRIP ALERT	Open	Open
1SA5-52	RP Channel D Dummy Bistable Inserted	TURB/RX TRIP BYP	Open	Open
1SA5-53 **REFLASH**	RP Channel E DC PS Failure	1E RPS TROUBLE	Open	Open
1SA5-54	RP Cabinet E Cooling Fan Failure	SPARE	Open	Spare
1SA5-55	NI Power Range 9 Power Supply Fail	SPARE	Closed	Spare

22.5 1SA7 PANEL

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (new)
1SA7-01 **REFLASH**	ES HP Injection Channel A Trip	1A1 ES TRIP	Open	Closed
1SA7-02 **REFLASH**	ES LP Injection Channel A Trip	1A2 ES TRIP	Open	Closed
1SA7-03 **REFLASH**	ES RB Isolation Channel A Trip	1A1 ES TROUBLE	Open	Open
1SA7-04 **REFLASH**	ES RB Spray Channel A Trip	1A2 ES TROUBLE	Open	Open
1SA7-05	ES Analog Channel A on Test	1A1 & 1A2 ES HPI BYP	Closed	Closed
1SA7-06	ES HP Channel A Bypassed	1A1 & 1A2 ES LPI BYP	Closed	Closed
1SA7-07	ES LP Channel A Bypassed	1A1 ES TEST	Closed	Closed
1SA7-08	ES Channel 1 on Test	1A2 ES TEST	Closed	Closed
1SA7-09	ES Channel 5 on Test	1A1 RCPMP TEST	Closed	Closed
1SA7-10 **REFLASH**	ES HP Injection Channel B Trip	1B1 ES TRIP	Open	Closed
1SA7-11 **REFLASH**	ES LP Injection Channel B Trip	1B2 ES TRIP	Open	Closed
1SA7-12 **REFLASH**	ES RB Isolation Channel B Trip	1B1 ES TROUBLE	Open	Open
1SA7-13 **REFLASH**	ES RB Spray Channel B Trip	1B2 ES TROUBLE	Open	Open
1SA7-14	ES Analog Channel B on Test	1B1 & 1B2 ES HPI BYP	Closed	Closed
1SA7-15	ES HP Channel B Bypassed	1B1 & 1B2 ES LPI BYP	Closed	Closed
1SA7-16	ES LP Channel B Bypassed	1B1 ES TEST	Closed	Closed
1SA7-17	ES Channel 2 on Test	1B2 ES TEST	Closed	Closed
1SA7-18	ES Channel 6 on Test	1A2 RCPMP TEST	Closed	Closed
1SA7-19 **REFLASH**	ES HP Injection Channel C Trip	1C1 ES TRIP	Open	Closed
1SA7-20 **REFLASH**	ES LP Injection Channel C Trip	1C2 ES TRIP	Open	Closed
1SA7-21 **REFLASH**	ES RB Isolation Channel C Trip	1C1 ES TROUBLE	Open	Open
1SA7-22 **REFLASH**	ES RB Spray Channel C Trip	1C2 ES TROUBLE	Open	Open
1SA7-23	ES Analog Channel C on Test	1C1 & 1C2 ES HPI BYP	Open	Closed
1SA7-24	ES HP Channel C Bypassed	1C1 & 1C2 ES LPI BYP	Open	Closed

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (new)
1SA7-25	ES LP Channel C Bypassed	1C1 ES TEST	Closed	Closed
1SA7-26	ES Channel 3 on Test	1C2 ES TEST	Closed	Closed
1SA7-27	ES Channel 7 on Test	1B1 RCPMP TEST	Closed	Closed
1SA7-28	ES Even Logic Power Failure/Module Removed	ES ODD VOTER 1 MAN BYP	Closed	Closed
1SA7-29	ES Odd Logic Power Failure/Module Removed	ES ODD VOTER 2 MAN BYP	Closed	Closed
1SA7-30 **REFLASH**	ES RB Spray Pwr Supply Fail or Channel A Module Removed	ES ODD VOTERS TROUBLE	Closed	Open
1SA7-31	ES RB Spray Pwr Supply Fail or Channel B Module Removed	ES ODD VOTERS TEST	Closed	Closed
1SA7-32	ES RB Spray Pwr Supply Fail or Channel C Module Removed	ES ODD EMER OVERRIDE	Closed	Closed
1SA7-33	RC Pump Monitor Sys. Chan. #1 Trip	ES HPI BYP PERMIT	Open	Closed
1SA7-34	RC Pump Monitor Sys. Chan. #1 Test	1A1 RCPMP TRIP	Open	Closed
1SA7-35	ES Channel 4 on Test	1A2 RCPMP TRIP	Open	Closed
1SA7-36	ES Channel 8 on Test	1B2 RCPMP TEST	Closed	Closed
1SA7-37	ES HPI ES Bypass Permit	ES EVEN VOTER 1 MAN BYP	Closed	Closed
1SA7-38	ES LPI ES Bypass Permit	ES EVEN VOTER 2 MAN BYP	Closed	Closed
1SA7-39 **REFLASH**	RC Pump Monitor Sys. Chan. #2 Trip	ES EVEN VOTERS TROUBLE	Open	Open
1SA7-40	RC Pump Monitor Sys. Chan. #2 Test	ES EVEN VOTERS TEST	Closed	Closed
1SA7-41	RC Pump Monitor Sys. Chan. #3 Trip	ES EVEN EMER OVERRIDE	Open	Closed
1SA7-42	RC Pump Monitor Sys. Chan. #3 Test	ES LPI BYP PERMIT	Closed	Closed
1SA7-43	RC Pump Monitor Sys. Chan. #4 Trip	1B1 RCPMP TRIP	Open	Closed
1SA7-44	RC Pump Monitor Sys. Chan. #4 Test	1B2 RCPMP TRIP	Open	Closed

22.6 1SA18 PANEL

Window	Existing Descriptor	New Descriptor	Contact Input to Alarm (existing)	Contact Input to Alarm (New)
1SA18-19	RPS FWPT/Reactor Trip P.S. Alert	SPARE (Moved to 1SA5-49)	Closed	Spare
1SA18-20	RPS FWPT/Reactor Channel Trip Bypass	SPARE (Moved to 1SA5-50)	Closed	Spare
1SA18-25	RPS Gen. Turb/React Trip P.S. Alert	SPARE (Moved to 1SA5-51)	Closed	Spare
1SA18-26	RPS Gen. Turb/React Channel Trip Bypass	SPARE (Moved to 1SA5-52)	Closed	Spare

23.0 NEW RPS / ESFAS KEYLOCKS and KEYSWITCHES

23.1 Door Keys

Unit 1 will have one key type for all RPS/ESFAS cabinet doors (different from the Unit 2 or 3 door key type).

23.2 Keyswitches

23.2.1 The four RPS SHUTDOWN BYPASS Keyswitches for any solitary Oconee Unit use the same key code. The keys are different for each Oconee Unit. Keys shall be non-removable in the BYPASS position.

23.2.2 The four RPS MANUAL BYPASS Keyswitches for any solitary Oconee Unit use the same key code. The keys are different for each Oconee Unit. Only one MANUAL BYPASS key will be available for each Oconee Unit. Keys shall be non-removable in the BYPASS position.

23.2.3 The five RPS Channel (A, B, C, D & E) PARAMETER CHANGE ENABLE Keyswitches, three ESFAS Channel (A, B & C) PARAMETER CHANGE ENABLE Keyswitches and two Voters (Voter 1 ODD, Voter 2 ODD, and the Status Computer in 1PPSCA0017 and Voter 1 EVEN, Voter 2 EVEN, and the Status Computer in 1PPSCA0018) PARAMETER CHANGE ENABLE Keyswitches for any solitary Oconee Unit use the same key code. The keys are different for each Oconee Unit. Keys shall be non-removable in the ENABLE position.

23.2.4 The four RPS Channel (A, B, C & D) and the three ESFAS Channel (A, B & C) TRIP Keyswitches for any solitary Oconee Unit use the same key code. The keys are different for each Oconee Unit. Keys shall be non-removable in the TRIP position.

23.2.5 Both ESFAS Voter 1 ODD & EVEN MANUAL BYPASS Keyswitches use the same key code and both ESFAS Voter 2 ODD & EVEN MANUAL BYPASS Keyswitches use the same key code, but they are different from each other. The keys are different for each Oconee Unit. Keys shall be non-removable in the BYPASS position.

23.3 RPS SHUTDOWN BYPASS Keyswitch

Note: Operation of the RPS SHUTDOWN BYPASS Keyswitches is administratively controlled by Operations procedures. SHUTDOWN BYPASS Keyswitches will be taken to BYPASS only after the unit has been shutdown (control rod drive breakers open). The SHUTDOWN BYPASS mode is required for shutdown operations when the CRD breakers are closed (such as CRD testing, zero power physics testing, and startup procedures.)

23.3.1 Each RPS Channel cabinet pair (A, B, C & D) includes a SHUTDOWN BYPASS Keyswitch.

23.3.2 Reference the RPS function sections for descriptions of the SHUTDOWN BYPASS features for affected functions.

23.3.3 The RPS SHUTDOWN BYPASS Keyswitches are administratively controlled (no hardware or software interlocks). All RPS Channels may be placed in SHUTDOWN BYPASS as required.

23.3.4 The RPS SHUTDOWN BYPASS Keyswitch status information is sent to the Statalarm panel, 1SA5, windows 3, 15, 27, 39; see Section 22 for window descriptors.

23.3.5 The RPS SHUTDOWN BYPASS Keyswitch status information is also sent to the OAC via the TXS Gateway.

23.3.6 The SHUTDOWN BYPASS Keyswitch is located at each RPS Channel and is operated using a manual key. In the BYPASS position, the following RPS Reactor Trips are affected:

23.3.6.1 Low RCS Pressure Trip is bypassed,

23.3.6.2 Variable Low RCS Pressure (based on RCS temperature) Trip is bypassed,

23.3.6.3 Flux/Flow/Imbalance Trip is bypassed,

23.3.6.4 Reactor Coolant Pump Power Monitor Trips are bypassed,

23.3.6.5 High RCS Pressure Trip setpoint is lowered to 1710 psig.

23.3.6.6 High Flux Reactor Trip setpoint is lowered to 4% RTP.

23.4 RPS MANUAL BYPASS Keyswitch

23.4.1 Each RPS Channel cabinet pair (A, B, C & D) includes a MANUAL BYPASS Keyswitch.

23.4.2 The RPS MANUAL BYPASS Keyswitch allows putting the complete RPS Channel into BYPASS for maintenance activities. This includes the power-down of the TXS computer of the RPS Channel. If the RPS MANUAL BYPASS Keyswitch is in the BYPASS position, it:

23.4.2.1 provides 24V to the relays of the hardwired "2-out-of-4" trip logic in parallel to the outputs of the TXS processor. This assures that the four output TRIP relays remain energized independent of the status of the TXS processor.

23.4.2.2 sets the FAULT status of all input signals prior to sending input signal data to the trip functions of the other channels, via the data links.

23.4.3 The RPS MANUAL BYPASS Keyswitches are administratively controlled (no hardware or software interlocks). Administrative control SHALL allow only one RPS Channel in BYPASS at a time. Only one MANUAL BYPASS key will be available for each unit.

23.4.4 The RPS MANUAL BYPASS Keyswitch status information is sent to the Statalarm panel 1SA5, windows 1, 13, 25, and 37; see Section 22 for window descriptors.

23.4.5 The RPS MANUAL BYPASS Keyswitch status information is also sent to the OAC via the TXS Gateway. The existing hardwired computer points listed below will be deleted and replaced with equivalent points using computer communications (OPC gateway to OAC). New OAC point IDs and descriptions (including reset/set state messages for binary points) will be issued during detailed modification design.

Existing Point ID	Existing Description (Reset/Set state messages for binary points)	Existing Physical Range	New Destination
O1D2364	RPS CH A MANUAL BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2365	RPS CH B MANUAL BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2366	RPS CH C MANUAL BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway
O1D2367	RPS CH D MANUAL BYPASS (NOT BYPASS) (BYPASS)	Binary	Gateway

23.5 RPS Logic Channel PARAMETER CHANGE ENABLE Keyswitch

23.5.1 Each RPS Channel cabinet pair (A, B, C, D) includes a PARAMETER CHANGE ENABLE Keyswitch for the associated logic computer (which includes RPS functions for A, B, C, and D, and ESFAS functions for A, B, and C located in the RPS cabinets).

23.5.2 The TXS system software controls the access to the TXS processor by controlling the operating modes of the computer. Under normal operating conditions, the TXS processor is in the OPERATION mode. The PARAM Mode allows the modification/tuning of software parameters. The TEST Mode allows disabling the application function and forcing the output signals. The DIAG Mode allows download of new application software. The permission to change from the OPERATION mode into the PARAM mode is controlled by the RPS Logic Channel PARAMETER CHANGE ENABLE Keyswitch. Placing the TXS processor into the TEST and DIAG modes requires first entering the PARAM Mode from the TXS Service Unit and then making additional parameter changes from the TXS Service Unit.

23.5.3 The RPS Logic Channel PARAMETER CHANGE ENABLE Keyswitches are administratively controlled (no hardware or software interlocks). Administrative control shall allow only one RPS Channel to be ENABLED (or placed out of NORMAL operation) at a time.

23.5.4 The RPS Logic Channel PARAMETER CHANGE ENABLE Keyswitch status information is sent to the Statalarm panel 1SA5, windows 2, 14, 26, and 38; see Section 22 for window descriptors.

23.5.5 The RPS Logic Channel PARAMETER CHANGE ENABLE Keyswitch status is sent to the OAC via the TXS gateway.

23.6 RPS Channel TRIP Keyswitch

23.6.1 Each RPS Channel cabinet pair (A, B, C & D) includes a TRIP Keyswitch for the associated logic computer.

23.6.2 If required, operations may place an RPS channel in TRIP (all RPS channel functions) by placing the associated channel TRIP Keyswitch in the TRIP position.

23.6.3 The RPS TRIP Keyswitches are administratively controlled (no hardware or software interlocks between channels prevents more than one channel from being placed in TRIP at a time). Administrative control shall allow only one RPS Channel to be in TRIP at a time.

23.6.4 Placing the RPS TRIP Keyswitch into the TRIP position shall result in a channel trip of all trip relays associated with that channel, and the status information is sent to the Statalarm panel 1SA1, window 1, 13, 25, or 37; see Section 22 for window descriptors.

23.6.5 The RPS TRIP Keyswitch status shall be sent to the OAC via the TXS gateway.

23.7 ESFAS Logic Channel PARAMETER CHANGE ENABLE Keyswitch

23.7.1 Each ESFAS Channel cabinet (A, B & C) includes a PARAMETER CHANGE ENABLE Keyswitch for the associated logic computer.

23.7.2 The TXS system software controls the access to the TXS processor by controlling the operating modes of the computer. Under normal operating conditions, the TXS processor is in the OPERATION mode. The PARAM Mode allows the modification/tuning of software parameters. The TEST Mode allows disabling the application function and forcing the output signals. The DIAG Mode allows download of new application software. The permission to change from the OPERATION mode into the PARAM mode is controlled by the ESFAS Logic Channel PARAMETER CHANGE ENABLE Keyswitch. Placing the TXS processor into the TEST and DIAG modes requires first entering the PARAM Mode from the TXS Service Unit and then making additional parameter changes from the TXS Service Unit.

23.7.3 The ESFAS Logic Change PARAMETER CHANGE ENABLE Keyswitches are administratively controlled (no hardware or software interlocks). Administrative control shall allow only one ESFAS Channel to be ENABLED (or placed out of NORMAL operation) at a time.

23.7.4 The ESFAS Logic Channel PARAMETER CHANGE ENABLE Keyswitch status information is sent to the Statalarm panel 1SA7, windows 7, 8, 16, 17, 25, and 26; see Section 22 for window descriptors.

23.7.5 The ESFAS Logic Channel PARAMETER CHANGE ENABLE Keyswitch status is sent to the OAC via the TXS gateway.

23.8 ESFAS Voter Parameter CHANGE ENABLE Keyswitch

23.8.1 Each ESFAS Voter train (ODD & EVEN) includes a Voter PARAMETER CHANGE ENABLE Keyswitch for the associated logic computers. This Keyswitch also enables parameter changes to the associated ESFAS status cabinet processors (1PPSCA0017 or 1PPSCA0018).

23.8.2 The TXS system software controls the access to the TXS processor by controlling the operating modes of the computer. Under normal operating conditions, the TXS processor is in the OPERATION mode. The PARAM Mode allows the modification/tuning of software parameters. The TEST Mode allows disabling the application function and forcing the output signals. The DIAG Mode allows download of new application software. The permission to change from the OPERATION mode into the PARAM, mode is controlled by the ESFAS Voter PARAMETER CHANGE ENABLE Keyswitch. Placing the TXS processor into the TEST and DIAG modes requires first entering the PARAM Mode from the TXS Service Unit and then making additional parameter changes from the TXS Service Unit.

23.8.3 The ESFAS Voter PARAMETER CHANGE ENABLE Keyswitches are administratively controlled (no hardware or software interlocks). Administrative control SHALL allow only one set of Voter channels (ODD Voters including 1PPSCA0017 or EVEN Voters including 1PPSCA0018) to be ENABLED (or placed out of NORMAL operation) at a time.

23.8.4 The ESFAS Voter PARAMETER CHANGE ENABLE Keyswitch status information is sent to the Statalarm panel 1SA7, windows 31 and 40; see Section 22 for window descriptors.

23.8.5 The ESFAS Voter PARAMETER CHANGE ENABLE Keyswitch status is sent to the OAC via the TXS gateway.

23.9 ESFAS Voter MANUAL BYPASS Keyswitch

23.9.1 Both ESFAS Voter Channel cabinets (1PPSCA0012 – ODD & 1PPSCA0014 - EVEN) include two ESFAS Voter MANUAL BYPASS Keyswitches, one for each Voter (1 and 2) for a total of four MANUAL BYPASS switches.

