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**Date:** Wed, Nov 2, 2005 7:32 PM  
**Subject:** AP1000 DCD Flow Sensor Changes and Response

Attached is an updated file of the Tier 1 and Tier 2 changes associated with the hot leg elbow tap flow sensor. This includes the corrections and withdrawal of changes discussed earlier.

The following presents our discussion of the hydraulic connection of the flow transmitters to the hot leg piping.

#### AP1000 Hot leg Elbow Tap Flow Measurement of Reactor Coolant Flow

The AP1000 revised method for the measurement of reactor coolant flow for reactor protection purposes uses taps located on the inside and outside radii of the elbow between the hot leg and the steam generator primary side inlet nozzle. Four differential pressure transmitters (one for each Protection and Safety Monitoring System division) share a common tap located on the outside radius of the elbow, the high pressure side of the fluid stream as it turns in the elbow. A leak in the sensing line would cause the differential pressure and, therefore, the measured flow to be less than the actual process value. This is in the conservative or safe direction since the reactor trip function occurs if the measured flow is less than a predetermined value.

The four transmitters share two inside radius taps, with two transmitters connected to each tap, that are connected the inside radius of the elbow. This is the low pressure side of the fluid stream as it turns in the elbow. A leak in the sensing line would cause the differential pressure and, therefore, the measured flow to be more than the actual process value. While this could cause two divisions to not trip when required to provide protection, the other two channels would trip as required because their common sensing line would be unaffected by the leak.

While infrequent, the reactor protection system can operate for short periods of time with a channel bypassed due to testing, repair or other activities. Should a leak occur at this time in the high pressure sensing line serving the two transmitters connected to the other tap, there might not be sufficient redundancy to actuate a required reactor trip. This is a very unlikely event, however. First, a leak would have to occur in one of the two sensing lines. Second, the event would have to go undetected until a loss of reactor coolant flow accident occurred. This is very unlikely because any significant difference between redundant instrument channels would be detected immediately by the continually operating diagnostics within the Protection and Safety Monitoring System that compare redundant channel measurements. In addition, the operators are required by Technical Specification Surveillance Requirement 3.3.1.1 to compare redundant channels at least every 12 hours. In practice, such checks are actually performed once per shift or about every eight hours. Finally, any leak large enough to cause a significant measurement error would be large enough to be detected by the leakage monitoring system. Therefore, it is not credible to postulate a leaking reactor coolant flow sensing line with an inoperable protection channel when protection might be required for a loss of reactor coolant flow event.

Based on our review of IEEE-603 the tap and sensing line arrangement is not inconsistent with the guidance of IEEE-603.

If you have any more questions please call

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**Tier 1 Table 2.1.2-1**

**Tier 2 Table 3.2-3, Table 3.11-1, Subsections 5.4.3.2.1, 5.4.3.2.3, 7.2.1.1.3, Table 7.2-2, Subsections 9A.3.1.1.7, 9A.3.1.1.8, Table 9A-2, Subsections 14.2.9.1.1, 14.2.10.1.17, 14.2.10.4.11, Table 15.0-4a, Subsections 15.3.1.1, 15.3.2.1, Table 15.3-1, Figures 15.3.1-2 through 15.3.1-6, Figures 15.3.3-3 through 15.3.3-7 and Technical Specification (Section 16.1) Table 3.3.1, Subsection 3.4.1 and Bases Subsections 3.3.1 and 3.4.1**

**Tier 2 Figure 5.1-3, Figure 5.1-5 (Sheet 1 of 3), and Figure 7.2-1 (Sheet 5 of 20)**

**Reactor Coolant System Flow Sensor**

**Description of Change**

This change deletes the RCS flow velocity probe and replaces it with a flow signal derived from the hot leg elbow. In Tier 1 Table 2.1.2-1. Cold leg flow signals are also added for indication and recording to facilitate compliance with Technical Surveillance Requirements to periodically measure reactor coolant flow.

References in Tier 2 text and tables to the cold leg flow signals are also changed to hot leg signals to be consistent with Tie 1 changes. Chapter 15 Figures related to analysis of partial loss of forced reactor coolant flow and the locked rotor event are also revised. The RCS loop layout, RCS P&ID, and the protection system functional diagram that show the flow instruments are revised.

**Technical Justification**

The AP1000 design uses a velocity probe to measure RCS flow. Experience with this type of probe has shown that there may be noise problems and signal to noise ratio with this type of flow sensor. The method to measure RCS flow is to be changed to elbow tap similar to the method typically used in operating nuclear power plants.

There is a small impact on the analysis results of partial loss of forced reactor coolant flow (Subsection 15.3.1) since reactor trip will be on low hot leg flow instead of low cold leg flow. Since AP1000 hot leg flow is the total of two cold legs, the reactor trip will be somewhat slower (less sensitive to trip of a cold leg pump). The acceptance criteria for the partial loss of flow event continue to be met with margin. The more limiting complete loss of forced reactor coolant flow event (Subsection 15.3.2) is not impacted. There is a very small impact on the locked rotor event (Subsection 15.3.3), but the acceptance criteria continue to be met with a wide margin. The time for the hot leg to drop to 87% flow is approximately 1.0 seconds slower for a trip of two reactor coolant pumps, and approximately 0.067 seconds slower for a locked rotor.

**Regulatory Consequence**

The design function of RCS flow measurement and the use of the flow measurement signals have not changed. This change affects only the technology used to perform the measurement. Analysis methods that use a reactor flow parameter are not changed. The impact on the analyses of partial loss of flow, complete loss of forced reactor coolant flow, and locked rotor is not adverse since acceptance criteria are met. The conclusions of the FSER write-up are not affected.

**Change Markup**

**Tier 1 Table 2.1.2-1 - Revise Tier 1 Table 2.1.2-1 (beginning on the fifth page of the table) as shown on the following pages.**

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Table 2.1.2-1 (cont.)									
Equipment Name	Tag No.	ASME Code Section III	Seismic Cat. I	Remotely Operated Valve	Class 1E/Qual. for Harsh Envir.	Safety-Related Display	Control PMS/DAS	Active Function	Loss of Motive Power Position
RCS Cold-Hot Leg 1A Flow Sensor	RCS-101A	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Hot Leg 1A Flow Sensor	RCS-101B	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Hot Leg 1A Flow Sensor	RCS-101C	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Hot Leg 1A Flow Sensor	RCS-101D	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Hot Leg 2+B Flow Sensor	RCS-102A	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Hot Leg 2+B Flow Sensor	RCS-102B	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Hot Leg 2+B Flow Sensor	RCS-102C	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Hot Leg 2+B Flow Sensor	RCS-102D	-	Yes	-	Yes/No Yes	No	-/-	-	-
RCS Cold-Leg-2A Flow Sensor	RCS-103A	-	Yes	-	Yes/Yes	No	+	-	-
RCS Cold-Leg-2A Flow Sensor	RCS-103B	-	Yes	-	Yes/Yes	No	+	-	-
RCS Cold-Leg-2A Flow Sensor	RCS-103C	-	Yes	-	Yes/Yes	No	+	-	-
RCS Cold-Leg-2A Flow Sensor	RCS-103D	-	Yes	-	Yes/Yes	No	+	-	-

Note: Dash (-) indicates not applicable.