23.9.2 The ESFAS Voter MANUAL BYPASS is a new function with no equivalents in the existing ESFAS system. Each of the two ESFAS Actuation Trains (ODD and EVEN) has two independent TXS processors (Voters). One of the Voters (Voter 1) is driven from the three RPS logic Channels (Channel A from cabinets 1PPSCA0001/2, Channel B from cabinets 1PPSCA0003/4, and Channel C from cabinets 1PPSCA0005/6). The other Voter (Voter 2) is driven from the three ESFAS Logic Channels (channel A from cabinet 1PPSCA0009, channel B from cabinet 1PPSCA0010, and channel C from cabinet 1PPSCA0011). Each Voter has the capability to actuate all of the ESF components of the respective ESFAS actuation channel (ODD or EVEN).

In order to be able to perform maintenance on the ESFAS logic channels (cabinet 1PPSCA0009, 1PPSCA0010, or 1PPSCA0011) or on the RPS/ESFAS logic channels (cabinets 1PPSCA0001/2, 1PPSCA0003/4, or 1PPSCA0005/6) without having the coincident ESFAS logic reduced to a "1-out-of-2" situation, it is required that the associated Voter (Voter 1 or Voter 2) handling the respective inputs, be placed into MANUAL BYPASS. This is done with ESFAS MANUAL BYPASS keyswitches located in ESFAS Actuation cabinets (1PPSCA0012 – ODD & 1PPSCA0014 - EVEN).

23.9.3 The ESFAS Voter MANUAL BYPASS Keyswitches are administratively controlled (no hardware or software interlocks). Administrative control SHALL allow only one set of Voters (ODD 1 and EVEN 1 or ODD 2 & EVEN 2) to be BYPASSED at a time during normal operation. ESFAS Automatic Actuation by the affected Voter is blocked. The MANUAL TRIP is still functional with the Voter in MANUAL BYPASS. Voter 1 ODD & EVEN shall be keyed the same and Voter 2 ODD & EVEN shall be keyed the same.

23.9.4 The ESFAS Voter MANUAL BYPASS Keyswitch status information is sent to the Statalarm panel 1SA7, windows 28, 29, 37, or 38; see Section 22 for window descriptors.

23.9.5 The ESFAS Voter MANUAL BYPASS Keyswitch status information is also sent to the OAC via the TXS Gateway.

23.10 **ESFAS Logic Channel TRIP Keyswitch**

23.10.1 Each ESFAS Logic Channel cabinet (A, B & C) includes a TRIP Keyswitch for the associated logic computer. The TRIP Keyswitch shall also provide a TRIP input to the associated ESFAS functions located in the RPS/ES cabinets (Channel A, B, & C).

23.10.2 If required, operations may place an ESFAS channel in TRIP (all ESFAS channel functions) by placing the associated channel TRIP Keyswitch in the TRIP position. This will also place the ESFAS logic Channel (A, B & C) located in the RPS cabinets in TRIP.

23.10.3 The ESFAS TRIP Keyswitches are administratively controlled (no hardware or software interlocks). Administrative control shall allow only one ESFAS Channel (and associated RPS/ES Channel) to be in TRIP at a time.

23.10.4 The ESFAS TRIP Keyswitch status information is sent to the Statalarm panel 1SA7, windows1 & 2, 10 & 11, 19 & 20; see Section 22 for window descriptors.

23.10.5 The ESFAS TRIP Keyswitch status is sent to the OAC via the TXS gateway.

23.11 RPS Channel E PARAMETER CHANGE ENABLE Keyswitch

23.11.1 The RPS Channel E cabinet includes a PARAMETER CHANGE ENABLE Keyswitch for the associated logic computer.

23.11.2 The TXS system software controls the access to the TXS processor by controlling the operating modes of the computer. Under normal operating conditions, the TXS processor is in the OPERATION mode. The PARAM Mode allows the modification/tuning of software parameters. The TEST Mode allows disabling the application function and forcing the output signals. The DIAG Mode allows download of new application software. The permission to change from the OPERATION mode into the PARAM mode is controlled by the PARAMETER CHANGE ENABLE Keyswitch. Placing the TXS processor into the TEST and DIAG modes requires first entering the PARAM Mode from the TXS Service Unit and then making additional parameter changes from the TXS Service Unit.

23.11.3 The RPS Channel E PARAMETER CHANGE ENABLE Keyswitch is administratively controlled (no hardware or software interlocks).

23.11.4 The RPS Channel E PARAMETER CHANGE ENABLE Keyswitch status is sent to the OAC via the TXS gateway.

24.0 NEW RPS / ESFAS OAC COMPUTER INTERFACE

The replacement RPS/ESFAS channels shall interface with the OAC. Data shall be transferred from each RPS/ESFAS channel to the OAC in a secure and reliable manner for all modes of operation including normal operation, testing and calibration. The communication between the ESFAS and OAC will be accomplished in a manner that ensures electrical isolation and also ensures that no credible OAC fault or failure can adversely affect the ability of the RPS/ESFAS to perform its safety functions when required.

The new RPS/ESFAS OAC interface shall be an OPC Gateway: a single, non-redundant data link from the RPS/ESFAS to the OAC. The information from each of the RPS/ESFAS channels in Unit 1 shall be combined into one data link. The data link will be used to provide RPS/ESFAS parameters (RPS/ESFAS inputs, RPS/ESFAS outputs, RPS/ESFAS internal status, etc.) to the OAC. The RPS/ESFAS shall not receive any parameters from the OAC.

The OAC interface (gateway) shall use an OLE for Process Control (OPC) communication interface; see specification OSS-0340.00-00-0003, Revision 0, "OAC OPC Communications Interface Project Specification" for more information.

25.0 General RPS/ESFAS System Monitoring, Alarming, Testing, Calibration, & Failure Handling Requirements

25.1 **CHANNEL CHECK (analog input deviation from 2.Min/2.Max)**

(Technical Specification Requirement)

25.1.1 The Oconee Technical Specification (T.S.) definition of a CHANNEL CHECK: "A CHANNEL CHECK shall be the qualitative assessment, by observation, of channel behavior during operation. This determination shall include, where possible, comparison of the channel indication and status to other indications or status derived from independent instrument channels measuring the same parameter."

25.1.2 The new RPS/ESFAS hardware and software shall provide automatic monitoring of each of the analog input signals, and perform software limit checking against required acceptance criteria so that the T.S. requirement for a CHANNEL CHECK is continuously being performed. If a channel fails the acceptance criteria, it shall be alarmed (OAC alarm & Statalarm window) so that the Operator may take appropriate action.

25.1.3 Channel Comparisons of the following analog RPS signals shall be performed in order to provide the monitoring functions currently performed manually by Operations as required by the current ONS Technical specifications: NI Power Range Total Power, RC Narrow Range Pressure, RC Hot Leg Temperature (Thot), and RC Total Flow.

25.1.4 Channel Comparisons of the following analog ESFAS signals shall be performed in order to provide the monitoring functions currently performed manually by Operations as required by the current ONS Technical specifications: RC Wide Range Pressure, Reactor Building Pressure.

25.1.5 Provisions shall be made to allow two sets of alarm limit values for RC Narrow Range Pressure Channel Comparison alarms, one set for 4 RC pump operation, and another set for <4 RC pumps running. Software shall use RC Pump status to automate swapover of Channel Comparison alarm settings. The software shall have provisions to allow maintenance to manually select via a GSM screen (1) automatic selection of the comparison set of values (automatic selection based on either 4 pumps running or less than 4 pumps running), (2) manually select 4 pump comparison set, or (3) manually select <4 pump comparison set.

25.1.6 Deleted.

25.1.7 Provisions shall be made to allow two methods of Channel Comparisons for Thot signals. Method 1 - Compare Loop A Thots (Ch. A to Ch. B) & Compare Loop B Thots (Ch. C to Ch. D). Method 2 - Compare all four Thot signals together (Thot Loop A and Thot Loop B). Software shall use RC Pump status to automate swapover of Channel Comparison alarm settings. With <4 RC pumps running, use Method 1. With 4 pumps running, use Method 2 (compare all signals). The software shall have provisions to allow maintenance to manually select via a GSM screen (1) automatic selection of the comparison set of values (automatic selection based on either 4 pumps running or less than 4 pumps running), (2) manually select 4 pump comparison set (Method 2), or (3) manually select <4 pump comparison set (Method 1).

25.2 FUNCTIONAL TEST

(Technical Specification Requirement)

25.2.1 The Oconee Technical Specification definition of a CHANNEL FUNCTIONAL TEST: "A CHANNEL FUNCTIONAL TEST shall be:

Analog and bistable channels - the injection of a simulated or actual signal into the channel as close to the sensor as possible to verify OPERABILITY, of all devices in the channel required for channel OPERABILITY."

Digital computer channels – the use of diagnostic programs to test digital computer hardware and the injection of simulated process data into the channel to verify channel operability.

The CHANNEL FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping or total channel steps so that the entire channel is tested.

25.2.2 The new RPS/ESFAS hardware and software shall provide the capability to perform periodic, semi-automatic channel Functional Testing.

25.2.3 The TXS Test Machine plug shall be designed such that when the plug is inserted into an RPS channel or ES channel, +24VDC will automatically be applied to a digital input and provide the logic to block the propagation of the input signal through the channel so that test signals may be injected into the input without tripping the channel. The RPS/ESFAS Test Enable status information is sent to the Statalarm panel 1SA5, windows 2, 14, 26, 38 (hardwired output of the RPS/ESFAS Channel A, B, C & D logic computers). The ESFAS Test Enable status information is sent to the Statalarm panel 1SA7, windows 7, 8, 16, 17, 25, 26, 31, 40 (hardwired output of the ESFAS Channel A1, A2, B1, B2, C1, C2, and ODD & EVEN Voter logic computers).

25.2.4 The TXS Test Machine can provide an automated means to inject various input test signals into the analog and contact input modules of each channel. The Test Machine is designed to connect to the input circuitry via a plug connector and also connect to the Service Unit via Ethernet data link, in order to receive information about the acquired loop signal values. The testing is semi-automatic, and can include a Graphical Service Monitor (GSM) interactive user-interface. The test machine and service unit combination can include a user friendly, menu driven graphical interface (Human Machine Interface - HMI). The machine graphics can provide maintenance, testing and operator required HMI interface functions, such as setpoint or other software variable settings changes and initiation, recording and printing out of test reports and documentation.

25.3 CHANNEL CALIBRATION

(Technical Specification Requirement)

25.3.1 The Oconee Technical Specification definition of a CHANNEL CALIBRATION: "A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The CHANNEL CALIBRATION shall encompass the entire channel, including the required sensor, alarm, display, and trip functions, and shall include the CHANNEL FUNCTIONAL TEST. Calibration of instrument channels with resistance temperature detector (RTD) or thermocouple sensors may consist of an in-place qualitative assessment of sensor behavior and normal calibration of the remaining adjustable devices in the channel. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is calibrated."

25.3.2 The new RPS/ESFAS shall provide the capability to perform periodic, semi-automatic CHANNEL CALIBRATIONS. Calibrations for loops with field transmitters are performed by using Measuring and Test Equipment to calibrate the transmitters locally at the transmitter. The RPS/ESFAS loops may be calibrated from the field transmitters through to the TXS or by injecting test signals into TXS input modules. Digital engineering units are readout at the TXS Service Unit for all calibrations. If the analog loops provide outputs to indicators, these indicators shall be included in the Channel Calibration. The CHANNEL FUNCTIONAL TEST will be conducted as an integral part of the CHANNEL CALIBRATION so that the system is tested from analog input through the entire system to verify alarms, interlocks, displays and trip function operability as well as to perform output tests (GO / NO-GO), as required.

25.3.3 The GSM "Input Signal Monitoring" screens shall be provided to monitor and record the analog and binary inputs to the TXS during the CHANNEL CALIBRATION tests. To prevent adverse system actions while performing these tests, the analog or binary signals

under test may be placed in Bypass using the GSM "Trip / Bypass" screens. See Section 25.6 GSM Screens.

25.4 Analog Signal Monitoring

25.4.1 All analog signals from field sensors shall be sent to the OAC gateway.

25.4.2 Analog signals from field sensors that deviate from predetermined parameters shall be alarmed to the OAC gateway.

25.5 New OAC Alarms

Additional new OAC gateway alarm points for system status shall be developed during the detailed design. These new alarm points shall include, but are not limited to:

25.5.1 New OAC gateway points for detectable signal failure alarms.

25.5.2 New OAC gateway points for Channel Check Failure alarms

25.5.3 New OAC gateway points for all process binary contact input trip alarms (pressure switch contact trip alarms, RCPPM contact trip alarms, etc).

25.5.4 New OAC gateway points for all RPS and ES Channel Trips.

25.5.5 New OAC gateway points for all 2nd Min/2nd Max functional trips and binary functional trips.

25.5.6 New OAC gateway points for all channel specific functional trip statuses.

25.5.7 New OAC gateway points for NI Variable High Flux Trip value and Variable High Flux Trip Select status.

25.5.8 System trouble alarms – hardware, software, and diagnostics.

25.5.9 Maintenance Bypasses (and Maintenance Test features that result in bypasses) of instrument signals and of channel trip/actuation functions shall be alarmed over the gateway so that local indication is provided in the control room in accordance with IEEE-603-1998 section 5.8.3 requirements.

25.6 **GSM Screens**

Graphical Service Monitor Screens shall be provided for human-machine interface. The design details of the GSM screens shall be developed with input from ONS for maintenance and operations considerations, and the organization of screens and functions in a manner different than described below is allowed. ONS shall review and approve the final GSM screen design details, preliminary information is provided below:

25.6.1 TXS System Overview Screen – The purpose of this screen is to show the trip, bypass, fault, test status, and channel deviation for each CPU in the RPS/ESFAS system.

25.6.2 RPS High Flux Variable Setpoint Screen – The purpose of this screen is to allow the High Flux Variable setpoint to be enabled and adjusted as described in Options B.7 and B.7a of the proposal.

25.6.3 RPS Trip/Bypass Screens – The purpose of these screens is to allow placing individual input signals into the Tripped or Bypassed condition, including at least one each showing all four channels of: Neutron Flux Power Range; RC Hot Leg Temp; RC Flow (A & B); RC Pressure; RB Pressure; MFP Trip (A & B); Main Turbine Trip and each RCP (4 screens) Power Monitor.

25.6.4 RPS RC Flow Gain Calibration Screen – Provide screen and programming needed to obtain RC average flow data for the 8 flow transmitters (4 for A loop, 4 for B loop) and for inputting new manually calculated Total Flow Gain into the Flux/Flow/Imbalance Trip algorithms for each channel. These functions are required to replace the average flow data provided by the existing STAR computer which provided an average flow using 20 data samples per transmitter. The average flow data was then used for manually calculating a new Total Flow Gain and calibrated into each channels Flux/Flow/Imbalance Trip algorithms. Reference IP/0/A/0305/004 "RPS Flow Check."

25.6.5 RPS Reactor Trip Test Screens - Separate screen for each channel for RPS trip relay testing is required. These screens provide for Tech. Spec. required monthly Reactor Trip breaker time response testing and for trip relay logic testing. The screens shall provide the ability to trip each of the four RPS trip relays in each channel such that all logic combinations can be tested (1/4, 2/4, etc). Trip relay checkback status for each relay and UV checkback status shall be provided on the screens.

25.6.6 RPS Output Test Screens – Tests for binary outputs including Statalarm outputs and Events Recorder outputs. Binary outputs to trip relays are excluded, since they are provided on the separate Reactor Trip Test screens described above.

25.6.7 Deleted.

25.6.8 RPS Flux/Flow Screen Scaling – These screens will show all four channels of Flux to Flow parameters, all four channels of Main Turbine Trip as well as a screen for all four channels of pressure parameters.

25.6.9 RPS Screen for 3 RCP Operation - This screen will provide manual mode selection for 3 or 4 RCP operation and will have the capability to automatically enable 3 RCP mode. They will depict all four RPS channels and provide individual command fields for RCS T_{HOT} and Narrow Range Pressure.

25.6.10 ESF Trip/Bypass – Screens shall be provided to show the measured field input data grouped together for each set of ESFAS trip signals (eg. One screen each showing all six channel sets for: RC pressure transmitter inputs; RB pressure inputs and RB pressure switch inputs).

25.6.11 ESFAS Interchannel Trip Screens. - This screen shows all six ESF channels to allow placing individual input signals into the tripped state and/or return them to normal operation. This allows the user to trip all incoming process signals from either one or both ESF channels in order to meet Technical Specification Requirements for testing.

25.6.12 ESFAS Go/No Go Output Test Screens – Eight screens (one for each output channel) for testing binary outputs to actuated field devices.

25.6.13 ESFAS Annunciator Output Test Screens – Two screens (one for each voter) for testing binary outputs to Statalarms.

25.6.14 An ESFAS Wide Range Pressure Swapover Screen shall be provided to allow the WR RC Pressure signal going to the recorder to be manually switched from Ch. A to B, or from Ch. B to A. See Section 20.8.

25.6.15 Miscellaneous Function screens – individual screens for CRC verification, EEPROM Parameter Updates and to verify system parameters.

25.7 **Failure Handling Requirements**

25.7.1 RPS/ESFAS Process Signal Input Failures – Failed/faulted input signals shall be excluded from processing in the 2^{nd} Min/2^{nd} Max and coincidence logic trip/actuation functions comparing all channels. Failed/faulted signals shall also be excluded from channel comparison functions. 2^{nd} Min/2^{nd} Max and coincidence logic trip/actuation functions comparing all channels which use signals derived from multiple process signal types (such as flux/flow/imbalance) shall exclude from processing derived signals which have one or more failed/faulted process input signal. Alarms shall occur on any process input signal fault.

25.7.2 Statalarms generated as the result of channel check comparisons shall be masked while the process signal is being manually bypassed or manually tripped. Computer points generated as the result of channel check comparisons shall not be masked while the process signal is being manually bypassed or manually tripped. These alarms (computer points and Statalarms) shall be masked when the process signal is in test.

25.7.3 Channel specific functional trip status (computer points, Statalarms, or event recorder points) shall not be masked while the process signal is being manually bypassed or while in test.

25.7.4 For RPS, a failure of all four process input signals for an RPS trip function shall result in a reactor trip signal. Alarms shall occur on any process input signal fault.

25.7.5 For ESFAS, a failure of all three process input signals for an actuation function shall not result in an inadvertent ESF actuation due to the faulted signals. Alarms shall occur on any process input signal fault.

25.7.6 RPS Interchannel Communications Failures – A total failure of all RPS inter-channel communications over fiber optic cables for Channels A, B, C, and D shall result in a 1/1 trip logic for each channel trip function such that the RPS system as a whole will remain operable. Alarms shall occur on any communications failure.

25.7.7 ESFAS Interchannel Communications Failures – A total failure of all ESFAS inter-channel communications over fiber optic cables for Channels A, B, and C shall result in a 1/1 trip logic for each channel trip function such that the ESFAS system as a whole will remain operable. Alarms shall occur on any communications failure.

26.0 GROUNDING REQUIREMENTS

26.1 TXS System Grounding Requirements

26.1.1 Each TXS cabinet shall include an isolated ground bar to be connected to Oconee Isolated Instrument Ground. This ground bar shall be located close to the bottom of the cabinet.

26.1.2 Each cabinet shall also include a ground bar which shall be connected to the cabinet. This ground will be connected to the Oconee Station Ground.

26.1.3 The Oconee Grounding requirements and the TXS guidelines shall be reviewed and applied as required during the detailed modification design phase.

26.2 Oconee Grounding References

The following Oconee documents provide requirements and guidance for grounding equipment, armored and shielded cables.

26.2.1 MPGE-005, "Shielding and Grounding Sensitive Equipment."

26.2.2 OEE-15, "Instrumentation and Control Cables Installation Procedures" (& OEE-15 series of drawings, as appropriate).

26.2.3 O-900, "Auxiliary Building Grounding Block Diagram Isolated Ground System "

26.2.4 O-903, "Grounding Block Diagram Isolated Ground System"

26.3 TXS Grounding Reference

EMF-2342(P), "Shielding and Grounding Guidelines for Application of TELEPERM XS"

27.0 ESFAS Document References

The following references include references from the ISD for modification NSM-X3075, "Engineered Safety Feature Actuation System (ESFAS) Replacement".

27.1 AREVA Proposal

AREVA Proposal No. I&C01-1.0 DPC, dated July 25, 2001.

AREVA Change Order Number 2004-02, Wide Range RC Pressure Changes, approved by Duke letter dated 12/2/2004.

AREVA Change Order Number 2004-03, Replace ESFAS Master Trip Wide Range RC Pressure Changes, approved by Duke letter dated 12/2/2004.

AREVA Change Order Number 2004-07, ESFAS Status Panel Changes, approved by Duke letter dated 12/2/2004.

AREVA Change Order Number 2005-01, Diverse LPI approved by Duke letter dated 4/4/2005

AREVA Change Order Number 2005-08, Development of Graphical Service Monitor Capability (Screens), approved by Duke letter dated 4/19/2005.

AREVA Change Order Number 2005-08 Supplemental Clarification #1, March 16, 2005.

AREVA Change Order Number 2007-02, Diverse HPI approved by Duke letter dated 12/19/2007.

27.2 Technical Specifications & Bases

Section 3.3.5 and Bases, "Engineered Safeguards Protective System (ESPS) Analog Instrumentation"

Section 3.3.6 and Bases, "Engineered Safeguards Protective System (ESPS) Manual Initiation"

Section 3.3.7 and Bases, "Engineered Safeguards Protective System (ESPS) Digital Automatic Actuation Logic Channels"

27.3 UFSAR

Section 3.1, "Conformance with NRC General Design Criteria"

Table 3-68, "Electrical Equipment Seismic Qualification"

Chapter 6, "Engineered Safeguards."

Chapter 7, "Instrumentation and Control"

- Section 7.1, "Introduction"
- Section 7.3, "Engineered Safeguards Protective System."
- Table 7-2, "Engineered Safeguards Actuation Conditions."
- Table 7-3, "Engineered Safeguards Actuated Devices."
- Table 7-5, "NNI Inputs to Engineered Safeguards."
- Figure 7-5, "Engineered Safeguards Protection System."

Section 9.5.1.4.3, "Electric Cable Construction, Cable Tray and Cable Penetrations"

Section 8.3.2.1.4, "120 VAC Vital Power Buses"

Chapter 15, "Accident Analysis"

Table 15-35. "Trip Setpoints and Time Delays Assumed in Accident Analyses"

27.4 **Equipment Specifications**

OSS-0311.00-00-0012, Revision 5, "Engineered Safeguards Features Actuation System (ESFAS) Replacement Project Specification"

OSS-0340.00-00-0003, Revision 1, "OAC OPC Communications Interface Project Specification"

27.5 **Design Basis Document**

OSS-0254.00-00-2003, Engineered Safety Features Actuation System

27.6 **Duke and Vendor Drawings**

O -0705	ONE LINE DIAG. 120VAC & 125 VDC STATION AUX CIRCUITS INSTRUMENTATION VITAL BUSES
O -0711-02	OUTLINE UNIT CONTROL BOARD 1UB2
O -0711-02-01	COMPONENT INDEX UNIT CONTROL BOARD 1UB2
O -0711-BC	CONNECTION DIAGRAM UNIT CONTROL BOARD 1UB1 & 1UB2
O -0711-E	CONNECTION DIAGRAM UNIT CONTROL BOARD #1UB2
O -0711-F	CONNECTION DIAGRAM UNIT CONTROL BOARD #1UB2
O -0711-G	CONNECTION DIAGRAM UNIT CONTROL BOARD #1UB2
O -0711-H	CONNECTION DIAGRAM UNIT CONTROL BOARD NO. 1UB2
O -0711-H1	CONNECTION DIAGRAM UNIT CONTROL BOARD NO. 1UB2
O -0711-K	CONNECTION DIAGRAM UNIT CONTROL BOARD #1UB1 & #1UB2
O -0711-L	CONNECTION DIAGRAM UNIT CONTROL BOARD #1UB2
O -0714-02	OUTLINE VERTICAL BOARD 1VB2
O -0714-02-01	COMPONENT INDEX VERTICAL BOARD 1VB2
O -0714-H	CONN/DIAG. VERTICAL BOARD #1VB2 INSIDE FRONT VIEW
O -0714-H1	C/D VERTICAL BOARD #1VB2 & 1VB3 INSIDE FRONT VIEW
O -0714-H2	CONNECTION DIAGRAM VERT BD #1VB2 & 1VB3 INSIDE FRONT VIEW
O -0714-H3	CONNECTION DIAGRAM VERTICAL BOARD NO. 1VB2 INSIDE FRONT VIEW
O -0714-I	C/D VERTICAL BOARD #1VB2 INSIDE REAR VIEW
O -0714-N	SECTIONS & DETAILS VERTICAL BOARD #1VB2
O -0714-O	MISCELLANEOUS CONNECTIONS DIAGRAM VERTICAL BOARDS NO 1VB1, 1VB2 & 1VB3
O -0714-S	CONNECTION DIAGRAM VERTICAL BOARD 1VB2 INSIDE FRONT VIEW
O -0715-I1	ELECTRICAL CONTROL BOARD PANEL NO. 1EB7 TEST PANEL POINT TABULATION
O -0721-A	C/D - VALVES - HIGH PRESS. INJECTION & PURIFICATION SYSTEM

O -0722-A	C/D - LP INJECTION & DECAY HEAT REMOVAL SYSTEM
O -0723	C/D - CORE FLOODING & RB SPRAY SYSTEMS
O -0733	C/D - COMPONENT COOLING SYSTEM & SPENT FUEL COOLING SYSTEM
O -0736-B	MISCELLANEOUS C/D CHEMICAL ADDITION SYSTEM
O -0737-F	C/D - WASTE DISPOSAL SYSTEM
O -0739	C/D PENT. RM. VENT. SAMPLE & R.B. PURGE SYS. & R.B. AUX. VENT. FANS
O -0742-A	C/D - MOTOR OPERATED VALVES L.P. SERVICE WATER SYSTEM
O -0747-C	CONNECTION DIAGRAM - COND . SYS. - DIAPHRAM OPER. VALVES
O -0751-01-03	CONNECTION DIAGRAM 7KV SWITCHGEAR TERM BOX 1TB342
O -0751-B	INTERCONNECTION DIAGRAM - 4KV SWITCHGEAR NO. 1TC
O -0751-D	INTERCONNECTION DIAGRAM - 4KV SWITCHGEAR NO. 1TD
O -0751-F	INTERCONNECTION DIAGRAM - 4KV SWITCHGEAR NO. 1TE
O -0751-K	INTERCONNECTION DIAGRAM 4 KV SWITCHGEAR #B1T
O -0751-M	INTERCONNECTION DIAGRAM 4 KV SWITCHGEAR #B2T
O -0751-N	INTERCONNECTION DIAGRAM 4 KV SWITCHGEAR #B2T
O -0751-O	LAYOUT & INTERCONN. DIAG. TRANSFER CONTR. PNL. ITC PA
O -0752-A15	I/D MOTOR CONTROL CENTER #1XS1 UNITS #F1, F2, F3, F4
O -0752-A17	I/D MOTOR CONTROL CENTER #1XS1 UNITS #R1, R2, R3, R4
O -0752-A19	I/D MOTOR CONTROL CENTER #1XS2 UNITS #F1, F2, F3, F4
O -0752-A20	I/D MOTOR CONTROL CENTER #1XS2 UNITS #R1, R2, R3, R4
O -0753-B	C/D EMERGENCY POWER SWITCHING LOGIC PANEL NO. 1EPS LP1 CHANNEL A
O -0753-C	C/D EMERGENCY POWER SWITCHING LOGIC PANEL NO. 1EPS LP1 CHANNEL B
O -0753-I	C/D EMERGENCY POWER SWITCHING LOGIC PANEL NO. 1EPS LP2
O -0753-J	C/D EMERGENCY POWER SWITCHING LOGIC PANEL NO. 1EPS LP2
O -0753-L	C/D KEOWEE EMERGENCY START PANEL
O -0755	CONNECTION DIAGRAM STATALARM INPUT CABINET NO. 1SAC
O -0757	OUTLINE ODD CHANNELS ENG. SAFEGUARDS RELAY CAB. 1ESTCI
O -0757-A	C/D ODD CHANNELS ENG. SAFEGUARDS TERMINAL CAB. NO. 1ESTC1
O -0757-B	OUTLINE EVEN CHANNELS ENG . SAFEGUARDS RELAY CAB. 1 ESTC2
O -0757-C	C/D EVEN CHANNELS ENG. SAFEGUARDS TERMINAL CABINET 1ESTC2
O -0757-D	OUTLINE ENGR. SAFEGUARDS ODD-EVEN CHANNELS RELAY C AB. 1ESTC3
O -0757-E	CONNECTION DIAGRAM ODD-EVEN CHANNELS ENGINEERED SAFEGUARDS LIGHTS

O -0757-E-1	C/D ODD/EVEN CHANNELS ENGINEERED SAFEGUARDS CAB. NO. 1ESTC3
O -0757-F	CONNECTION DIAGRAM ODD-EVEN CHANNELS ENGINEERED SAFEGUARDS LIGHTS
O -0757-G	CONNECTION DIAGRAM ENGINEERED SAFEGUARDS NORMAL CONTROL CABINET 8
O -0757-H	CONNECTION DIAGRAM ENGINEERED SAFEGUARDS NORMAL CONTROL CABINET 9
O -0757-I	CONNECTION DIAGRAM ENGINEERED SAFEGUARDS LOGIC CABINETS 4 & 5
O -0757-J	CONNECTION DIAGRAM ENGINEERED SAFEGUARDS LOGIC CABINETS 6 & 7
O -0757-K	CONNECTION DIAGRAM ENGINEERED SAFEGUARDS ANALOG CABINETS 1, 2, 3
O -0757-L	CONN DIAG EVEN CHANNELS AUX RELAY CAB NO. 1ESTC2A
O -0767-A10	C/D R.B. PEN. PEN. #ED10, TYPE D PEN.
O -0767-A11	C/D R.B. PEN. PEN. #ED11 TYPE D PEN.
O -0767-A16	C/D R.B. PEN. PEN. #WD6 T YPE D PEN.
O -0767-A17	C/D R.B. PEN. PEN. #WD7, TYPE D PEN.
O -0767-A18	C/D R.B. PEN. TYPE D WD8
O -0767-A20	CONN. DIAG. REACTOR BLDG. PENETRATIONS TYPE -J-PENETRATIONS NO. EA 12 & 13
O -0767-A21	CONN. DIAG. REACTOR BLDG. PENETRATIONS TYPE-J- PENETRATIONS NO. EC4 & WA1
O -0767-A22	CONN. DIAG. REACTOR BLDG. PENETRATION TYPE -J- PENETRATIONS NO. WA13
O -0767-A59	CONNECTION DIAGRAM REACTOR BLDG PENETRATION TYPE D6 PENETRATION NO. WA3
O -0785-B	CONNECTION DIAGRAM INTEGRATED CONTROL SYSTEM BAILEY CABINETS NO 4 & 5
O -0785-D	CONNECTION DIAGRAM INTEGRATED CONTROL SYSTEM BAILEY CABINETS NO. 8 & 9
O -0790-B	CONNECTION DIAGRAM COMPUTER CAB.
O -0790-C	CONNECTION DIAGRAM COMPUTER CAB.
O -0790-C1	CONNECTION DIAGRAM COMPUTER CAB. G-1 REAR WALL
O -0790-D	CONNECTION DIAGRAM COMPUTER CAB.
O -0790-D1	CONNECTION DIAGRAM COMPUTER CAB. G-2 LEFT SIDE WALL
O -0790-D2	CONNECTION DIAGRAM COMPUTER CAB. G-2 LEFT SIDE WALL

O -0790-E	CONNECTION DIAGRAM COMPUTER MISC. MONIT. THERMOCOUPLES
O -0790-E1	CONNECTION DIAGRAM COMPUTER CAB. G-2 REAR WALL
O -0790-E2	CONNECTION DIAGRAM COMPUTER CAB. G-2 REAR WALL
O -0790-E3	CONNECTION DIAGRAM COMPUTER CAB. G-2 REAR WALL
O -0790-F	CONNECTION DIAGRAM MISC. COMPUTER MONITORED EQUIPMENT
O -0790-P	CONNECTION DIAGRAM COMPUTER CAB. G-7 LEFT SIDE WALL
O -0790-P1	CONNECTION DIAGRAM COMPUTER CAB. G-7 LEFT SIDE WALL
O -0791-H	CONNECTION DIAGRAM COMPUTER CAB. I-1 LEFT SIDE WALL
O -0791-I	CONNECTION DIAGRAM COMPUTER CAB. I-2 LEFT SIDE WALL
O -0791-I2	CONNECTION DIAGRAM COMPUTER CAB. I-2 LEFT SIDE WALL
O -0985-C4	CONNECTION DIAGRAM STANDBY SHUTDOWN FACILITY EOC SYS RIGHT FRONT HALF SSF IC1
O-422-BB-2	REACTOR COOLANT PRESSURE TRANSMITTERS "A" – UNIT 1
O-422-BB-02-01	REACTOR COOLANT PRESSURE TRANSMITTERS "B" – UNIT 1
O-422-BB-3	REACTOR COOLANT PRESSURE TRANSMITTERS LOOP A
O-422-EE-1-A	INSTRUMENT DETAIL REACTOR BUILDING PRESSURE
O-422-EE-1-B	REACTOR BUILDING PRESSURE INSTRUMENTATION
O EE-14-B2	WIRE AND CABLE TABULATION PREFAB CABLES FOR BAILEY SYSTEM TYPE E2
O EE-14-B2A	WIRE AND CABLE TABULATION PREFAB CABLES FOR BAILEY SYSTEM TYPE E2
O EE-14-B5	WIRE AND CABLE TABULATION PREFAB CABLES FOR BAILEY SYSTEM TYPE D1
O EE-14-B6	WIRE AND CABLE TABULATION PREFAB CABLES FOR BAILEY SYSTEM TYPE D2
O EE-117-1H	E/D STANDBY BREAKER CLOSING INITIATION & LOAD SHEDDING INITIATION & TESTING
O EE-117-1I	E/D STANDBY BREAKER CLOSI NG & LEAD SHEDDING INITIATION & TESTING
O EE-117-6	E/D 4160 V SWTGR. #B1T ST ANDBY FEEDER BRKR. UNIT # 5
O EE-117-6-B	E/D 4160 V SWTGR. #B1T ST ANDBY FEEDER BKR. UNIT #5
O EE-117-23	E/D 4160 VOLT SWGR. #B2T STANDBY FDR. BKR. UNIT 9
O EE-117-23-B	E/D 4160 VOLT SWGR. #B2T STANDBY FDR. BKR. UNIT 9
O EE-117-47	E/D 4160 V SWGR #1TC UNIT #9 HP. INJECT PUMP MOTOR #1A
O EE-117-48	E/D 4160 V SWGR. #1TC L.P. INJECT. PUMP MOTOR #1A UNIT #10
O EE-117-49	E/D 4160 V SWGR. #1TC REACTOR BLDG. SPRAY PUMP MOTOR #1A
O EE-117-50	E/D 4160 V SWGR #1TC L.P. SERVICE WATER PUMP MOTOR #A UNIT #12
O EE-117-62	E/D 4160 SWGR. #1TD - H. P. INJECTION PUMP MOTOR N O. 1C