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Table 2.1.2-1 (cont.)									
Equipment Name	Tag No.	ASME Code Section III	Seismic Cat. I	Remotely Operated Valve	Class 1E/Qual. for Harsh Envir.	Safety-Related Display	Control PMS/DAS	Active Function	Loss of Motive Power Position
RCS Cold Leg 2B Flow Sensor	RCS-104A	-	Yes	-	Yes/Yes	No	+	-	-
RCS Cold Leg 2B Flow Sensor	RCS-104B	-	Yes	-	Yes/Yes	No	+	-	-
RCS Cold Leg 2B Flow Sensor	RCS-104C	-	Yes	-	Yes/Yes	No	+	-	-
RCS Cold Leg 2B Flow Sensor	RCS-104D	-	Yes	-	Yes/Yes	No	+	-	-
RCS Cold Leg 1A Narrow Range Temperature Sensor	RCS-121A	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg 1B Narrow Range Temperature Sensor	RCS-121B	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg 1B Narrow Range Temperature Sensor	RCS-121C	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg 1A Narrow Range Temperature Sensor	RCS-121D	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg 2B Narrow Range Temperature Sensor	RCS-122A	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg 2A Narrow Range Temperature Sensor	RCS-122B	-	Yes	-	Yes/Yes	No	-/-	-	-

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Tier 2 Table 3.2-3 Revise Tier 2 Table 3.2-3, sheets 22 and 23 of 65, as follows:

Table 3.2-3 (Sheet 22 of 65)					
<b>AP1000 CLASSIFICATION OF MECHANICAL AND FLUID SYSTEMS, COMPONENTS, AND EQUIPMENT</b>					
Tag Number	Description	AP1000 Class	Seismic Category	Principal Construction Code	Comments
<b>Reactor Coolant System (Continued)</b>					
RCS-PL-V014D	Fourth Stage ADS Isolation	A	I	ASME III-1	
RCS-PL-V095	Hot Leg 2 Level Instrument Root	B	I	ASME III-2	
RCS-PL-V096	Hot Leg 2 Level Instrument Root	B	I	ASME III-2	ADS Test Valve
RCS-PL-V097	Hot Leg 1 Level Instrument Root	B	I	ASME III-2	
RCS-PL-V098	Hot Leg 1 Level Instrument Root	B	I	ASME III-2	
RCS-PL-V101A	Cold-Hot Leg 1A Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V101B	Cold-Hot Leg 1A Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V101C	Cold-Hot Leg 1A Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V101D	Cold-Hot Leg 1A Flow Meter Instrument Root	B	I	ASME III-2	
RCS PL V101E	Cold-Hot Leg 1A Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V101F	Hot Leg 1 Flow Instrument Root	B	I	ASME III-2	
RCS-PL-V102A	Cold-Hot Leg 1B2 Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V102B	Cold-Hot Leg 1B2 Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V102C	Cold-Hot Leg 1B2 Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V102D	Cold-Hot Leg 1B2 Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V102E	Cold-Hot Leg 1B-2 Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V102F	Hot Leg 2 Flow Instrument Root	B	I	ASME III-2	
RCS-PL-V171A+0 3A	Cold Leg 2A-1A Flow Meter Bend Instrument Root	B	I	ASME III-2	
RCS-PL-V171B+0 3B	Cold Leg 2A-1A Flow Meter Bend Instrument Root	B	I	ASME III-2	
RCS-PL-V172A+0 3C	Cold Leg 2A-1B Flow Meter Bend Instrument Root	B	I	ASME III-2	

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Table 3.2-3 (Sheet 23 of 65)

**AP1000 CLASSIFICATION OF MECHANICAL AND  
FLUID SYSTEMS, COMPONENTS, AND EQUIPMENT**

Tag Number	Description	AP1000 Class	Seismic Category	Principal Construction Code	Comments
<b>Reactor Coolant System (Continued)</b>					
RCS-PL-V172B40 3D	Cold Leg 2A-1B Flow Meter Bend Instrument Root	B	I	ASME III-2	
RCS-PL-V103E	Cold Leg 2A Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V173A40 4A	Cold Leg 2B-2A Bend Flow Meter-Instrument Root	B	I	ASME III-2	
RCS-PL-V173B40 4B	Cold Leg 2B-2A Bend Flow Meter-Instrument Root	B	I	ASME III-2	
RCS-PL-V174A40 4C	Cold Leg 2B Bend Flow Meter-Instrument Root	B	I	ASME III-2	
RCS-PL-V174B40 4D	Cold Leg 2B Bend Flow Meter-Instrument Root	B	I	ASME III-2	
RCS-PL-V104E	Cold Leg 2B Flow Meter Instrument Root	B	I	ASME III-2	
RCS-PL-V108A	Hot Leg 1 Sample Isolation	B	I	ASME III-2	
RCS-PL-V108B	Hot Leg 2 Sample Isolation	B	I	ASME III-2	
RCS-PL-V110A	Pressurizer Spray Valve	A	I	ASME III-1	
RCS-PL-V110B	Pressurizer Spray Valve	A	I	ASME III-1	
RCS-PL-V111A	Pressurizer Spray Block Valve	A	I	ASME III-1	
RCS-PL-V111B	Pressurizer Spray Block Valve	A	I	ASME III-1	
RCS-PL-V120	Reactor Vessel Flange Leakoff	D	NS	ANSI B31.1	
RCS-PL-V121	Reactor Vessel Flange Leakoff	D	NS	ANSI B31.1	
RCS-PL-V122A	Reactor Vessel Flange Leakoff	D	NS	ANSI B31.1	
RCS-PL-V122B	Reactor Vessel Flange Leakoff	D	NS	ANSI B31.1	
RCS-PL-V150A	Reactor Vessel Head Vent	A	I	ASME III-1	
RCS-PL-V150B	Reactor Vessel Head Vent	A	I	ASME III-1	
RCS-PL-V150C	Reactor Vessel Head Vent	A	I	ASME III-1	
RCS-PL-V150D	Reactor Vessel Head Vent	A	I	ASME III-1	



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Tier 2 Table 3.11-1 Revise Tier 2 Table 3.11-1, sheet 12 of 45, as follows:

Table 3.11-1 (Sheet 12 of 45)