O EE-117-63	E/D 4160 V SWGR #1TD - L.P . INJECTION PUMP MOTOR NO . 1B
O EE-117-64	E/D 4160V SWGR #1TD - - REACTOR BLDG. SPRAY PUMP MOTOR NO. 1B
O EE-117-76	E/D 4160VSWGR. #1TE - H.P . INJECT. PUMP MOTOR NO. 1B
O EE-117-83	E/D 4160V SWGR. #1TD - L. P. SERVICE WATER PUMP MOTOR NO. B
O EE-117-83-A	E/D 4160V SWGR #1TD & 2TD L.P. SERV. WATER PUMP MOTOR #B
O EE-117-100	E/D A POWER LOCA LOAD SHED PANEL 1LS1
O EE-117-100-0A	E/D A POWER DEVELOPMENT LOCA LOAD SHED PANEL 1LS1
O EE-117-100-0B	E/D A & B POWER SWITCH DEVELOPMENT LOCA LOAD SHED VERTICAL BD. 1VB1
O EE-117-101	E/D B POWER LOCA LOAD SHED PANEL 1LS1
O EE-117-101-0A	E/D B POWER CONTACT DEVELOPMENT LOCA LOAD SHED PANEL 1LS1
O EE-118-15	LIST - STATALARM NO. 1SA7 - VERTICAL BOARD 1VB2
O EE-118-16	LIST - STATALARM NO. 1SA7 - VERTICAL BOARD 1VB2
O EE-118-50	LIST – ES STATUS PANEL 1SA20 – VERTICAL BOARD 1VB2 (Rev. A)
O EE-118-51	LIST – ES STATUS PANEL 1SA21 – VERTICAL BOARD 1VB2 (Rev. A)
O EE-120	E/D CHANNEL "A" KEOWEE EMERGENCY START
O EE-120-A	ELEMENTARY DIAGRAM CHANNEL A KEOWEE EMERG START
O EE-120-1	E/D CHANNEL "B" KEOWEE EMERGENCY START
O EE-120-1-A	ELEMENTARY DIAGRAM CHANNEL B KEOWEE EMERG START
O EE-138-7	E/D L P SERVICE WATER SYS. RB COOLER 1A OUTLET VLV #1LPSW-18
O EE-138-9	E/D L P SERVICE WATER SYS. RB COOLER 1B OUTLET VL V. #1LPSW-21
O EE-138-11	E/D L P SERVICE WATER SYS. RB COOLER 1C OUTLET VL V. #1/14/97
O EE-138-12	E/D L P SERVICE WATER SYS. RC PUMP MTRS. BRG. COO L SUPPLY VLV. #1/14/59
O EE-138-17	E/D L P SERVICE WATER SYS. RC PUMP MTRS. BRG. COO L OUTLET VLV. 1/14/94
O EE-138-18	E/D L P SERVICE WATER SYS. RB COOLING UNIT FAN A
O EE-138-20	E/D L P SERVICE WATER SYS. RB COOLING UNIT FAN B
O EE-138-22	E/D L P SERVICE WATER SYS. RB COOLING UNIT FAN C
O EE-138-24	E/D ENGINEERED SAFEGUARDS ODD & EVEN RELAY CAB. 1ESTC3
O EE-138-25	E/D ENGINEERED SAFEGUARDS ODD & EVEN RELAY CAB. 1ESTC3
O EE-138-36	ELEMENTARY DIAGRAM LP SERVICE WATER SYS RB AUX VENT FANS COOLING WTR ISOL VLV NO ILPSW-565
O EE-138-37	ELEMENTARY DIAGRAM LP SERVICE WATER SYSTEM RB COOLER IB COOLING WTR ISOL VLV NO 1LPSW-566
O EE-138-60	ELEMENTARY DIAGRAM LPSW SYSTEM RBAC SUPPLY BLOCK VLV 1LPSW-1055

O EE-138-61	ELEMENTARY DIAGRAM LPSW SYSTEM RBAC RETURN BLOCK VLV 1LPSW-1061
O EE-138-63	ELEMENTARY DIAGRAM LPSW SYSTEM RBAC SUPPLY CONTROL VLV 1LPSW-1054
O EE-138-64	ELEMENTARY DIAGRAM LPSW SYSTEM RBAC RETURN CONTROL VLV 1LPSW-1062
O EE-142	E/D COMPONENT COOLING VLV . 1/55/14
O EE-142-1	E/D COMPONENT COOLING VLV . 1/55/15
O EE-145-31	E/D - FEEDWATER SYSTEM - STEAM GENERATOR A SHELL D RAIN VLV. #1/04A/1
O EE-145-32	E/D - FEEDWATER SYSTEM - STEAM GENERATOR B SHELL D RAIN VLV. #1/04A/2
O EE-151	ELEMENTARY DIAGRAM LETDOWN COOLER "A" OUTLET VALVE 1HP3 (FS/1/51/3)
O EE-151-A	ELEMENTARY DIAGRAM LETDOWN COOLER "A" OUTLET VALVE 1HP3 (FS/1/51/3)
O EE-151-1	E/D - LET-DOWN COOLER 1B OUTLET VLV. FS/1/51/4 1 HP4
O EE-151-1-A	ELEMENTARY DIAGRAM LETDOWN COOLER B OUTLET VALVE 1HP4 (FS/1/51/4)
O EE-151-2	E/D - RC PUMP SEAL RET. V ALVE FS/1/51/39 1HP20
O EE-151-2-A	ELEMENTARY DIAGRAM RC PUMP SEAL RETURN VALVE 1HP20 (FS/51/39)
O EE-151-3	E/D - LETDOWN ISOL. VLV. FS/1/51/5
O EE-151-3-1	ELEMENTARY DIAGRAM LETDOWN ISOL VALVE FS/1/51/5
O EE-151-4	E/D - 1A HPI BWST SUCTION VLV. 1/51/7 (1HP-V22A)(1HP-24)
O EE-151-4-1	ELEM DIAG 1A HPI BWST SUCTION (VLV 1/51/7)
O EE-151-5	ELEMENTARY DIAGRAM 1B HPI BWST SUCTION VLV. 1/51/8 (1HP-V22B) (1HP-25)
O EE-151-5-1	ELEM DIAG 1B HPI BWST SUCTION VLV 1/51/8
O EE-151-6	E/D - HP INJ. TO REACTOR INLET VLV. FS/1/51/60
O EE-151-6-1	ELEMENTARY DIAGRAM HP INJ TO REACTOR INLET VLV FS1/51/60
O EE-151-7	E/D - HP INJ. TO REACTOR INLET VLV. FS/1/51/159
O EE-151-8	E/D - RC PUMP SEAL RET. I SOL. VLV #1HP-21
O EE-152-9	E/D - L.P. INJ. LINE A VL V. NO. 1/53/43
O EE-152-9-1	ELEM DIAG LP INJ LINE A VALVE NO 1/53/43
O EE-152-10	E/D - L.P. INJ. LINE B VL V. NO. 1/53/44
O EE-152-10-1	ELEM DIAG LP INJ LINE B VALVE NO 1/53/44

O EE-157-A	ELEMENTARY DIAGRAM CONTACT DEVELOPMENT FOR VLV 1RC-5 (FS/1/63/1)
O EE-157	E/D CHEM. ADDITION SYS. SSF CONTROL FOR VLV. 1RC# 5 FS/1/63/1
O EE-157-1	E/D CHEM. ADDITION SYS. SSF CONTROL FOR VLV. 1RC# 6 FS/1/63/3
O EE-157-1-A	ELEMENTARY DIAGRAM CONTACT DEVELOPMENT FOR VLV 1RC-6 (FS/1/63/3)
O EE-157-2	E/D CHEM ADDITION SYS. VLV. FS/1/63/4
O EE-157-3	E/D CHEM ADDITION SYS. VLV. FS/1/63/5
O EE-157-4	E/D CHEM ADDITION SYS. SOLENOID VLV. 09J-338
O EE-157-5	E/D CHEM ADDITION SYS. SOLENOID VLV. FS/1/63/6
O EE-157-6	E/D CHEM ADDITION SYS. SOLENOID VLV. FS/1/63/7
O EE-158-1	E/D RB PENETRATION RM. VENT. & SAMP. SYSTEM RB PURGE OUTLET VLV. 1/20B-21/1 1PR-1
O EE-158-2	RB PENETRATION RM VENT & SAMP SYSTEM RB PURGE OUTLET VALVE 1/20B-21/2 1PR-2
O EE-158-3	RB PENETRATION RM VENT. & SAMP SYSTEM E/D RB PURGE OUTLET VALVE 1/20B-2-1/3 1PR-3
O EE-158-4	RB PENETRATION RM VENT. & SAMP SYSTEM E/D RB PURGE INLET VALVE 1/20B-21/4 1PR-4
O EE-158-5	RB PENETRATION RM VENT. & SAMP SYSTEM E/D RB PURGE OUTLET VALVE 1/20B-21/5 1PR-5
O EE-158-6	E/D RB PENETRATION RM. VENT. & SAMP SYSTEM RB PURGE INLET VLV. 1/20B-21/6 1PR-6
O EE-158-7	E/D RB PENETRATION RM. VENT & SAMP SYSTEM SAMPLING LINE INLET VLV 1/67/1 1PR-7
O EE-158-8	RB PENETRATION RM VENT & SAMP SYS. E/D SAMPLE LINE CONTROL INLET VLV. 1/67/2 1PR-8
O EE-158-9	RB PENETRATION RM VENT & SAMP SYS. E/D SAMPLE LINE CONTROL OUTLET VLV. 1/67/3 1PR-10
O EE-158-10	E/D RB PENETRATION RM. VENT. & SAMP SYS. SAMPLING LINE OUTL. VLV. 1/67/4 1PR-9
O EE-158-11	RB PENETRATION RM SAMP & VENT SYSTEM E/D RB PENETRATION RM EXHAUST FAN 1A
O EE-158-12	RB PENETRATION RM SAMP & VENT SYSTEM E/D RB PENETRATION RM EXHAUST FAN 1B
O EE-159-3	REACTOR BLDG. SPRAY SYSTEM E/D RB SPRAY PUMP "A" OUTLET VLV. 1/54/14

O EE-159-4	REACTOR BLDG. SPRAY SYSTEM E/D RB SPRAY PUMP "B" O UTLET VLV. 1/54/15
O EE-160	ELEMENTARY DIAG WASTE DISPOSAL SYS RB ISOLATION VLV 1/57/2
O EE-160-1	E/D WASTE DISPOSAL SYS. R B ISOLATION VALVE 1/59/5
O EE-160-2	E/D WASTE DISPOSAL SYS. R B NORMAL SUMP DISCHARGE V LV. 1/59/3
O EE-160-3	E/D WASTE DISPOSAL SYS. R B ISOLATION VALVE 1/59/4
O EE-160-4	E/D WASTE DISPOSAL SYS. QUENCH TANK VENT VALVE 1/5 7/1
O EE-160-5	E/D WASTE DISPOSAL SYS. COMPONENT DRAIN PUMP VLV. 1/59/6
OM 201.J--0001.001	FUNCTIONAL DIAG.ENGR.SAFEGUARDS SYS.CHANNELS 1,2,3, & 4
OM 201.J--0002.001	FUNCTIONAL DIAG.EMGR.SAFEGUARDS SYS. CHANNELS 5 & 6
OM 201.J--0003.001	FUNCTIONAL DIAG.ENGR.SAFEGUARDS SYS. CAHNNELS 7 & 8
OM 201.J--0004.001	SCHEM.DIAG.ENGR.SAFEGUARDS SYS.REACTOR PRESS.ANALOG -SUB-SYS.PART 1
OM 201.J--0005.001	SCHEM.DIAG.ENGR.SAFEGUARDS SYS.REACTOR PRESS.ANALOG SUB-SYS.PART 2
OM 201.J--0006.001	SCHEM. DIAG. ENGR.SAFEGUARDS SYS.BUILDING PRESS.ANALOG SUB-SYS.
OM 201.J--0007.001	SCHEM. DIAG. ENGR. SAFEGUARDS SYS. DIGITAL CHANNEL 1 – Part 1
OM 201.J--0008.001	SCHEM. DIAG. ENGR. SAFEGUARDS SYS. DIGITAL CHANNEL 1 – Part 2
OM 201.J--0009.001	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.002	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.003	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.004	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.005	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.006	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.007	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.008	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.009	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.010	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.011	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.012	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.013	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.014	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.015	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.016	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.017	ENGINEERED SAFEGUARDS SYSTEM

OM 201.J--0009.018	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.019	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.020	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.021	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.022	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.023	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.024	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.025	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.026	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.027	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.028	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.029	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.030	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.031	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.032	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.033	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.034	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.035	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.036	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.037	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.038	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.039	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.040	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.041	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.042	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.043	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0009.044	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0010.001	SCHEM.DIAG.SAFEGUARDS SYS .REACTOR PRESS.ANALOG SUB -SYS.-PART 1
OM 201.J--0011.001	SCHEM.DIAG.ENGR.SAFEGUARDS SYS.REACTOR PRESS.ANALOG SUB-SYS. PART 2
OM 201.J--0012.001	SCHEM.DIAG.ENGR.SAFEGUARDS SYS.BUILDING PRESS.ANALOG SUB-SYS
OM 201.J--0013.001	SCHEM.DIAG.ENGR.SAFEGUARDS SYS.REACTOR PRESS.ANALOG SUB-SYS.-PART 1
OM 201.J--0014.001	SCHEMDIAG.ENGR.SAFEGUARDS SYS.REACTOR PRESS.ANALOG SUB-SYS - PART 2

OM 201.J--0015.001	SCHEM.DAIG.ENGR.SAFEGUARDS SYS.BUILDING PRESS.ANALOG SUB-SYS
OM 201.J--0016.001	SCHEM.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CH. 2 – Part 1
OM 201.J--0017.001	SCHEM.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CH. 2 - Part 2
OM 201.J--0018.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 3 - PART 1
OM 201.J--0019.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 3 - PART 2
OM 201.J--0020.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 4 - PART 1
OM 201.J--0021.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 4 - PART 2
OM 201.J--0022.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 5 - PART 1
OM 201.J--0023.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 5 - PART 2
OM 201.J--0024.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 6 - PART 1
OM 201.J--0025.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 6 - PART 2
OM 201.J--0026.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 7 - PART 1
OM 201.J--0027.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 7 - PART 2
OM 201.J--0028.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 8 - PART 1
OM 201.J--0029.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 8 - PART 2
OM 201.J--0030.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.NORMAL CONTROL
OM 201.J--0031.001	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.002	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.003	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.004	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.005	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.006	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.007	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.008	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.009	NORMAL CONTROL CONNECTIONS

OM 201.J--0031.010	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.011	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.012	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.013	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.014	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.015	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.016	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.017	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.018	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.019	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.020	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.021	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.022	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.023	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.024	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.025	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.026	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.027	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.028	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.029	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.030	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.031	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.032	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.033	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.034	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.035	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.036	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.037	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.038	ENGINEERED SAFEGUARDS SYSTEMS
OM 201.J--0031.039	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0031.040	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0031.041	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0031.042	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.043	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.044	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.045	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.046	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0031.047	ENGINEERED SAFEGUARDS SYSTEM

OM 201.J--0031.048	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0031.049	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.050	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.051	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.052	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.053	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.054	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.055	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.056	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0031.057	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.058	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.059	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.060	NORMAL CONTROL CONNECTIONS
OM 201.J--0031.061	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0031.062	NORMAL CONTROL CONNECTIONS
OM 201.J--0032.001	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0032.002	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0032.003	ENGINEERED SAFEGUARDS SYSTEM
OM 201.J--0033.001	SCHEMATIC DIAG.OF POWER WIRING ANALOG CHANNEL 1 ENGR.SAFEGUARDS SYS.
OM 201.J--0034.001	SCHEMATIC DIAG.OF POWER WIRING ANALOG CHANNEL 2 ENGR. SAFEGUARDS SYS.
OM 201.J--0035.001	SCHEMATIC DIAG.OF POWER ANALOG CHANNEL 3 ENGR.SAFE GUARDS SYS.
OM 201.J--0036.001	SCHEMATIC DIAG.ENGR.SAFEGUARDS SYS.NORMAL CONTROL FOR LOAD SHED
OM 201.J--0037.001	EXTERNAL CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 1&3-PART 1
OM 201.J--0038.001	EXTERNAL CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 1-PART 2
OM 201.J--0039.001	EXTERNAL CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 2&4-PART 1
OM 201.J--0040.001	EXTERNAL CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 2-PART 2
OM 201.J--0041.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 1&3 NOR.CONT.PART 1
OM 201.J--0042.001	EXTERNAL CONN. DIAG. ENGR. SAFEGUARDS SYS. DIGITAL CHANNELS 3&7-PART 2

OM 201.J--0043.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.CHANNELS 2&4 NOR M.CONT.-PART 1
OM 201.J--0044.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 4&8 - PART 2
OM 201.J--0045.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 5&7 - PART 1
OM 201.J--0046.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 1&5 - PART 2
OM 201.J--0047.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL 5&CHANNE L 1- PART 3
OM 201.J--0048.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 6&8 -PART 1
OM 201.J--0049.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 6&2 - PART 2
OM 201.J--0050.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 6 - PART 3
OM 201.J--0051.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.CHANNELS 5&7 NOR M.CONT.-PART 1
OM 201.J--0052.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 6&8 NORM.CONT.PART
OM 201.J--0053.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.ANALOG CHANNEL 1
OM 201.J--0054.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.ANALOG CHANNEL 2
OM 201.J--0055.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.ANALOG CHANNEL 3
OM 201.J--0056.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 1 NORMCONT.-PART 2
OM 201.J--0057.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 2 NORM.CONT.-PART 2
OM 201.J--0058.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.CHANNELS 3&7-NORM. CONT. PART 2
OM 201.J--0059.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNELS 4&8 NORM.CONT.PART
OM 201.J--0060.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 5 NORM. CONT.PART 2
OM 201.J--0061.001	EXT.CONN.DIAG.ENGR.SAFEGUARDS SYS.DIGITAL CHANNEL 1
OM 201.J--0062.001	EXT.CONN.DIAG.BUILDING SPRAY SYSTEM - PART 4
OM 201.J--0063.001	EXTERNAL CONNECTION DIAGRAM REACTOR COOLANT SYS.- PART A