**ENVIRONMENTALLY QUALIFIED ELECTRICAL AND MECHANICAL EQUIPMENT**

Description	AP1000 Tag No.	Envir. Zone (Note 2)	Function (Note 1)	Operating Time Required (Note 5)	Qualification Program (Note 6)
<b>TRANSMITTERS</b>					
PCS Water Delivery Flow	PCS JE FT 001	9	PAMS	2 wks	E
PCS Water Delivery Flow	PCS JE FT 002	9	PAMS	2 wks	E
PCS Water Delivery Flow	PCS JE FT 003	9	PAMS	2 wks	E
PCS Water Delivery Flow	PCS JE FT 004	9	PAMS	2 wks	E
PCS Storage Tank Water Level	PCS JE LT 010	9	PAMS	2 wks	E
PCS Storage Tank Water Level	PCS JE LT 011	9	PAMS	2 wks	E
PRHR HX Flow	PXS JE FT 049A	1	PAMS	4 mos	E *
PRHR HX Flow	PXS JE FT 049B	1	PAMS	4 mos	E *
RCS ColdHot Leg 1A Flow	RCS JE FT 101A	1	RT	Note 3	E
RCS ColdHot Leg 1A Flow	RCS JE FT 101B	1	RT	Note 3	E
RCS ColdHot Leg 1A Flow	RCS JE FT 101C	1	RT	Note 3	E
RCS ColdHot Leg 1A Flow	RCS JE FT 101D	1	RT	Note 3	E
RCS ColdHot Leg 1B2 Flow	RCS JE FT 102A	1	RT	Note 3	E
RCS ColdHot Leg 1B2 Flow	RCS JE FT 102B	1	RT	Note 3	E
RCS ColdHot Leg 1B2 Flow	RCS JE FT 102C	1	RT	Note 3	E
RCS ColdHot Leg 1B2 Flow	RCS JE FT 102D	1	RT	Note 3	E
<del>RCS Cold Leg 2A Flow</del>	<del>RCS JE FT 103A</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
<del>RCS Cold Leg 2A Flow</del>	<del>RCS JE FT 103B</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
<del>RCS Cold Leg 2A Flow</del>	<del>RCS JE FT 103C</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
<del>RCS Cold Leg 2A Flow</del>	<del>RCS JE FT 103D</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
<del>RCS Cold Leg 2B Flow</del>	<del>RCS JE FT 104A</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
<del>RCS Cold Leg 2B Flow</del>	<del>RCS JE FT 104B</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
<del>RCS Cold Leg 2B Flow</del>	<del>RCS JE FT 104C</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
<del>RCS Cold Leg 2B Flow</del>	<del>RCS JE FT 104D</del>	<del>1</del>	<del>RT</del>	<del>Note 3</del>	<del>E</del>
SG1 Startup Feedwater Flow	SGS JE FT 055A	2	ESF PAMS	5 min 2 wks	E
SG1 Startup Feedwater Flow	SGS JE FT 055B	2	ESF PAMS	5 min 2 wks	E
SG2 Startup Feedwater Flow	SGS JE FT 056A	2	ESF PAMS	5 min 2 wks	E
SG2 Startup Feedwater Flow	SGS JE FT 056B	2	ESF PAMS	5 min 2 wks	E
Plant Vent Flow	VFS JE FT 101	7	PAMS	2 wks	E +

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Revise the tenth bullet of subsection 5.4.3.2.1 as follows:

**5.4.3.2.1 Piping Elements**

- ~~Reactor coolant velocity head measurement probe, p~~Pressurizer spray scoop, reactor coolant temperature element installation boss, and the temperature element well itself

Delete the second bullet of subsection 5.4.3.2.3 as follows:

**5.4.3.2.3 Encroachment into Coolant Flow**

- ~~The velocity head probe for flow indicators protrudes into the cold leg piping.~~

Revise the fourth subsections of subsection 7.2.1.1.3 as follows:

**7.2.1.1.3 Core Heat Removal Trips**

**Reactor Trip on Low Reactor Coolant Flow**

This trip protects against departure from nucleate boiling in the event of low reactor coolant flow. ~~Pitot tubes in each reactor coolant cold leg are used to measure reactor coolant flow.~~ Flow in each hot leg is measured at the hot leg elbow. The trip on low flow in ~~any single cold~~ either hot leg is automatically blocked when reactor power is below the P-8 permissive setpoint, and the trip on low flow in ~~multiple cold~~ both hot legs is automatically blocked when reactor power is below the P-10 permissive setpoint. This enhances reliability by preventing unnecessary reactor trips. The two trip functions are automatically reset when reactor power is above the P-8 and P-10 setpoints.

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**Tier 2 Table 7.2-2** Revise the 12th entry of Table 7.2-2, sheet 1 of 2, as follows:

Table 7.2-2 (Sheet 1 of 2)				
REACTOR TRIPS				
Reactor Trip <sup>(1)</sup>	No. of Channels	Division Trip Logic	Bypass Logic	Permissives and Interlocks (See Table 7.2-3)
Low Reactor Coolant Flow	4-8 (4/cold-hot leg)	2/4 in any single cold either hot leg	Yes <sup>(2)</sup>	P-8
		2/4 in 2/4-cold both legs	Yes <sup>(2)</sup>	P-10

Revise the next-to-last paragraph of subsection 9A.3.1.1.7 as follows:

**9A.3.1.1.7 Fire Zone 1100 AF 11300A**

The redundant reactor coolant system cold-hot leg flow instrumentation located in fire zones 1100 AF 11300B and 1100 AF 11301 is sufficient to perform applicable functions to achieve and maintain safe shutdown.

**9A.3.1.1.8 Fire Zone 1100 AF 11300B**

Revise the fifth-to-last paragraph of subsection 9A.3.1.1.8 as follows:

The redundant reactor coolant system cold-hot leg flow instrumentation located in fire zones 1100 AF 11300A and 1100 AF 11301 is sufficient to perform applicable functions to achieve and maintain safe shutdown.

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**Tier 2 Table 9A-2** Revise Tier 2 Table 9A-2, sheets 2, 3, and 5 of 14, as follows:

Table 9A-2 (Sheet 2 of 14)						
SAFE SHUTDOWN COMPONENTS						
Fire Area/ Fire Zone	System	Description	Class 1E Division			
			A	C	B	D
1000 AF 01/ 1100 AF 11300A	PSS	Containment Air Sample Cont. Isolation Valve			V008	
		Liquid Sample Line Cont. Isolation Valve			V010A	V010B
	RCS	Cold-Hot Leg 2A Flow			FT- 103B102B	FT- 103D102D
		Cold Leg 2B Flow			FT-104B	FT-104D
	VFS	Containment Purge Discharge Cont. Isolation Valve				V009
	VFS	Containment Purge Inlet Cont. Isolation Valve				V004
	PXS	IRWST Level			LT-046	LT-048
		IRWST Gutter Isolation Valve			V130A	V130B
		Core Makeup Tank (MT-02A)				
	PCS	Containment Pressure			PT-006	PT-008
	SGS	Steam Generator 2 Wide Range Level			LT-014	LT-018
	1000 AF 01/ 1100 AF 11300B	CCS	Outlet Line Cont. Isolation Valve	V207		
CVS		Letdown Containment Isolation Valve	V045			
		Makeup Line Cont. Isolation Valve	V091			
		RCS Purification Stop Valve (RCPB)	V001	V002		

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Table 9A-2 (Sheet 3 of 14)