OM 201.J--0064.001	CABINET LAYOUT NO.1 ENGR. SAFEGUARDS SYSTEM ANALOG CHANNEL NO.1
OM 201.J--0065.001	CABINET LAYOUT NO.2 ENGR. SAFEGUARDS SYSTEM ANALOG CHANNEL NO.2
OM 201.J--0066.001	CABINET LAYOUT NO.3 ENGR. SAFEGUARDSSYSTEM ANALOG CHANNEL NO.3
OM 201.J--0067.001	CABINET LAYOUT NO.4 ENGR. SAFEGUARDS SYSTEM DIGITAL CHANNELS 1 & 3
OM 201.J--0068.001	CABINET LAYOUT NO.5 ENGR. SAFEGUARDS SYSTEM DIGITAL CHANNELS 5 & 7
OM 201.J--0069.001	CABINET LAYOUT NO.6 ENGR. SAFEGUARDS SYSTEM DIGITAL CHANNELS 2 & 4
OM 201.J--0070.001	CABINET NO.7 ENGR. SAFEGUARDS SYSTEM DIGITAL CHANNELS 2, 6, & 8
OM 201.J--0071.001	CABINET LAYOUT NO.8 ENGR. SAFEGUARDS SYSTEM NORMAL CONTROL
OM 201.J--0072.001	CABINET LAYOUT NO.9 ENGR. SAFEGUARDS SYSTEM NORMAL CONTROL

27.7 **Calculations**

SRC-OSA-SA-85-022-0, Miscellaneous Instrumentation Error Analysis (Reactor Coolant System Pressure)

OSC-0208, Seismic Anchorage of Miscellaneous Electrical Equipment in the Auxiliary Building

OSC-2495, Reactor Building Narrow Range Pressure Instrumentation Loop Accuracy Calculation

OSC-2509, Seismic Qualification of Safety Devices on the Oconee 1-3 Main Control Boards

OSC-2759, Wide Range RCS Pressure Uncertainty

OSC-2820, Emergency Procedure Setpoints

OSC-3446, Reactor Building Pressure Instrument Loop Accuracy Calculation

OSC-6134, 120VAC Vital I&C Power System Analysis and Regulated Power Fault Duty Analysis

OSC-6928, Containment Isolation Single Failure Analysis

OSC-7548, High Pressure Injection System Single Failure Analysis

OSC-7549, Low Pressure Injection System Single Failure Analysis

OSC-7550, Low Pressure Service Water System Single Failure Analysis

OSC-7552, Penetration Room Ventilation (PRV) System Single Failure Analysis

OSC-7553, Control Room Pressurization Single Failure Analysis

OSC-7554, Reactor Building Cooling (RBC) System Single Failure Analysis

OSC-7555, Reactor Building Spray (RBS) System Single Failure Analysis

OSC-7688, Engineered Safeguards System Online Calibration Drift Analysis.

OSC-8695, Unit 1 Software Parameters Basis for TXS RPS/ESFAS

OSC-8125, Diverse High/Low Pressure Injection Actuation System Uncertainty and Setpoint Determination

OSC-8829, Digital RPS/ESFAS Wide Range Reactor Coolant System (RCS) Pressure Instrument Loop Uncertainty

27.8 **Station Procedures**

27.8.1 Performance Test Procedures

PT/1/A/0202/12 - Component Test of ES Channels 1 & 2

PT/1/A/0203/08 - Component Test of ES Channels 3 & 4

PT/1/A/0160/03 - Component Test of ES Channels 5 & 6

PT/1/A/0204/09 - Component Test of ES Channels 7 & 8

PT/1/A/0600/01 - Periodic Instrument Surveillance

PT/1/A/0610/01J – Emergency Power Switching Logic Functional Test

27.8.2 Abnormal & Emergency Procedures

EP/1/A/1800/01 – Emergency Operating Procedure (Reactivity Management Related).

27.8.3 Analog Channel Procedures - Online

IP/0/A/0310/014A – Engineered Safeguards System Analog Channel A On-Line Calibration

IP/0/A/0310/014B – Engineered Safeguards System Analog Channel B On-Line Calibration

IP/0/A/0310/014C – Engineered Safeguards System Analog Channel C On-Line Calibration

27.8.4 Calibration Procedures for Analog Channels

IP/0/A/0310/003B – Engineered Safeguards System Analog Channel A RC Pressure Channel Calibration

IP/0/A/0310/003C – ES System Reactor Building Narrow Range Pressure Calibration and Analog Channel A Test

IP/0/A/0310/003D –Engineered Safeguards System Analog Channel A RB Pressure Switch Calibration and Pressure Switch Contact Buffer Tests

IP/0/A/0310/004B –Engineered Safeguards System Analog Channel B RC Pressure Channel Calibration

IP/0/A/0310/004C – ES System Reactor Building Narrow Range Pressure Calibration and Analog Channel B Test

IP/0/A/0310/004D –Engineered Safeguards System Analog Channel B RB Pressure Switch Calibration and Pressure Switch Contact Buffer Tests

IP/0/A/0310/005B –Engineered Safeguards System Analog Channel C RC Pressure Channel Calibration

IP/0/A/0310/005C –ES System Reactor Building Narrow Range Pressure Calibration and Analog Channel C Test

IP/0/A/0310/005D –Engineered Safeguards System Analog Channel C RB Pressure Switch Calibration and Pressure Switch Contact Buffer Tests

27.8.5 Functional Procedures

IP/0/A/0310/003A – Engineered Safeguards System Analog Channel A DC Power and Fan Failure Functional Test

IP/0/A/0310/004A – Engineered Safeguards System Analog Channel B DC Power and Fan Failure Functional Test

IP/0/A/0310/005A – Engineered Safeguards System Analog Channel C DC Power and Fan Failure Functional Test

27.8.6 Digital Channel Procedures - Online

IP/0/A/0310/012A – Engineered Safeguards System Logic Subsystem 1 HPI and RB Isolation Channel 1 On Line Test

IP/0/A/0310/013A – Engineered Safeguards System Logic Subsystem 2 HPI and RB Isolation Channel 2 On Line Test

IP/0/A/0310/012B – Engineered Safeguards System Logic Subsystem 1 LPI Channel 3 On Line Test

IP/0/A/0310/013B – Engineered Safeguards System Logic Subsystem 2 LPI Channel 4 On Line Test

IP/0/A/0310/012C – Engineered Safeguards System Logic Subsystem 1 RB Isolation and Cooling Channel 5 On Line Test

IP/0/A/0310/013C – Engineered Safeguards System Logic Subsystem 2 RB Isolation and Cooling Channel 6 On Line Test

IP/0/A/0310/012D – Engineered Safeguards System Logic Subsystem 1 Channel 7 On Line Test

IP/0/A/0310/013D – Engineered Safeguards System Logic Subsystem 2 Channel 8 On Line Test

27.8.7 Functional Procedures for Digital Channels

IP/0/A/0310/007A – Engineered Safeguards System Logic Subsystem 1 HPI and RB Isolation Channel 1 Functional Test

IP/0/A/0310/008A – Engineered Safeguards System Logic Subsystem 2 HPI and RB Isolation Channel 2 Functional Test

IP/0/A/0310/007B – Engineered Safeguards System Logic Subsystem 1 LP Injection Channel 3 Functional Test

IP/0/A/0310/008B – Engineered Safeguards System Logic Subsystem 2 LP Injection Channel 4 Functional Test

IP/0/A/0310/007C – Engineered Safeguards System Logic Subsystem 1 RB Isolation & Cooling Channel 5 Functional Test

IP/0/A/0310/008C – Engineered Safeguards System Logic Subsystem 2 RB Isolation & Cooling Channel 6 Functional Test

IP/0/A/0310/007D – Engineered Safeguards System Logic Subsystem 1 RB Spray Channel 7 Functional Test

IP/0/A/0310/008D – Engineered Safeguards System Logic Subsystem 2 RB Spray Channel 8 Functional Test

IP/0/A/0310/006 – Engineered Safeguards System Logic Subsystem 1 and 2 Fan Failure Alarm Test

27.8.8 Miscellaneous ES Procedures

IP/0/A/0310/022 – PR Valves 2, 3, 4, and 5 Close and Open Link Procedure

IP/0/A/0310/023 – Engineered Safeguards System System Power Supply Capacitor Replacement

IP/0/A/0310/024 – Engineered Safeguards System Removing and Restoring System Power

IP/0/A/0310/025 – Engineered Safeguards System Bailey Meter Cabinet Module Inspection and Cleaning

IP/0/A/0310/015 – Reactor Building Pneumatic Isolation and EQ Valve Check

27.8.9 Operating Procedures

OP/1/A/6101/001 – Alarm Response Guide 1SA-01

OP/1/A/6101/007 – Alarm Response Guide 1SA-01

27.9 **Miscellaneous Documents**

OP-OC-IC-ES - Operations Training - ES Lesson Plan.

AREVA 38-1288545-00, EMF-2342(P), Shielding and Grounding Guidelines for Application of TELEPERM XS

AREVA 51-1167947-03, TMI-1 Setpoint Basis

AREVA 51-1173557-01, Technical Specification Bases Back Up Document for Crystal River Unit 3 Low Pressure Injection System Function of the Engineered Safety Features Actuation System

AREVA 51-1173626-01, Technical Specification Bases Back Up Document for Emergency Core Cooling System T_{ave} > 280F

AREVA 51-1173714-01, Technical Specification Bases Back Up Document for Crystal River Unit 3 Engineered Safety Features Actuation System Instrumentation High Pressure Injection System

AREVA 51-1173755-01, Technical Specification Bases Back Up Document for Crystal River Unit 3 Engineered Safety Features Actuation System Reactor Building Cooling, Reactor Building Spray, Reactor and Reactor Building Isolation

28.0 RPS Document References

The following references include references from the ISD for modification NSM ON-X3072, "Reactor Protection System (RPS) Replacement".

28.1 AREVA Proposal

AREVA Proposal No. I&C01-1.0 DPC, dated July 25, 2001.

AREVA Change Order Number 2004-11, Relocation of FPT Anticipatory Trip Annunciators, approved by Duke letter dated 2/17/2004.

AREVA Change Order Number 2004-12, Redesign of RCPPM, approved by Duke letter dated 2/9/2004.

AREVA Change Order Number 2005-07, Variable Delay for Temperature Compensated High Flux Trip, approved by Duke letter dated 4/4/2005.

AREVA Change Order Number 2005-08, Development of Graphical Service Monitor Capability (Screens), approved by Duke letter dated 4/19/2005.

AREVA Change Order Number 2005-08 Supplemental Clarification #1, March 16, 2005.

AREVA Change Order Number 2005-12, 3-RC Pump Operation and Additional GSM Capability, approved by Duke letter dated July 21, 2005.

AREVA Change Order Number 2008-6, NI-9 Signal removal, approved by Duke letter dated 9/12/08.

AREVA Change Order Number 2008-10, Core Thermal Power Hardwired Points, approved by Duke letter dated 10/9/08.

28.2 Technical Specifications and Bases

Section 3.3.1 and Bases, "Reactor Protective System (RPS) Instrumentation"

Section 3.3.2 and Bases, "Reactor Protective System (RPS) Manual Reactor Trip"

Section 3.3.3 and Bases, "Reactor Protective System (RPS) Reactor Trip Module"

28.3 SLCs

SLC 16.7.9, "RCP Monitor".

28.4 UFSAR

Chapter 3.1, "Conformance with NRC General Design Criteria"

Table 3-68. "Electrical Equipment Seismic Qualification"

Chapter 6, "Engineered Safeguards."

Chapter 7, "Instrumentation and Control"

Section 7.2, "Reactor Protective System"

Chapter 15, "Accident Analysis"

28.5 **Design Basis Document**

OSS-0254.00-00-2002, Reactor Protection System

28.6 **Equipment Specifications**

OSS-0311.00-00-0013, Revision 5, Reactor Protective System (RPS) Replacement Project Specification

OSS-0340.00-00-0003, Revision 1, OAC OPC Communications Interface Project Specification

28.7 **Duke and Vendor Drawings**

O-705	120VAC * 125VDC INSTRUMENTATION VITAL BUSES
O-711-01.01	UNIT CONTROL BOARD 1UB1 COMPONENT INDEX
O-711-B	UNIT CONTROL BOARD 1UB1
O-711-BB	UNIT CONTROL BOARD 1UB1
O-711-BC	UNIT CONTROL BOARD 1UB1 & 1UB2
O-711-C	Connection Diagram Unit Control Board # 1UB1
O-711-F	UNIT CONTROL BOARD 1UB2
O-713-L	AUX BENCHBOARD 1AB3 TERMINAL CABINET 1AT8
O-714-G	VERTICAL BOARDS 1VB1
O-714-H	VERTICAL BOARDS 1VB2
O-714-H2	VERTICAL BOARDS 1VB2 & 1VB3
O-715-I1	TEST PANEL POINT TABULATION 1EB7
O-719	Connection Diagram RCPPM Panel W/D
O-719-A	Connection Diagram RCPPM Panel W/D
O-755	STATALARM INPUT CABINET 1SAC
O-757-C	ENGINEERED SAFEGUARD TERM CABINET 1ESTC2
O-767-A20	RB PENETRATIONS (EA12 &EA13)
O-767-A21	RB PENETRATIONS (EC4)
O-767-A22	RB PENETRATIONS (WA13)
O-767-A65	ELECT PENETRATION EF-2
O-767-A66	ELECT PENETRATION EF-4
O-781	NI/RPS INTERCONNECTION DWG CHANNEL A CABINETS 1 & 2
O-781-A	NI/RPS INTERCONNECTION DWG CHANNEL B CABINETS 1 & 2
O-781-B	NI/RPS INTERCONNECTION DWG CHANNEL C CABINETS 1 & 2
O-781-C	NI/RPS INTERCONNECTION DWG CHANNEL D CABINETS 1 & 2
O-781-D	NI/RPS INTERCONNECTION DWG CHANNEL E CABINET 1
O-781-E	NI/RPS INTERCONNECTION DWG MISC EQUIP
O-781-F	NI/RPS CONNECTION DWG (ROW 7) CHs. A, B, C, D
O-781-G	NI CONNECTION DWG "SSF EOC" SYSTEM
O-781-I	NI/RPS REMOTE MOUNTED EQUIPMENT

O-781-J	RPS CHANNEL A 1NI-1 COMPOSITE
O-781-K	RPS CHANNEL B 1NI-3 COMPOSITE
O-781-L	RPS CHANNEL C 1NI-2 COMPOSITE
O-781-M	RPS CHANNEL D 1NI-4 COMPOSITE
O-781-N	NI/RPS MISC WIRING DETAILS
O-785-B	ICS CABINETS 4 & 5
O-785-D	ICS CABINETS 8 & 9
O-790-B1	COMPUTER CABINET 1G1 (LEFT SIDE WALL)
O-790-E3	COMPUTER CABINET 1G2 (REAR WALL)
O-790-F	COMPUTER CABINET 1G2 (RIGHT SIDE WALL)
O-790-F1	COMPUTER CABINET 1G2 (RIGHT SIDE WALL)
O-790-P	COMPUTER CABINET 1G7 (LEFT SIDE WALL)
O-791-H1	COMPUTER CABINET 1I1 (LEFT SIDE WALL)
O-791-H2	COMPUTER CABINET 1I1 (LEFT SIDE WALL)
O-791-I	COMPUTER CABINET 1I2 (LEFT SIDE WALL)
O-791-I1	COMPUTER CABINET 1I2 (LEFT SIDE WALL)
O-791-I2	COMPUTER CABINET 1I2 (LEFT SIDE WALL)
O-797	SEQUENCE OF EVENTS RECORDER ON0EL CR0125, CABINET A
O-797-A	SEQUENCE OF EVENTS RECORDER ON0EL CR0125, CABINET B
OEE-117-30	6900 SWGR # 1TA-3 RCPM # 1A1
OEE-117-30A	6900 SWGR # 1TA-3 RCPM # 1A1
OEE-117-31	6900 SWGR # 1TA-4 RCPM # 1B1
OEE-117-31A	6900 SWGR # 1TA-4 RCPM # 1B1
OEE-117-36	6900 SWGR # 1TB-3 RCPM # 1A2
OEE-117-36A	6900 SWGR # 1TB-3 RCPM # 1A2
OEE-117-37	6900 SWGR # 1TB-4 RCPM # 1B2
OEE-117-37A	6900 SWGR # 1TB-4 RCPM # 1B2
OEE-118-11	STATALARM 1SA5, VERTICAL BOARD 1VB1
OEE-118-12	STATALARM 1SA5, VERTICAL BOARD 1VB1
OEE-118-3	STATALARM 1SA1, UNIT BOARD 1UB1
OEE-118-37	STATALARM 1SA18, AUX CNTRL BOARD 1VB3
OEE-118-38	STATALARM 1SA18, AUX CNTRL BOARD 1VB3
OEE-118-4	STATALARM 1SA1, UNIT BOARD 1UB1
OEE-118-5	STATALARM 1SA2, UNIT BOARD 1UB1
OEE-118-6	STATALARM 1SA2, UNIT BOARD 1UB1
OEE-119-D	EVENT RECORDER CONTACT LIST
OEE-119-E	EVENT RECORDER CONTACT LIST
OEE-119-G	EVENT RECORDER CONTACT LIST
OEE-119-H	EVENT RECORDER CONTACT LIST