**SAFE SHUTDOWN COMPONENTS**

Fire Area/ Fire Zone	System	Description	Class 1E Division			
			A	C	B	D
1000 AF 01/ 1100 AF 11300B	IDS	Class 1E Electrical Penetrations	EY-P11Z	EY-P27Z		
		Class 1E Electrical Penetrations	EY-P12Y	EY-P29Y		
		Class 1E Electrical Penetrations	EY-P13Y	EY-P28Y		
		Class 1E Cable Trays	Note 1	Note 1		
	PCS	Containment Pressure	PT-005	PT-007		
	PXS	PRHR Heat Exchanger Control Valve		V108B	V108A	
		IRWST Level	LT-045	LT-047		
		Core Makeup Tank (MT-02B)				
	RCS	Pressurizer Pressure	PT-191A	PT-191C		
		Reference Leg Temperature	TE-193A	TE-193C		
		Pressurizer Level	LT-195A	LT-195C		
		PRHR Heat Exchanger Outlet Temperature		TE-161		
		ColdHot Leg 1A Flow	FT-101A	FT-101C		
		ColdHot Leg 1B2 Flow	FT-102A	FT-102C		
		Cold Leg 2A Flow	FT-103A	FT-103C		
		Cold Leg 2B Flow	FT-104A	FT-104C		
	SGS	Steam Generator 1 Narrow Range Level	LT-001	LT-003		
		Steam Generator 2 Narrow Range Level	LT-005	LT-007		
		Steam Generator 2 Wide Range Level	LT-013	LT-017		

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Table 9A-2 (Sheet 5 of 14)

**SAFE SHUTDOWN COMPONENTS**

Fire Area/ Fire Zone	System	Description	Class 1E Division			
			A	C	B	D
1000 AF 01/ 1100 AF 11301	RCS	Hot Leg 1 Temperature (Wide Range)		TE-135A		
		Pressurizer Pressure			PT-191B	PT-191D
		Reference Leg Temperature			TE-193B	TE-193D
		Pressurizer Level			LT-195B	LT-195D
		RCP Shaft Speed	ST-281	ST-282		
		Cold Hot Leg 1A Flow			FT-101B	FT-101D
		Cold Leg 1B Flow			FT-102B	FT-102D
	SGS	Steam Generator 1 Wide Range Level			LT-012	LT-016
1000 AF 01/ 1100 AF 11302	RCS	RCP 2A Bearing Water Temperature	TE-213A	TE-213C	TE-213B	TE-213D
		RCP 2B Bearing Water Temperature	TE-214A	TE-214C	TE-214B	TE-214D
		Cold Leg 2B Temper- ature (Narrow Range)	TE-122A			TE-122D
		Cold Leg 2A Temper- ature (Narrow Range)		TE-122C	TE-122B	
		Cold Leg 2A Temper- ature (Wide Range)			TE-125B	
		Cold Leg 2B Temper- ature (Wide Range)				TE-125D
		Hot Leg 2 Temperature (Narrow Range)			TE-131B	TE-131D
		Hot Leg 2 Temperature (Narrow Range)			TE-132B	TE-132D
		Hot Leg 2 Temperature (Narrow Range)			TE-133B	TE-133D
		Hot Leg 2 Temperature (Wide Range)			TE-135B	
		RCP Shaft Speed			ST-283	ST-284

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Revise part (g) of the "General Test Method and Acceptance Criteria" subsection of subsection 14.2.9.1.1 as follows:

**14.2.9.1.1 Reactor Coolant System Testing**

**General Test Method and Acceptance Criteria**

- g) Proper calibration and operation of safety-related instrumentation, controls, actuation signals and interlocks are verified. This testing includes the following:
- Hot leg and cold leg resistance temperature detectors
  - ~~Cold leg~~ Flow instrumentation at selected locations in the reactor coolant loop
  - Reactor coolant system wide range pressure transmitters
  - Hot leg level instruments
  - Pressurizer pressure and level instruments
  - Reactor coolant pump bearing water temperature detectors
  - Reactor coolant pump speed sensor instruments
  - Reactor vessel head vent valve controls

This testing includes demonstration of proper actuation of safety-related functions from the main control room.

Revise the "Test Method" subsection of subsection 14.2.10.1.17 as follows:

**14.2.10.1.17 Reactor Coolant System Flow Measurement**

**Prerequisites**

- The core is installed and the plant is at normal operating temperature and pressure.
- Special instrumentation is installed and calibrated for obtaining reactor coolant flow ~~velocity head~~ data.

**Test Method**

- Prior to initial criticality, measure the reactor coolant flow measurement parameters ~~velocity head~~ with all four coolant pumps in operation. Estimate the reactor coolant flow rate using these data.

Revise the "Test Method" subsection of subsection 14.2.10.4.11 as follows:

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**14.2.10.4.11 Reactor Coolant System Flow Measurement at Power Conditions**

**Test Method**

With the reactor at steady-state power greater than 75 percent and up to and including 100 percent of rated thermal power, measure the reactor thermal power and coolant inlet and outlet temperatures. Determine the reactor coolant flow rate using the data in conjunction with hydraulic analysis of differential pressures at different locations in the reactor coolant system.

**Tier 2 Table 15.0-4a** Revise the 9th entry of Table 15.0-4a, sheet 1 of 2, as follows:

Table 15.0-4a (Sheet 1 of 2)		
<b>PROTECTION AND SAFETY MONITORING SYSTEM SETPOINTS AND TIME DELAY ASSUMED IN ACCIDENT ANALYSES</b>		
Function	Limiting Setpoint Assumed in Analyses	Time Delays (seconds)
Reactor trip on low reactor coolant flow in <del>any cold</del> either hot leg	87% loop flow	1.45

Revise the fourth paragraph of subsection 15.3.1.1 as follows:

**15.3.1.1 Identification of Causes and Accident Description**

Protection against this event is provided by the low primary coolant flow reactor trip signal, which is actuated by two-out-of-four low-flow signals. Above permissive P8, low flow in ~~any one cold~~ either hot leg actuates a reactor trip (see Section 7.2). Between approximately 10-percent power (permissive P10) and the power level corresponding to permissive P8, low flow in ~~any two cold~~ both hot legs actuates a reactor trip.

Revise the last paragraph of subsection 15.3.2.1 as follows:

**15.3.2.1 Identification of Causes and Accident Description**

A complete loss of flow accident is a Condition III event (an infrequent fault), as defined in subsection 15.0.1. The following signals provide protection against this event:

- Reactor coolant pump underspeed
- Low reactor coolant loop flow

The reactor trip on low primary coolant loop flow is provided to protect against loss of flow conditions that affect only one or two reactor coolant loop cold legs. This function is



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generated by two-out-of-four low-flow signals per reactor coolant loop cold-hot leg. Above permissive P8, low flow in ~~any loop~~ either hot leg actuates a reactor trip. Between approximately 10-percent power (permissive P10) and the power level corresponding to permissive P8, low flow in ~~any two~~ both reactor coolant loop cold-hot legs actuates a reactor trip. If the maximum grid frequency decay rate is less than approximately 2.5 hertz per second, this trip function also protects the core from this underfrequency event. This effect is described in WCAP-8424, Revision 1 (Reference 3).

Revise the first paragraph of subsection 15.3.3.2.2 as follows:

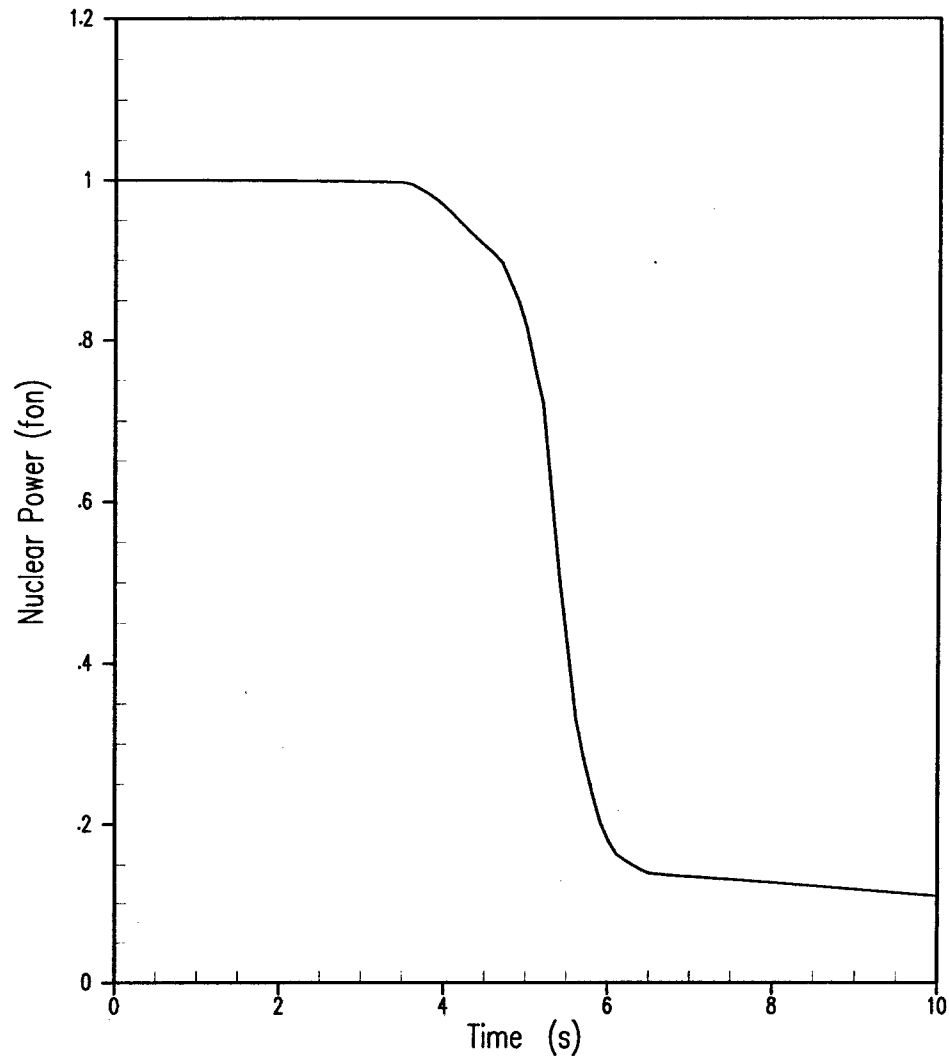
**Tier 2 Table 15.3-1** Revise Tier 2 Table 15.3-1 as shown below:

Table 15.3-1		
<b>TIME SEQUENCE OF EVENTS FOR INCIDENTS THAT RESULT IN A DECREASE IN REACTOR COOLANT SYSTEM FLOW RATE</b>		
Accident	Event	Time (seconds)
Partial loss of forced reactor coolant flow  – Loss of two pumps with four pumps running	Coastdown begins	0.00
	Low-flow reactor trip	<del>0.60</del> 1.61
	Rods begin to drop	<del>2.06</del> 3.06
	Minimum DNBR occurs	<del>3.90</del> 4.90
Complete loss of forced reactor coolant  – Loss of four pumps with four pumps running	Operating pumps lose power and begin coasting down	0.00
	Reactor coolant pump underspeed trip point reached	0.47
	Rods begin to drop	1.24
	Minimum DNBR occurs	3.0
Reactor coolant pump shaft seizure (locked rotor)  – One locked rotor with four pumps running with offsite power available  – One locked rotor with four pumps running without offsite power available	Rotor on one pump locks	0.00
	Low-flow trip point reached	<del>0.03</del> 0.10
	Rods begin to drop	<del>1.48</del> 1.55
	Maximum reactor coolant system pressure occurs	2.30
	Maximum cladding temperature occurs	<del>3.80</del> 3.90
	Rotor on one pump locks	0.00
	Low-flow trip point reached	<del>0.03</del> 0.10
	Rods begin to drop, loss of offsite power occurs	<del>1.48</del> 1.55
Maximum reactor coolant system pressure occurs	2.30	
Maximum cladding temperature occurs	<del>3.80</del> 3.90	

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**Tier 2 Figures 15.3.1-2 through 15.3.1-6** Replace Tier 2 Figures 15.3.1-2 through 15.3.1-6 with the following figures:



15.3.1-2

**Nuclear Power Transient for Four Cold  
Legs in Operation, Two Pumps Coasting Down**

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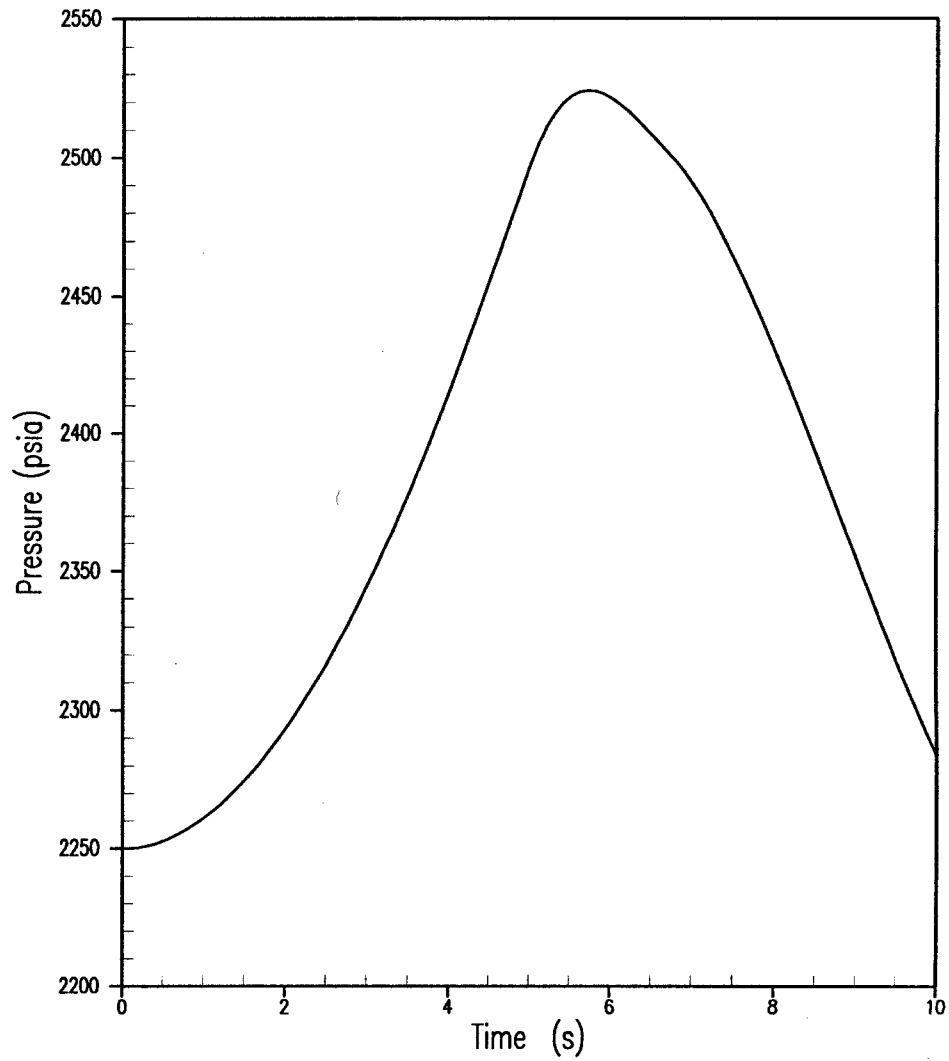