OEE-119-J	EVENT RECORDER CONTACT LIST
OEE-119-J-02	EVENT RECORDER CONTACT LIST
OEE-139-01	ELEMENTARY DIAGRAM REACTOR TRIP BREAKER "A" CRD AC BREAKER TRIP CIRCUIT RPS CHANNEL "A"
OEE-139-02	ELEMENTARY DIAGRAM REACTOR TRIP BREAKER "B" CRD AC BREAKER TRIP CIRCUIT RPS CHANNEL "B"
OEE-139-03	ELEMENTARY DIAGRAM REACTOR TRIP BREAKER "C" CRD AC BREAKER TRIP CIRCUIT RPS CHANNEL "C"
OEE-139-04	ELEMENTARY DIAGRAM REACTOR TRIP BREAKER "D" CRD AC BREAKER TRIP CIRCUIT RPS CHANNEL "D"
OM-201.K-0001	880 NI SYSTEM
OM-201.K-0002	880 TRIP & MANUAL BYPASS INTERFACE LOGIC
OM-201.K-0003	NI SYSTEM ANALOG LOGIC DRAWING
OM-201.K-0004	880 NI/RPS DIGITAL LOGIC (1 OF 4)
OM-201.K-0005	880 NI/RPS DIGITAL LOGIC (2 OF 3)
OM-201.K-0006	REACTOR PROTECTION SYSTEM
OM-201.K-0007	NI/RPS SUBASSEMBLY "E" ICS ANALOG LOGIC
OM-201.K-0008	SUBASSEMBLY "A" DELTA FLUX SCHEMATIC
OM-201.K-0009	SUBASSEMBLY "A" DELTA FLUX SCHEMATIC
OM-201.K-0011	SUBASSEMBLY "A" RCPPM/RC FLOW SCHEMATIC
OM-201.K-0012	SUBASSEMBLY "A" TEMP & PRESS CHANNELS
OM-201.K-0013	RB HIGH PRESSURE TRIP "SUBASSEMBLY A"
OM-201.K-0014	SUBASSEMBLY "A" BISTABLE TRIP STRING (1 OF 2)
OM-201.K-0015	SUBASSEMBLY "A" BISTABLE TRIP STRING (2 OF 2)
OM-201.K-0016	SUBASSEMBLY "A" PWR DISTRIBUTION DRAWING
OM-201.K-0017	SUBASSEMBLY "A" BUSS BAR WIRING
OM-201.K-0018	REACTOR TRIP ASSEMBLIES
OM-201.K-0021	SUBASSEMBLY "B" DELTA FLUX SCHEMATIC
OM-201.K-0022	SUBASSEMBLY "B" DELTA FLUX SCHEMATIC
OM-201.K-0024	SUBASSEMBLY "B" RCPPM/RC FLOW SCHEMATIC
OM-201.K-0025	SUBASSEMBLY "B" TEMP & PRESS CHANNELS
OM-201.K-0026	RB HIGH PRESSURE TRIP "SUBASSEMBLY B"
OM-201.K-0027	SUBASSEMBLY "B" BISTABLE TRIP STRING (1 OF 2)
OM-201.K-0028	SUBASSEMBLY "B" BISTABLE TRIP STRING (2 OF 2)
OM-201.K-0029	SUBASSEMBLY "B" PWR DISTRIBUTION DRAWING
OM-201.K-0030	SUBASSEMBLY "B" BUSS BAR WIRING
OM-201.K-0031	SUBASSEMBLY "C" DELTA FLUX SCHEMATIC
OM-201.K-0032	SUBASSEMBLY "C" DELTA FLUX SCHEMATIC

OM-201.K-0034	SUBASSEMBLY "C" RCPPM/RC FLOW SCHEMATIC
OM-201.K-0035	SUBASSEMBLY "C" TEMP & PRESS CHANNELS
OM-201.K-0036	RB HIGH PRESSURE TRIP "SUBASSEMBLY C"
OM-201.K-0037	SUBASSEMBLY "C" BISTABLE TRIP STRING (1 OF 2)
OM-201.K-0038	SUBASSEMBLY "C" BISTABLE TRIP STRING (2 OF 2)
OM-201.K-0039	SUBASSEMBLY "C" PWR DISTRIBUTION DRAWING
OM-201.K-0040	SUBASSEMBLY "C" BUSS BAR WIRING
OM-201.K-0041	SUBASSEMBLY "D" DELTA FLUX SCHEMATIC
OM-201.K-0042	SUBASSEMBLY "D" DELTA FLUX SCHEMATIC
OM-201.K-0044	SUBASSEMBLY "D" RCPPM/RC FLOW SCHEMATIC
OM-201.K-0045	SUBASSEMBLY "D" TEMP & PRESS CHANNELS
OM-201.K-0046	RB HIGH PRESSURE TRIP "SUBASSEMBLY D"
OM-201.K-0047	SUBASSEMBLY "D" BISTABLE TRIP STRING (1 OF 2)
OM-201.K-0048	SUBASSEMBLY "D" BISTABLE TRIP STRING (2 OF 2)
OM-201.K-0049	SUBASSEMBLY "D" PWR DISTRIBUTION DRAWING
OM-201.K-0050	SUBASSEMBLY "D" BUSS BAR WIRING
OM-201.K-0051	SUBASSEMBLY "E" PWR RANGE CHANNEL
OM-201.K-0052	SUBASSEMBLY "E" PRESSURE CHANNEL
OM-201.K-0053	SUBASSEMBLY "E" PWR RANGE ALARM BISTABLE
OM-201.K-0054	SUBASSEMBLY "E" PWR DISTRIBUTION DRAWING
OM-201.K-0055	SUBASSEMBLY "E" BUSS BAR WIRING
OM-201.K-0056	SUBASSEMBLY "A" SHUTDOWN BYPASS
OM-201.K-0057	SUBASSEMBLY "B" SHUTDOWN BYPASS
OM-201.K-0058	SUBASSEMBLY "C" SHUTDOWN BYPASS
OM-201.K-0059	SUBASSEMBLY "D" SHUTDOWN BYPASS
OM-201.K-0060	SUBASSEMBLY "A" AUXILIARY RELAY
OM-201.K-0061	SUBASSEMBLY "B" AUXILIARY RELAY
OM-201.K-0062	SUBASSEMBLY "C" AUXILIARY RELAY
OM-201.K-0063	SUBASSEMBLY "D" AUXILIARY RELAY
OM-201.K-0064	SUBASSEMBLY "A" AUXILIARY RELAY
OM-201.K-0065	SUBASSEMBLY "B" AUXILIARY RELAY
OM-201.K-0066	SUBASSEMBLY "C" AUXILIARY RELAY
OM-201.K-0067	SUBASSEMBLY "D" AUXILIARY RELAY
OM-201.K-0068	NI/RPS SUBASSEMBLY "A" CABINET 1
OM-201.K-0069	NI/RPS SUBASSEMBLY "B" CABINET 1
OM-201.K-0070	NI/RPS SUBASSEMBLY "C" CABINET 1
OM-201.K-0071	NI/RPS SUBASSEMBLY "D" CABINET 1
OM-201.K-0072	NI/RPS SUBASSEMBLY "A" CABINET 2 (1 OF 2)
OM-201.K-0073	NI/RPS SUBASSEMBLY "A" CABINET 2 (2 OF 2)

OM-201.K-0074	NI/RPS SUBASSEMBLY "B" CABINET 2 (1 OF 2)
OM-201.K-0075	NI/RPS SUBASSEMBLY "B" CABINET 2 (2 OF 2)
OM-201.K-0076	NI/RPS SUBASSEMBLY "C" CABINET 2 (1 OF 2)
OM-201.K-0077	NI/RPS SUBASSEMBLY "C" CABINET 2 (2 OF 2)
OM-201.K-0078	NI/RPS SUBASSEMBLY "D" CABINET 2 (1 OF 2)
OM-201.K-0079	NI/RPS SUBASSEMBLY "D" CABINET 2 (2 OF 2)
OM-201.K-0080	NI/RPS INTERNAL SUBASSEMBLY WIRING
OM-201.K-0081	NI SUBASSEMBLY "E" CONTROL SIGNALS
OM-201.K-0082	880 NI CABINET LAYOUT SUBASSEMBLY "A" CAB 1
OM-201.K-0083	880 NI CABINET LAYOUT SUBASSEMBLY "A" CAB 2
OM-201.K-0084	880 NI CABINET LAYOUT SUBASSEMBLY "B" CAB 1
OM-201.K-0085	880 NI CABINET LAYOUT SUBASSEMBLY "B" CAB 2
OM-201.K-0086	880 NI CABINET LAYOUT SUBASSEMBLY "C" CAB 1
OM-201.K-0087	881 NI CABINET LAYOUT SUBASSEMBLY "C" CAB 2
OM-201.K-0088	880 NI CABINET LAYOUT SUBASSEMBLY "D" CAB 1
OM-201.K-0089	881 NI CABINET LAYOUT SUBASSEMBLY "D" CAB 2
OM-201.K-0090	880 NI CABINET LAYOUT SUBASSEMBLY "E" CAB 1
OM-201.K-0091	885 NI/RPS DIGITAL LOGIC (MFW PUMP & TURBINE TRIP)
OM-201.K-0092	885 NI/RPS MFW PUMP TRIP SUBASSEMBLY "A"
OM-201.K-0093	885 NI/RPS TURBINE TRIP SUBASSEMBLY "A"
OM-201.K-0094	885 NI/RPS MFW PUMP TRIP SUBASSEMBLY "B"
OM-201.K-0095	885 NI/RPS TURBINE TRIP SUBASSEMBLY "B"
OM-201.K-0096	885 NI/RPS MFW PUMP TRIP SUBASSEMBLY "C"
OM-201.K-0097	885 NI/RPS TURBINE TRIP SUBASSEMBLY "C"
OM-201.K-0098	885 NI/RPS MFW PUMP TRIP SUBASSEMBLY "D"
OM-201.K-0099	885 NI/RPS TURBINE TRIP SUBASSEMBLY "D"
OM-201.K-0106	SUBASSEMBLY "A" STAR SYSTEM FLUX/IMB/FLOW REACTOR TRIP
OM-201.K-0107	SUBASSEMBLY "B" STAR SYSTEM FLUX/IMB/FLOW REACTOR TRIP
OM-201.K-0108	SUBASSEMBLY "C" STAR SYSTEM FLUX/IMB/FLOW REACTOR TRIP
OM-201.K-0109	SUBASSEMBLY "D" STAR SYSTEM FLUX/IMB/FLOW REACTOR TRIP
OM-311-0233-1	RCPPM Outline and Mounting Details
OM-311-0233-2	RCPPM Cabinet Fabrication
OM-311-0234-1	RCPPM Schematic
OM-311-0235-1	RCPPM System W/D Sheet 1
OM-311-0235-2	RCPPM System W/D Sheet 2
OM-311-0235-3	RCPPM System W/D Sheet 3
OM-311-0235-4	RCPPM System W/D Sheet 4
O-422-M-49	INSTRUMENT DETAIL TURBINE EHC OIL PRESSURE
O-422-BB-1B	REACTOR COOLANT FLOW LOOP B TRANSMITTERS

28.8 **Calculations**

OSC-2699, "Arming Threshold for Anticipatory Reactor Trip"

OSC-2820, "Emergency Procedure Setpoints"

OSC-3302, "Reactor Coolant System Narrow Range Pressure Instrument Loop Current Leakage Calculation"

OSC-3395, "RPS Main Feedwater Pump Pressure Instrument Loop Accuracy Calculation"

OSC-3416, "RPS Flux/Flow Ratio Uncertainty Evaluation"

OSC-3446, "Reactor Building Pressure Instrument Loop Accuracy Calculation"

OSC-3712, "RCS Flow Noise"

OSC-4048, "Variable Low Pressure Safety Limit"

OSC-4168, "Loss of MFW Event with EFW in Manual"

OSC-4276, "ONS Units 1-3 125VDC Vital Instrumentation and Control Voltage Adequacy"

OSC-4475, "FSAR Section 15.14.5 - LBLOCA Peak Containment Pressure Analysis"

OSC-4775, "Justification of UST Temp at 30% FP"

OSC-4860, "FSAR Section 15.13 - Main Steam Line Break Accident"

OSC-5064, "Power-Imbalance Safety Limits and Tech. Spec. Setpoints Using Error-Adjusted Flux/Flow Ratio of 1.094"

OSC-5280, "FSAR Section 15.14.5 - LBLOCA Long Term Containment Cooling Requirements II"

OSC-5233, "FSAR Section 15.13 - Steam Line Break Mass and Energy Release"

OSC-5350, "FSAR Section 10.4.7.1.2 - Loss of MFW With LOOP"

OSC-5371, "FSAR Section 15.14.5 - SBLOCA Containment Response"

OSC-5373, "Steam Line Break Containment Temp and Pressure Response"

OSC-5502, "LBLOCA Containment Response With No RBCUs"

OSC-6134, "120VAC Vital I&C Power System Analysis & Regulated Power Fault Duty Analysis"

OSC-6217, "Loss of MFW Without Anticipatory Reactor Trip System"

OSC-6519, "FSAR Section 15.13 - Large Steam Line Break"

OSC-6533, "FSAR Section 15.9 - Steam Generator Tube Rupture Accident"

OSC-7237, "RPS High Flux and Power/Pump Monitor Trip Function Uncertainty Analysis"

OSC-7362, "LOCA Analysis Input"

OSC-7572, "UFSAR Section 6.2 – Peak Containment Pressure Mass and Energy Release Analysis"

OSC-7573, "UFSAR Section 6.2 – Long Term Mass and Energy Release Analysis"

OSC-8024, "SBLOCA Long Term Mass and Energy Release Analysis"

OSC-8695, "Unit 1 Software Parameters Basis for TXS RPS/ESFAS"

OSC-8784, "Anticipated Transient Without SCRAM (ATWS)"

OSC-8828, Digital RPS RCS Pressure and Temperature Trip Function Uncertainties and Variable Low RCS Pressure Safety limit.

OSC-8856, Digital RPS Neutron Overpower (Neutron Flux) and Pump Power/Flux Trip Function.

OSC-8857 Digital RPS Neutron Overpower Flux/Flow/Imbalance /Flux Trip Uncertainty Analysis.

28.9 Station Procedures

IP/0/A/0301/003 A1	NI-1 Neutron Flux Instrument Calibration
IP/0/A/0301/003 B1	NI-2 Neutron Flux Instrument Calibration
IP/0/A/0301/003 C1	NI-3 Neutron Flux Instrument Calibration
IP/0/A/0301/003 D1	NI-4 Neutron Flux Instrument Calibration
IP/1/A/0301/003 E	Nuclear Instrumentation NI-5 Power Range Calibration
IP/1/A/0301/003 F	Nuclear Instrumentation NI-6 Power Range Calibration
IP/1/A/0301/003 G	Nuclear Instrumentation NI-7 Power Range Calibration
IP/1/A/0301/003 H	Nuclear Instrumentation NI-8 Power Range Calibration
IP/0/A/0301/003 J	Nuclear Instrumentation and Reactor Protective System Nuclear Detector Installation and Removal
IP/0/B/0301/003 O	RPS and Nuclear Instrumentation RPS D.C. Power Supply, Fan Failure, Dummy Bistable Inserted and Module Removal Trip Test (ADMIN HOLD)
IP/0/A/0301/003 S1	Wide Range Nuclear Instrumentation Channel Check
IP/0/A/0301/003 T	Reactor Protective System Manual Calculation For Power Range Calibration Instrument Procedure
IP/0/A/0301/003 T-1	Wide Range Neutron Flux Instrumentation Calibration At Power
IP/0/A/0301/003 T-2	Reactor Protective System Computer Calculation For Power Range Calibration Instrument Procedure
AM/0/A/0301/003 U	Procedure To Reset the Flux/Imbalance/Flow and High Flux Trips For Operation With Excessive Power Tilt, Dropped Control Rod Or Other Conditions
IP/0/A/0301/003 V	Procedure For Setting High Flux Trip And Reactor Building Evacuation Alarm
IP/0/A/0301/003 X	Nuclear Instrumentation Gamma-Metrics Cable Check Out
IP/0/A/0301/002	Nuclear Instrumentation Detector Cabling Electrical Test
IP/0/A/0305/001 A	Reactor Protective System Channel A Pump Power Monitor Instrument Calibration
IP/0/A/0305/001 B	Reactor Protective System Channel B Pump Power Monitor Instrument Calibration
IP/0/A/0305/001 C	Reactor Protective System Channel C Pump Power Monitor Instrument Calibration
IP/0/A/0305/001 D	Reactor Protective System Channel D Pump Power Monitor Instrument Calibration
IP/0/A/0305/001 M	Reactor Protective System Channel A RC Pressure Instrument Calibration
IP/0/A/0305/001 N	Reactor Protective System Channel B RC Pressure Instrument Calibration

IP/0/A/0305/001 O	Reactor Protective System Channel C RC Pressure Instrument Calibration
IP/0/A/0305/001 P	Reactor Protective System Channel D RC Pressure Instrument Calibration
Deleted.	
IP/0/A/0305/004	RPS Flow Check
IP/0/A/0305/005 A	Reactor Building HI Pressure Trip Channel A
IP/0/A/0305/005 B	Reactor Building HI Pressure Trip Channel B
IP/0/A/0305/005 C	Reactor Building HI Pressure Trip Channel C
IP/0/A/0305/005 D	Reactor Building HI Pressure Trip Channel D
IP/0/A/0305/001 E	Reactor Protective System Channel A RC Temperature Instrumentation Calibration
IP/0/A/0305/001 F	Reactor Protective System Channel B RC Temperature Instrumentation Calibration
IP/0/A/0305/001 G	Reactor Protective System Channel C RC Temperature Instrumentation Calibration
IP/0/A/0305/001 H	Reactor Protective System Channel D RC Temperature Instrumentation Calibration
IP/1/A/0305/001 I	Reactor Protective System Channel A RC Flow Instrumentation Calibration
IP/1/A/0305/001 J	Reactor Protective System Channel B RC Flow Instrumentation Calibration
IP/1/A/0305/001 K	Reactor Protective System Channel C RC Flow Instrumentation Calibration
IP/1/A/0305/001 L	Reactor Protective System Channel D RC Flow Instrumentation Calibration
Deleted	
IP/1/A/0305/003 A	NI/RPS Channel A Calibration and Functional Test
IP/1/A/0305/003 B	NI/RPS Channel B Calibration and Functional Test
IP/1/A/0305/003 C	NI/RPS Channel C Calibration and Functional Test
IP/1/A/0305/003 D	NI/RPS Channel D Calibration and Functional Test
IP/0/A/0305/008	Procedure To Disable/Enable RPS Trip Or To Maintain A Channel In Manual Bypass
IP/0/A/0305/009	RPS Channel A Main Feedwater Pumps and Main Turbine Trips Calibration
IP/0/A/0305/010	RPS Channel B Main Feedwater Pumps and Main Turbine Trips Calibration
IP/0/A/0305/011	RPS Channel C Main Feedwater Pumps and Main Turbine Trips Calibration