Figure 15.3.1-3

**Pressurizer Pressure Transient for Four Cold  
Legs in Operation, Two Pumps Coasting Down**

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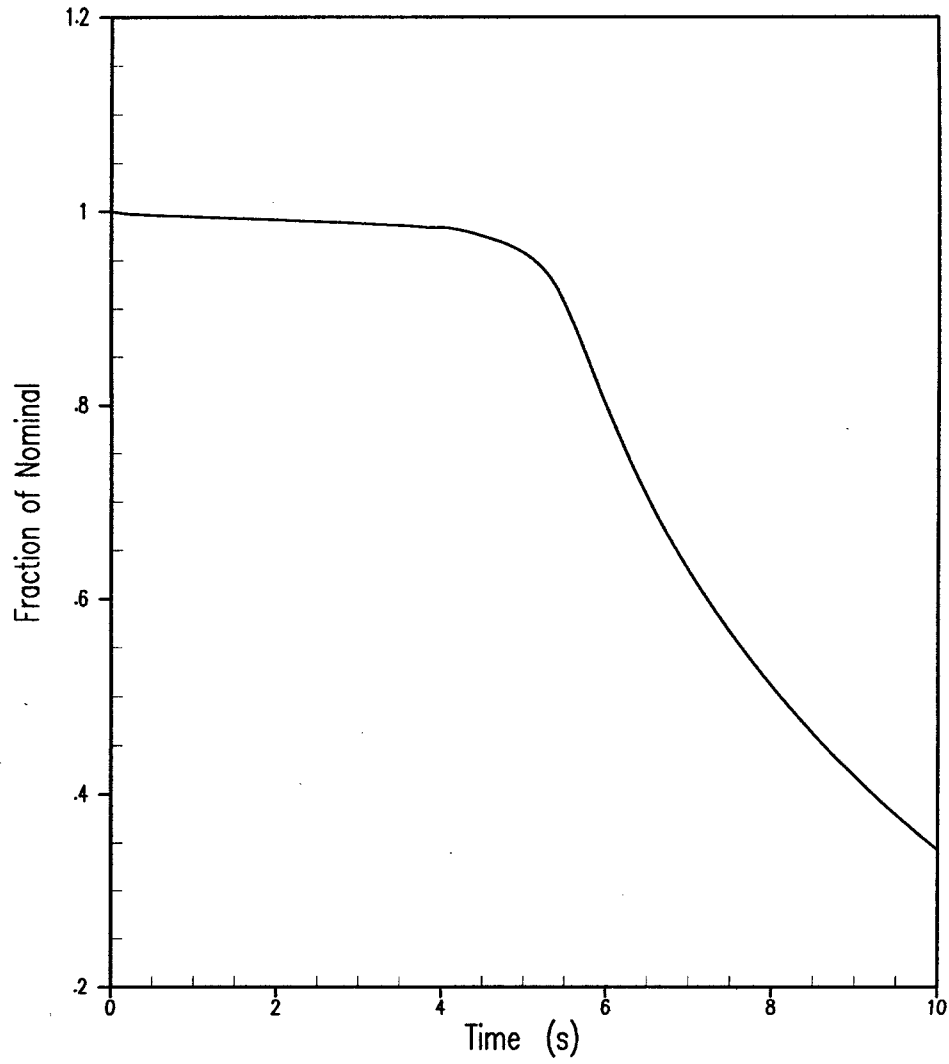