IP/0/A/0305/012	RPS Channel D Main Feedwater Pumps and Main Turbine Trips Calibration
IP/0/A/0305/013	Nuclear Instrument and Reactor Protective System System Power Supply Capacitor Replacement
IP/0/A/0305/014	RPS Control Rod Drive Breaker Trip and Event Recorder Timing Test (Units 1 & 3)
IP/0/A/0305/014 A	RPS Control Rod Drive Breaker Trip And Events Recorder Timing Test
IP/0/A/0305/015	Nuclear Instrumentation RPS Removal From And Return To Service For Channel A, B, C, And D
IP/0/A/0305/016	Bailey Meter Cabinet Module Inspection And Cleaning
IP/0/A/0305/018	RPS STAR Module Analog Input/Output Calibration And Setpoint Change
IP/0/A/0306/003	Nuclear Instrumentation Power Range Nuclear Detector Electrical Test
IP/0/A/0306/004	Power Range Neutron Detector Leakage Resistance & Voltage Response Test

28.10 **Operating Procedures**

EP/1/A/1800/001	EOP – IMAs and SAs
Deleted	
OP/0/A/1103/020 A	Operator Aid Computer Use
OP/1/A/1102/001	Controlling Procedure for Unit Startup
OP/1/A/1102/010	Controlling Procedure for Unit Shutdown
OP/1/A/1102/10A	Controlling Procedure for Rapid Shutdown (Superseded)
OP/1/A/1102/020	Control Room Rounds
Deleted	
OP/1/A/6101/001	Alarm Response Guide 1SA-01
OP/1/A/6101/005	Alarm Response Guide 1SA-05
OP/1/A/6101/007	Alarm Response Guide 1SA-07
OP/1/A/6101/018	Alarm Response Guide 1SA-18

28.11 **Miscellaneous Documents**

OD101542, Provide NI Signals to ICS from NI-5, 6, 7 & 8 (installed 1EOC24 in 2008)

OP-OC-IC-RPS, Operations Training Lesson Plan for the Reactor Protective System

AREVA 01-1228962-00 - 05, STAR Instruction Manual

AREVA 08-5008769-02, Equipment Specification for FRA-ANP Linear Amplifier Module

AREVA 32-1124162-00, Duke III NI RPS String Error Calculation

AREVA 32-1125233-00, RCS Pressure Drop, Core Outlet to Hot Leg Pressure Tap, ONS-3 Deleted

AREVA 51-5019055-00, Interface Information for Oconee RPS NF Hardware

AREVA 51-1119850-00, RPS-1 Functional Requirements

AREVA 51-1172599-01, Technical Specification Bases Backup Document for Crystal River Unit 3 Reactor Protection System High Reactor Coolant System Pressure Trip

AREVA 51-1172957-01, Technical Specification Bases Backup Document for Crystal River Unit 3 Reactor Protection System Nuclear Overpower Trip

AREVA 51-1172980-01, Technical Specification Bases Backup Document for Crystal River Unit 3 Reactor Protection System Variable Low RCS Pressure Trip

AREVA 51-1173551-01, Technical Specification Bases Backup Document for Crystal River Unit 3 Reactor Protection System Reactor Coolant Pump Power Monitors Trip

AREVA 51-1173554-01, Technical Specification Bases Backup Document for Crystal River Unit 3 Reactor Protection System Nuclear Overpower Based on RCS Flow and Axial Imbalance Trip

AREVA 51-1173563-01, Technical Specification Bases Backup Document for Crystal River Unit 3 Reactor Protection System Low Reactor Coolant System Pressure Trip

AREVA 51-1173567-01, Technical Specification Bases Backup Document for Crystal River Unit 3 Reactor Coolant System Safety Limits

AREVA 58-95-00, 880 Nuclear Instrumentation Qualification Test Report

ONEI-0400-50, Rev. 26, Duke Power Company Oconee 1 Cycle 24 Core Operating Limits Report (COLR)

Duke Letter, OS-285.P-07-0111, "ONS RCP Pump Monitor Delay", from Jeff Abbott to Barbara Thomas, dated February 26, 2007.

29.0 OPEN ITEMS / ADDITIONAL REQUIREMENTS

29.1 **NSM 13090 (CLOSED Item)**

An open item existed to finalize design requirements for LOCA Load Shed contacts fed from the RPS channels (NSM 13090), and to select the proper signal combinations and incorporate into the RPS Functional Requirements Specification (FRS). NSM 13090 will not require contacts from the RPS.

29.2 **ESFAS RESET (CLOSED Item)**

This open item has been closed based on review of proposed software logic with system engineering and operations during 6/20/2005 Level 3 Software Review Meeting (see sections 15.8.3, 16.8.3, 17.8.2 & 18.8). Operation and RESET of ESFAS actuations following an ESFAS actuation needs to be reviewed and approved by ONS.

29.3 **ESFAS LPI DIVERSE SYSTEM MODIFICATION (CLOSED Item)**

This open item has been closed based on approved Change Order 2005-01. DLPIAS added to new Section 30.

29.4 **RPS Channel E Power Range NI (CLOSED Item)**

This open item has been closed based on direction provided by ONS management for use of a two-channel detector in the Unit 1 RPS design: ONS Unit 1 is unique in that it has a three-chamber detector installed. The other units use a two-chamber detector.

29.5 **A-MRC SOFTWARE PROGRAMMING BLOCK (CLOSED Item)**

This open item has been closed: See Section 25.4 for discussion of the operation of the analog signal range limit monitoring features, alarming, etc.

29.6 **New OAC ALARMS (CLOSED Item)**

This open item has been closed. Section 25 has been updated to indicate that TXS will provide:

29.6.1 new OAC gateway points for A-MRC signal range limit alarms

29.6.2 new OAC gateway points for Channel Check Failure alarms

29.6.3 new OAC gateway points for process binary contact input trip alarms (pressure switch contact trip alarms, RCPPM contact trip alarms, etc)

29.7 **OAC Points which Alarm (CLOSED Item)**

ONS needs to review and approve which OAC points will be alarmed to the Operator Alarm Console. TXS alarm requirements are provided in section 25.5, therefore this open item is closed.

29.8 **RESET VALUES FOR SETPOINTS (CLOSED Item)**

These values will be developed after completion of the ONS uncertainty calculations. Actual setpoints will be installed/verified correct in the RPS/ESFAS software via approved plant calibration (surveillance) procedure(s). Reset values for setpoints found in this document are initial values until calculations are completed. Final RPS/ESFAS electronic reset values will be documented in OSC-8695.

29.9 **Deleted.**

29.10 **GRAPHICAL SERVICE MONITOR SCREENS (CLOSED Item)**

Section 25.6 has been added to address GSM screen requirements.

29.11 **T_{COLD} RTD Scaling (RPS FUNCTION 2) (CLOSED Item)**

This open item has been closed. T_{COLD} RTD Scaling will be addressed by the ONS T_{COLD} modifications. NOTE: RPS Trip Function #2 has been deleted from this functional description.

29.12 **T_{HOT} RTD Scaling (RPS FUNCTION 7) (CLOSED Item)**

This open item has been closed. Specific resistance/temperature data sheets for each Hot Leg RTD serial number/ID will be addressed in OSC-8695 Unit 1 Software Parameters document.

29.13 **Transmitter Scaling for RPS & ESFAS Inputs (CLOSED Item)**

This open item has been closed; it will be in OSC-8695 Unit 1 Software Parameters document. Verify calibrated ranges for RPS and ESFAS Reactor Coolant pressure, Reactor Building pressure and RPS Reactor Coolant Flow transmitters.

29.14 **Analog Signal Channel Check (CLOSED Item)**

This open item has been closed: See Section 25.1. Acceptance criteria values for Channel Checks done with 2.Min/2.Max deviation features need to be reviewed and approved by ONS.

29.15 **Flux/Delta Flux/Flow Function 3 (CLOSED Item)**

This open item has been closed based on input from NGO Safety Analysis: See Section 3; determine where to best place the 2.Max functions.

29.16 **Temperature Compensated High Flux Trip Function 2 (CLOSED Item)**

This open item has been closed based on input from NGO Safety Analysis: See Section 2, definition of X_C is not clearly defined in the tables or description. Also it is not clear how the conditional statement **{For (T_{EVAL} - $T_{COLDm2.Min}$) > X_C where $X_C \geq 0$}** applies to the trip function equation. NOTE: RPS Trip Function #2 has been deleted from this functional description.

29.17 **Test Machine Purchase (CLOSED Item)**

The TXS Test Machine was included in the scope of the original purchase order.

29.18 **RBCU Fans Receiving ES-5 and ES-6 Signals (CLOSED Item)**

ONS is currently evaluating the ES-5 and ES-6 signals that are sent to the RBCU A, B and C fans. Changes to current design will require a design scope change.

29.19 **RTD Transmitter Accuracy, Time Response, and Qualifications (CLOSED Item)**

Accuracy of new RTD transmitters has been determined to be slightly better than the existing RTD bridges. Duke Calculation OSC-4048 provides the accuracy of the existing Bailey string as ±1.27°F. Duke Calculation OSC-8828 provides the accuracy of new TXS string of ±1.26°F. Other issues with the RTD transmitters are resolved, including the Time Response Calculation and the EQ Report, therefore this open item has been closed.

29.20 **Function 3 Flux/Flow/Imbalance Trip analog scaling Issues (CLOSED Item)**

The information concerning a review of STAR manual for details of the flux/flow/imbalance algorithm and scaling has been moved to Function #3 section as a requirement, therefore this open item is closed.

30.0 DIVERSE LOW PRESSURE INJECTION ACTUATION SYSTEM

30.1 Diverse LPI Actuation System Features

The AREVA design includes the following features:

1. The non-safety related DLPIAS components are installed in Cabinet 16 (RPS Channel E).
2. Three Moore analog bistables which monitor the Wide Range RC pressure signals from ESFAS channels A, B & C. These are powered from 120 VAC supplied from 1KI breaker 10.
3. Two 1E interposing relays will be mounted in cabinet 12 (ODD voter) and cabinet 14 (EVEN voter), and powered from the 24 VDC power supplies in cabinet 16, RPS Channel E. These relays will be qualified for 1E/non-1E isolation. These relays will actuate Channel 3 and Channel 4 respectively, once at least 2 out of the 3 bistables are tripped.
4. A BYPASS/ENABLE pushbutton (mounted on 1UB2) will be installed. Depressing the BYPASS pushbutton will drop out the interposing Channel 3 & 4 actuation relays, disable the DLPIAS and light the BYPASSED amber LED on 1UB2. Depressing the ENABLE pushbutton will enable the DLPIAS and the amber BYPASSED LED will go out.
5. If one (or more) bistables are tripped, a red LED labeled BISTABLE TRIPPED will be lit on 1UB2.
6. An OVERRIDE/RESET pushbutton (mounted on 1UB2) will be installed. Depressing the OVERRIDE pushbutton will drop out the interposing Channel 3 & 4 actuation relays, disable the DLPIAS and light the OVERRIDE red LED on 1UB2. Depressing the RESET pushbutton will enable the interposing Channel 3 & 4 actuation relays and the OVERRIDE red LED will go out.

30.2 New Algorithm for DLPIAS Actuation Functions

Actual in-plant setpoints are derived in OSC-8125, "Diverse High/Low Pressure Injection Actuation System Loop Uncertainty and Setpoint Determination".

RCS Pressure Low Low

ALGORITHM

Channel Trip: $P_{m()} \leq P_{SP\ PRESS}$

(a) $P_{m()}$ = measured RCS pressure in each DLPIAS bistable.
(b) $P_{SP\ PRESS}$ = LPI Trip; setpoint 462 psig, decreasing.
(c) 2 out of 3 channels tripped = ESFAS Channels 3 & 4 Actuation

30.3 **Process Parameters for New Algorithm**

Actual in-plant setpoints are derived in OSC-8125, "Diverse High/Low Pressure Injection Actuation System Loop Uncertainty and Setpoint Determination"

Logical ID	Description	Parameter Range or Value	Reset Value	Units
P_m	Measured Reactor Coolant System Pressure in each ESFAS channel.	0 – 2500	N/A	psig
$P_{SP\ PRESS}$	ESFAS Diverse LPI Actuation Trip setpoint on decreasing pressure.	462 Automatically Trip on decreasing pressure	512 Automatically reset on increasing pressure	psig

30.4 **Design Features**

(For more information see AREVA Change Order number 2005-01.)

30.4.1 Non-Safety System

The system will be a combination of Safety and Non-Safety Related components. The TRIP relays which interface with the 24 VDC LPI actuation circuits will be safety related. The bistable devices, two out of three logic relays, BYPASS, OVERRIDE and annunciator circuits will be supplied as non-safety related. The Diverse LPI components in Cabinet 16 and the UB2 control switches will be wired for non-1E separation accordingly. The power for the bistables and relay logic will be non-safety related.

30.4.2 Automatic and Manual Actuation Capability

The DLPIAS will provide for automatic actuation of the Channel 3 and Channel 4 components. This includes LPI pumps, LPSW pumps and LPI Injection valves.

Manual initiation is accomplished with the existing Trip/Reset buttons located on the main control board. The logic for this manual trip bypasses the TXS logic and allows the Operator to initiate ES actuation on a per channel basis.

30.4.3 Equipment Quality

The quality of the components will be based on selection of known components that have a proven reliability. The relays and switches selected will be the same type as those supplied for the ES actuation circuits. The bistables will be standard commercial grade quality, similar as those provided for the RCPPM.

30.4.4 Actuate LPI on Low-Low RC Pressure

The DLPIAS is intended to provide automatic LPI injection in the case of a Loss of Coolant Accident (LOCA) concurrent with a common mode software failure of the TXS.

30.4.5 Accuracy

The Setpoint of the DLPIAS will be chosen to allow the ESFAS to actuate prior to actuation of the DLPIAS.

30.4.6 Minimize Inadvertent Actuation

The DLPIAS will require 2 out of 3 bistables to be tripped for an LPI actuation to occur. Actuation circuit relays are energized to actuate. Loss of 24 VDC control power will not result in actuation.

30.4.7 Diverse Hardware

Two-out-of-three bistables are required to trip to initiate an actuation. No software is required or provided for the DLPIAS.

30.4.8 Reactor Coolant Pressure Signals

The non-Safety Related Reactor Coolant Pressure signals fed into the DLPIAS will be isolated from the Safety Related Reactor Coolant Pressure signals utilizing the TXS SNV1 isolators. The signal isolation occurs in the Safety Related analog signal conditioning portion of the TXS, prior to the analog-to-digital conversion.

30.4.9 Power Source

The DLPIAS control power will be supplied from the 24 VDC Absopulse power supplies used for Channel E of the RPS. The Absopulse power supplies are non-safety related and are supplied from 120 VAC inverter 1KI, breaker 10. The Moore ECA (bistable) modules are powered directly from the same 120 VAC source.

30.4.10 Physical Separation

Physical separation will be maintained as it relates to IEEE-384 separation criteria between safety related and non-safety components. The bistables and relays will be DIN Rail mounted components.

30.4.11 Electrical Separation

Electrical separation between safety and non-safety will be maintained by the use of isolators and relays.

30.4.12 Safety to Non-Safety Isolation

Physical separation will be maintained in accordance with IEEE Std. 384-1992, IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits. Electrical separation between safety and non-safety will be maintained by the use of isolators and relays.

30.4.13 Equipment Qualification

All equipment associated with the DLPIAS system with the exception of the existing Reactor Coolant Pressure transmitters and cabling (which is Environmentally Qualified) is located in the Control Room (mild environment) and will be seismically mounted.

30.4.14 Operating Bypass or Maintenance Bypass

The Diverse LPI BYPASS/ENABLE pushbutton will be used to bypass the DLPIAS system during both maintenance and operation. Plant procedures will require that the DLPIAS be bypassed during controlled shutdowns at the same time the LPI Bypass is initiated for the ESFAS.

30.4.15 DLPIAS OVERRIDE

A separate OVERRIDE/RESET switch (maintained contacts) is provided as a redundant means of terminating a DLPIAS actuation.

30.4.16 DLPIAS Actuation

The Diverse LPI actuation shall go to completion once initiated. BYPASS and ENABLE are manual functions and will be controlled by procedure.

30.4.17 Information Display

The DLPIAS provides two annunciator alarms, "DIVERSE LPI TRIP" and "DIVERSE LPI BYPASSED". In addition, the Diverse LPI BYPASS switch includes a "BYPASSED" light on the switch and a "BISTABLE TRIPPED" light adjacent to the switch. The "BISTABLE TRIPPED" light provides indication to alert the operator if any/all bistables are tripped, prior to an operator resetting the DLPIAS on increasing Reactor Coolant pressure. A DLPIAS OVERRIDE light is provided to indicate the interposing relays are disabled.

30.4.18 Augmented Quality Program (GL85-06)

The DLPIAS non-Safety Related components do not require unique or special procurement requirements.

30.4.19 Software Quality Assurance

Not required for the DLPIAS design, since the analog system has no software.

30.4.20 Technical Specifications

Selected Licensee Commitments (SLC) will be developed to provide appropriate actions commensurate with other Diverse systems (DSS).

30.5 Safety Classification

The DLPIAS hardware is non-safety related with the exception of the interposing trip relays located in ESFAS cabinets 12 & 14, which are safety related isolation devices.

30.6 Response Time Requirements

The response time for the rack/processing equipment shall be < 500 ms. The channel response time does not include the sensor response time or the time required for the field devices to go to the ES position from the Non-ES position.

30.7 Input Signals

The RC pressure input signals are shared with ESFAS Functions #1 and #2. The pressure signals provided to the DLPIAS shall be provided independent of any TXS software elements. Pushbuttons are wetted from RPS Channel E 24 VDC power.

ID Code	Description	Physical Range	Electrical Range
New DLPIAS pushbutton #1 tag number (1LPIPB0074UB2)	DLPIAS ENABLE pushbutton	Binary	Contact input
New DLPIAS pushbutton #1 tag number (1LPIPB0074UB2)	DLPIAS BYPASS pushbutton	Binary	Contact input
New DLPIAS pushbutton #2 tag number (1LPIPB0075UB2)	DLPIAS OVERRIDE pushbutton	Binary	Contact input
Isolated Output (from section 15)	RC Pressure analog CH A	0 - 2500 psig	4 - 20 mADC
Isolated Output (from section 15)	RC Pressure analog CH B	0 - 2500 psig	4 - 20 mADC
Isolated Output (from section 15)	RC Pressure analog CH C	0 - 2500 psig	4 - 20 mADC

30.8 Output Signals

(Lights are powered from RPS Channel E 24 VDC power; statalarms provide 145 VDC to output contacts in RPS Channel E cabinet)

ID Code	Description	Physical Range	Electrical Range
New DLPIAS indication light #1 tag number (1LPILI0222UB2)	BISTABLE TRIPPED indicating light on 1UB2	Binary	24 VDC
New DLPIAS pushbutton #1 tag number (1LPIPB0074UB2)	BYPASSED light on pushbutton	Binary	24 VDC
New DLPIAS indicating light #2 tag number (1LPILI0223UB2)	OVERRIDE LIGHT on 1UB2	Binary	24 VDC
1SA1-58	DIVERSE LPI BYP	Binary	145 VDC
1SA1-59	DIVERSE LPI TRIP	Binary	145 VDC

30.9 **Actuated Field Devices (via TXS R_O contacts)**

(These outputs are shared with ESFAS Functional Trip #2).

Channel 3	Channel 4
1LPIPU0001 (LPI P1A) (ES Position Run)	1LPIPU0002 (LPI P1B) (ES Position Run)
1LP VA0017 (1LP-17) (ES Position Open)	1LP VA0018 (1LP-18) (ES Position Open)
0LPSPU000A (A LPSW PUMP) (ES Position Run)	0LPSPU000B (B LPSW PUMP) (ES Position Run)
0LPSPU000C (C LPSW PUMP) (ES Position Run)	0LPSPU000C (C LPSW PUMP) (ES Position Run)

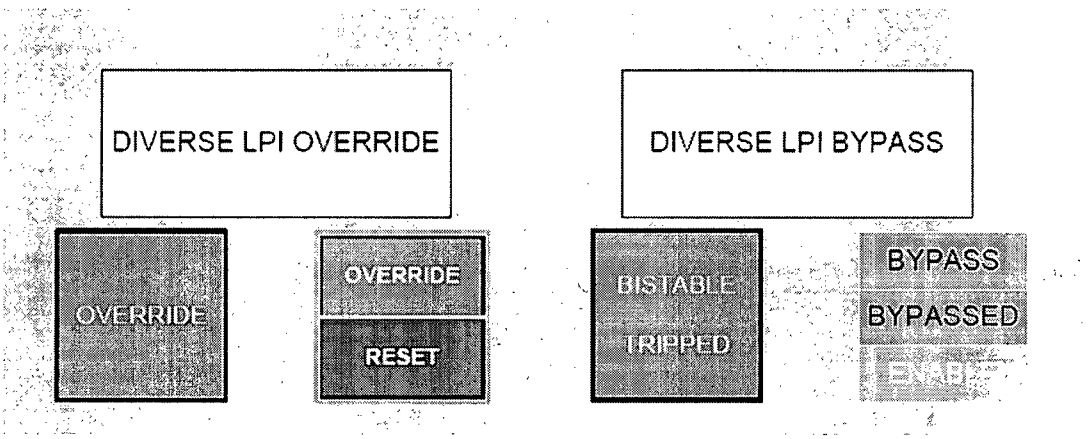
30.10 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

30.11 **References**

See Section 27.

30.12 **Diverse LPI BYPASS/ENABLE & OVERRIDE/RESET Pushbuttons & Lights Layout**



31.0 DIVERSE HIGH PRESSURE INJECTION ACTUATION SYSTEM

31.1 Diverse HPI Actuation System Features

The AREVA design includes the following features:

1. The non-safety related DHPIAS components are installed in Cabinet 16 (RPS Channel E).
2. Three Moore analog bistables which monitor the Wide Range RC pressure signals from ESFAS channels A, B & C. These are powered from 120 VAC supplied from 1KI breaker 10.
3. Two 1E interposing relays will be mounted in cabinet 12 (ODD voter) and cabinet 14 (EVEN voter), and powered from the 24 VDC power supplies in cabinet 16, RPS Channel E. These relays will be qualified for 1E/non-1E isolation. These relays will actuate Channel 1 and Channel 2 respectively, once at least 2 out of the 3 bistables are tripped.
4. A BYPASS/ENABLE pushbutton (mounted on 1UB1) will be installed. Depressing the BYPASS pushbutton will drop out the interposing Channel 1 & 2 actuation relays, disable the DHPIAS and light the BYPASSED amber LED on 1UB1. Depressing the ENABLE pushbutton will enable the DHPIAS and the amber BYPASSED LED will go out.
5. If one (or more) bistables are tripped, a red LED labeled BISTABLE TRIPPED will be lit on 1UB1.
6. An OVERRIDE/RESET pushbutton (mounted on 1UB1) will be installed. Depressing the OVERRIDE pushbutton will drop out the interposing Channel 1 & 2 actuation relays, disable the DHPIAS and light the OVERRIDE red LED on 1UB1. Depressing the RESET pushbutton will enable the interposing Channel 1 & 2 actuation relays and the OVERRIDE red LED will go out.

31.2 New Algorithm for DHPIAS Actuation Functions

Actual in-plant setpoints are derived in OSC-8125, "Diverse High/Low Pressure Injection Actuation System Loop Uncertainty and Setpoint Determination"

RCS Pressure Low

ALGORITHM

Channel Trip: $P_{m()} \leq P_{SP\ PRESS}$

(a) $P_{m()}$ = measured RCS pressure in each DHPIAS bistable.
(b) $P_{SP\ PRESS}$ = HPI Trip; setpoint 1550 psig, decreasing.
(c) 2 out of 3 channels tripped = ESFAS Channels 1 & 2 Actuation

31.3 Process Parameters for New Algorithm

Actual in-plant setpoints are derived in OSC-8125, "Diverse High/Low Pressure Injection Actuation System Loop Uncertainty and Setpoint Determination"

Logical ID	Description	Parameter Range or Value	Reset Value	Units
P_m	Measured Reactor Coolant System Pressure in each ESFAS channel.	0 – 2500	N/A	psig
$P_{SP\ PRESS}$	ESFAS Diverse HPI Actuation Trip setpoint on decreasing pressure.	1550 Automatically Trip on decreasing pressure	1600 Automatically reset on increasing pressure	psig

31.4 Design Features

(For additional information, see AREVA Change Order number 2007-02.)

31.4.1 Non-Safety System

The system will be a combination of Safety and Non-Safety Related components. The TRIP relays which interface with the 24 VDC HPI actuation circuits will be safety related. The bistable devices, two out of three logic relays, BYPASS, OVERRIDE and annunciator circuits will be supplied as non-safety related. The Diverse HPI components in Cabinet 16 and the UB1 control switches will be wired for non-1E separation accordingly. The power for the bistables and relay logic will be non-safety related.

31.4.2 Automatic and Manual Actuation Capability

The DHPIAS will provide for automatic actuation of the Channel 1 and Channel 2 components. This includes HPI pumps, HPI Injection valves and components listed in the table in Section 31.9. Manual initiation is accomplished with the existing Trip/Reset buttons located on the main control board. The logic for this manual trip bypasses the TXS logic and allows the Operator to initiate ES actuation on a per channel basis.

31.4.3 Equipment Quality

The quality of the components will be based on selection of known components that have a proven reliability. The relays and switches selected will be the same type as those supplied for the ES actuation circuits. The bistables will be standard commercial grade quality, similar as those provided for the RCPPM.

31.4.4 Actuate HPI on Low RC Pressure

The DHPIAS is primarily intended to provide automatic HPI injection in the case of a Loss of Coolant Accident (LOCA) concurrent with a common mode software failure of the TXS.

31.4.5 Accuracy

The Setpoint of the DHPIAS will be chosen to allow the ESFAS to actuate prior to actuation of the DHPIAS.

31.4.6 Minimize Inadvertent Actuation

The DHPIAS will require 2 out of 3 bistables to be tripped for an HPI actuation to occur. Actuation circuit relays are energized to actuate. Loss of 24 VDC control power will not result in actuation.

31.4.7 Diverse Hardware

Two-out-of-three bistables are required to trip to initiate an actuation. No software is required or provided for the DHPIAS.

31.4.8 Reactor Coolant Pressure Signals

The non-Safety Related Reactor Coolant Pressure signals fed into the DHPIAS will be isolated from the Safety Related Reactor Coolant Pressure signals utilizing the TXS SNV1 isolators. The signal isolation occurs in the Safety Related analog signal conditioning portion of the TXS, prior to the analog-to-digital conversion.

31.4.9 Power Source

The DHPIAS control power will be supplied from the 24 VDC Absopulse power supplies used for Channel E of the RPS. The Absopulse power supplies are non-safety related and are supplied from 120 VAC inverter 1KI, breaker 10. The Moore ECA (bistable) modules are powered directly from the same 120 VAC source.

31.4.10 Physical Separation

Physical separation will be maintained as it relates to IEEE-384 separation criteria between safety related and non-safety components. The bistables and relays will be DIN Rail mounted components.

31.4.11 Electrical Separation

Electrical separation between safety and non-safety will be maintained by the use of isolators and relays.

31.4.12 Safety to Non-Safety Isolation

Physical isolation will be maintained in accordance with IEEE Std. 384-1992, IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits. Electrical isolation between safety and non-safety will be maintained by the use of isolators and relays.

31.4.13 Equipment Qualification

All equipment associated with the DHPIAS system with the exception of the existing Reactor Coolant Pressure transmitters and cabling (which is Environmentally Qualified) is located in the Control Room (mild environment).

31.4.14 Operating Bypass or Maintenance Bypass

The Diverse HPI BYPASS/ENABLE pushbutton will be used to bypass the DHPIAS system during both maintenance and operation. Plant procedures will require that the

DHPIAS be bypassed during controlled shutdowns at the same time the HPI Bypass is initiated for the ESFAS.

31.4.15 DHPIAS OVERRIDE

A separate OVERRIDE/RESET switch (maintained contacts) is provided as a redundant means of terminating a DHPIAS actuation.

31.4.16 DHPIAS Actuation

The Diverse HPI actuation shall go to completion once initiated. BYPASS and ENABLE are manual functions and will be controlled by procedure.

31.4.17 Information Display

The DHPIAS provides two annunciator alarms, "DIVERSE HPI TRIP" and "DIVERSE HPI BYPASSED". In addition, the Diverse HPI BYPASS switch includes a "BYPASSED" light on the switch and a "BISTABLE TRIPPED" light adjacent to the switch. The "BISTABLE TRIPPED" light provides indication to alert the operator if any/all bistables are tripped, prior to an operator resetting the DHPIAS on increasing Reactor Coolant pressure. A DHPIAS OVERRIDE light is provided to indicate the interposing relays are disabled.

31.4.18 Augmented Quality Program (GL85-06)

The DHPIAS non-Safety Related components do not require unique or special procurement requirements.

31.4.19 Software Quality Assurance

Not required for the DHPIAS design, since the analog system has no software.

31.4.20 Technical Specifications

Selected Licensee Commitments (SLC) will be developed to provide appropriate actions commensurate with other Diverse Systems (DSS).

31.5 Safety Classification

The DHPIAS hardware is non-safety related with the exception of the interposing trip relays located in ESFAS cabinets 12 & 14, which are safety related isolation devices.

31.6 Response Time Requirements

The response time for the rack/processing equipment shall be < 500 ms. The channel response time does not include the sensor response time or the time required for the field devices to go to the ES position from the Non-ES position.

31.7 Input Signals

The RC pressure input signals are shared with ESFAS Functions #1 and #2. The pressure signals provided to the DHPIAS shall be provided independent of any TXS software elements. Pushbuttons are wetted from RPS Channel E 24 VDC power.

ID Code	Description	Physical Range	Electrical Range
New DHPIAS pushbutton #1 tag number (1HPIPB0076UB1)	DHPIAS ENABLE pushbutton	Binary	Contact input
New DHPIAS pushbutton #1 tag number (1HPIPB0076UB1)	DHPIAS BYPASS pushbutton	Binary	Contact input
New DHPIAS pushbutton #2 tag number (1HPIPB0077UB1)	DHPIAS OVERRIDE pushbutton	Binary	Contact input
Isolated Output (from section 15)	RC Pressure analog CH A	0 2500 psig	4 - 20 mADC
Isolated Output (from section 15)	RC Pressure analog CH B	0 - 2500 psig	4 - 20 mADC
Isolated Output (from section 15)	RC Pressure analog CH C	0 - 2500 psig	4 - 20 mADC

31.8 Output Signals

(Lights are powered from RPS Channel E 24 VDC power; statalarms provide 145 VDC to output contacts in RPS Channel E cabinet)

ID Code	Description	Physical Range	Electrical Range
New DHPIAS indication light #1 tag number (1HPILI0224UB1)	BISTABLE TRIPPED indicating light on 1UB1	Binary	24 VDC
New DHPIAS pushbutton #1 tag number (1HPIPB0076UB1)	BYPASSED light on pushbutton	Binary	24 VDC
New DHPIAS indicating light #2 tag number (1HPILI0225UB1)	OVERRIDE LIGHT on 1UB1	Binary	24 VDC
1SA1-56	DIVERSE HPI BYP	Binary	145 VDC
1SA1-57	DIVERSE HPI TRIP	Binary	145 VDC

31.9 **Actuated Field Devices (via TXS R_O contacts)**

(These outputs are shared with ESFAS Functional Trip #1).

Channel 1	Channel 2
1HPIPU0001 (HPI P1A) (ES Position Run)	1HPIPU0002 (HPI P1B) (ES Position Run)
1HPIPU0002 (HPI P1B) (ES Position Run)	1HPIPU0003 (HPI P1C) (ES Position Run)
1HP VA0024 (1HP-24) (ES Position Open)	1HP VA0025 (1HP-25) (ES Position Open)
1HP VA0026 (1HP-26) (ES Position Open)	1HP VA0027 (1HP-27) (ES Position Open)
1HP VA0003 (1HP-3) (ES Position Closed)	1HP VA0005 (1HP-5) (ES Position Closed)
1HP VA0004 (1HP-4) (ES Position Closed)	1HP VA0021 (1HP-21) (ES Position Closed)
1HP VA0020 (1HP-20) (ES Position Closed)	1GWD VA0013 (1GWD-13) (ES Position Closed)
KHU 1 (Keowee CH A) (ES EMERG START)	1LWD VA0002 (1LWD-2) (ES Position Closed)
KHU 2 (Keowee CH A) (ES EMERG START)	KHU 1 (Keowee CH B) (ES EMERG START)
STBY Bus (SK 1) (ES Position FDR Closed)	KHU 2 (Keowee CH B) (ES EMERG START)
Load Shed (ES Position Complete)	STBY Bus (SK 2) (ES Position FDR Closed)
STBY Bkr 1 (S1 1) (ES Position Closed)	Load Shed (ES Position Complete)
	STBY Bkr 2 (S2 1) (ES Position Closed)
1GWD VA0012 (1GWD-12) (ES Position Closed)	1CS VA0006 (1CS-6) (ES Position Closed)
1LWD VA0001 (1LWD-1) (ES Position Closed)	1PR VA0002 (1PR-2) (ES Position Closed)
1CS VA0005 (1CS-5) (ES Position Closed)	1PR VA0003 (1PR-3) (ES Position Closed)
1PR VA0001 (1PR-1) (ES Position Closed)	1PR VA0004 (1PR-4) (ES Position Closed)
1PR VA0006 (1PR-6) (ES Position Closed)	1PR VA0005 (1PR-5) (ES Position Closed)
1PR VA0007 (1PR-7) (ES Position Closed)	1PR VA0008 (1PR-8) (ES Position Closed)
1PR VA0009 (1PR-9) (ES Position Closed)	1PR VA0010 (1PR-10) (ES Position Closed)
1RC VA0005 (1RC-5) (ES Position Closed)	1RC VA0007 (1RC-7) (ES Position Closed)
1RC VA0006 (1RC-6) (ES Position Closed)	1FDW VA0106 (1FDW-0106) (ES Position Closed)
1FDW VA0105 (1FDW-105) (ES Position Closed)	1FDW VA0108 (1FDW-108) (ES Position Closed)
1FDW VA0107 (1FDW-107) (ES Position Closed)	1FDW VA0103 (1FDW-103) (ES Position Closed)
	1FDW VA0104 (1FDW-104) (ES Position Closed)

31.10 **New Statalarm Panel Changes**

Statalarm Panel changes are shown in Section 22.

31.11 **References**

See Section 27.

31.12 **Diverse HPI BYPASS/ENABLE & OVERRIDE/RESET Pushbuttons & Lights Layout**