Figure 15.3.1-4

**Average Channel Heat Flux Transient for Four  
Cold Legs in Operation, Two Pumps Coasting Down**

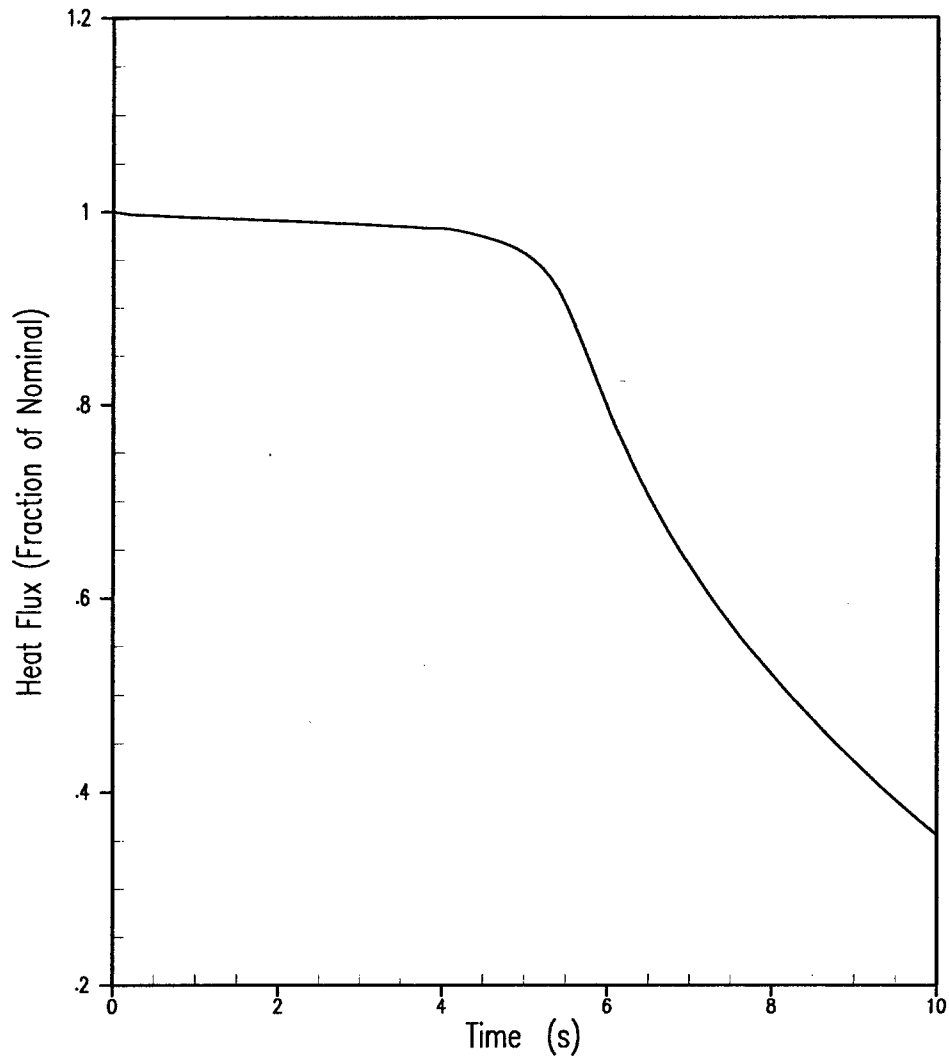


Figure 15.3.1-5

**Hot Channel Heat Flux Transient for Four  
Cold Legs in Operation, Two Pumps Coasting Down**

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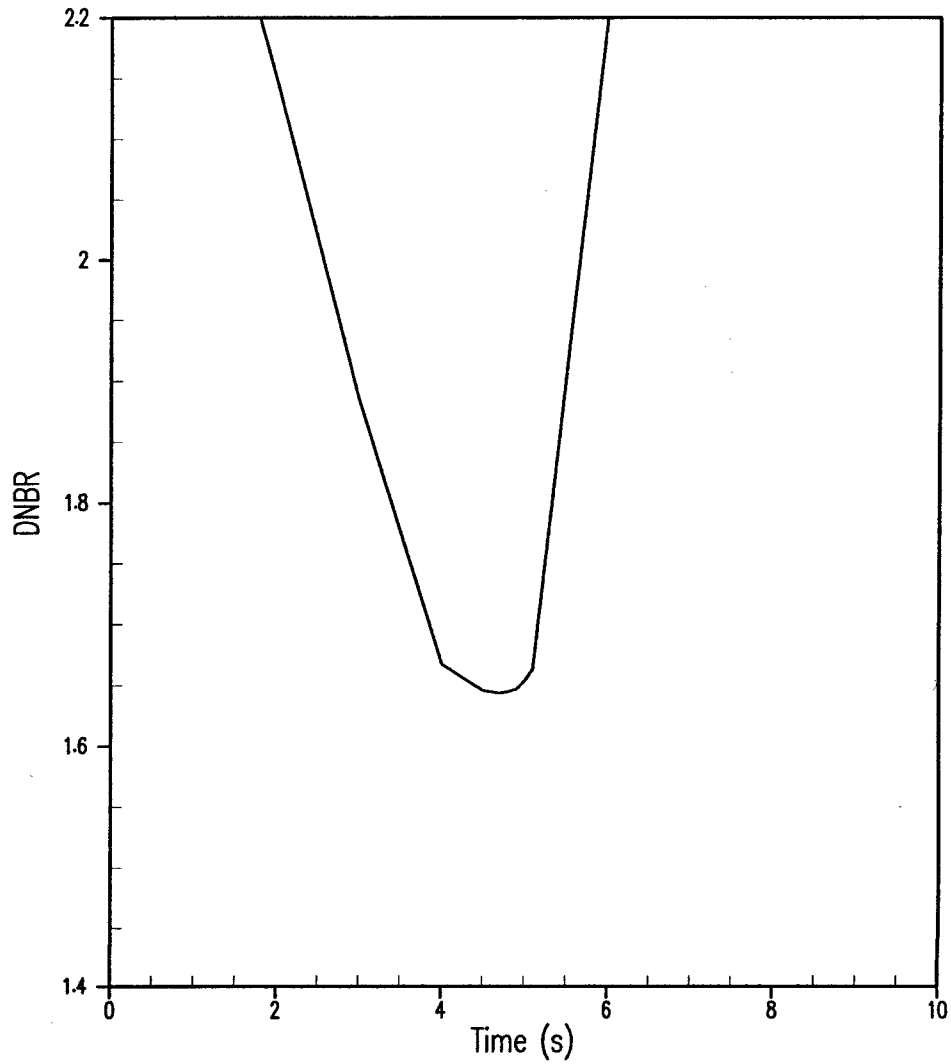


Figure 15.3.1-6

**DNB Transient for Four Cold Legs in  
Operation, Two Pumps Coasting Down**

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**Tier 2 Figures 15.3.3-3 through 15.3.3-7** Replace Tier 2 Figures 15.3.3-3 through 15.3.3-7 with the following figures:

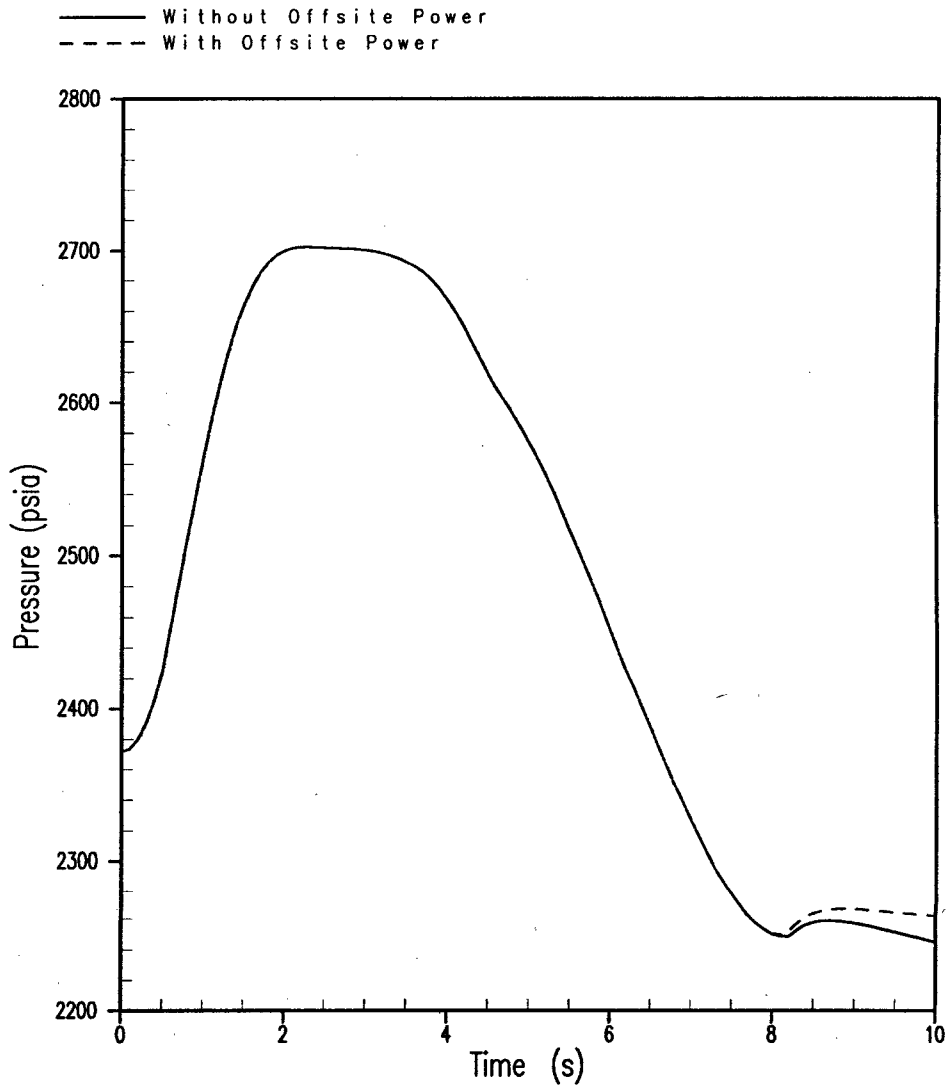


Figure 15.3.3-3

**Peak Reactor Coolant Pressure for  
Four Cold Legs in Operation, One Locked Rotor**

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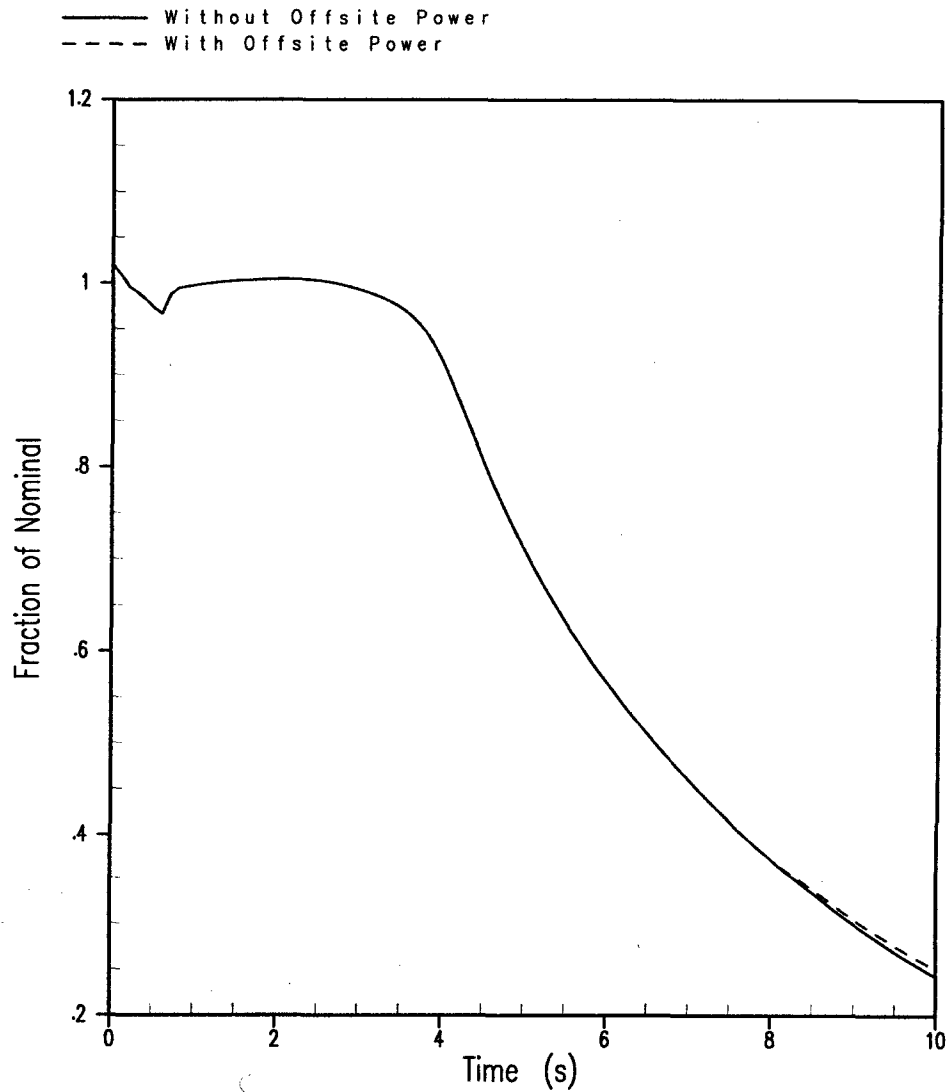


Figure 15.3.3-4

**Average Channel Heat Flux Transient for  
Four Cold Legs in Operation, One Locked Rotor**



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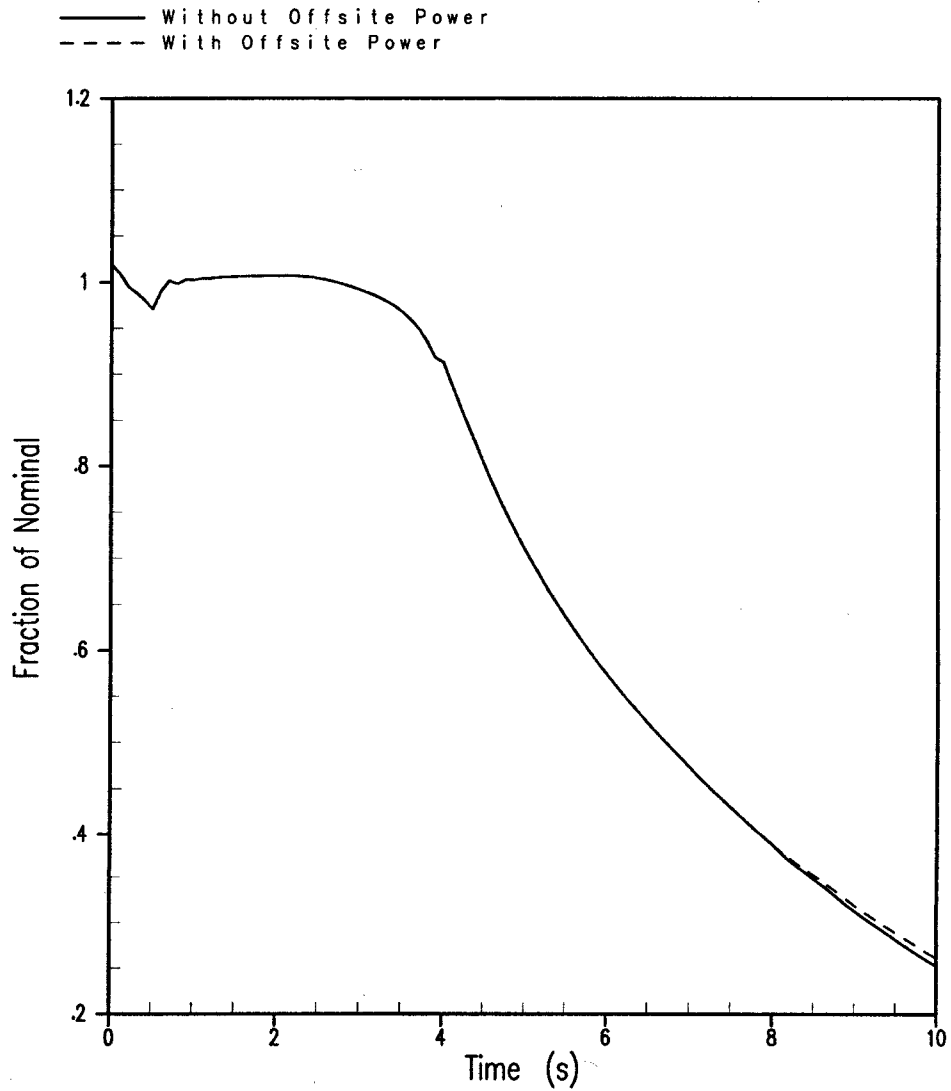


Figure 15.3.3-5

**Hot Channel Heat Flux Transient for  
Four Cold Legs in Operation, One Locked Rotor**

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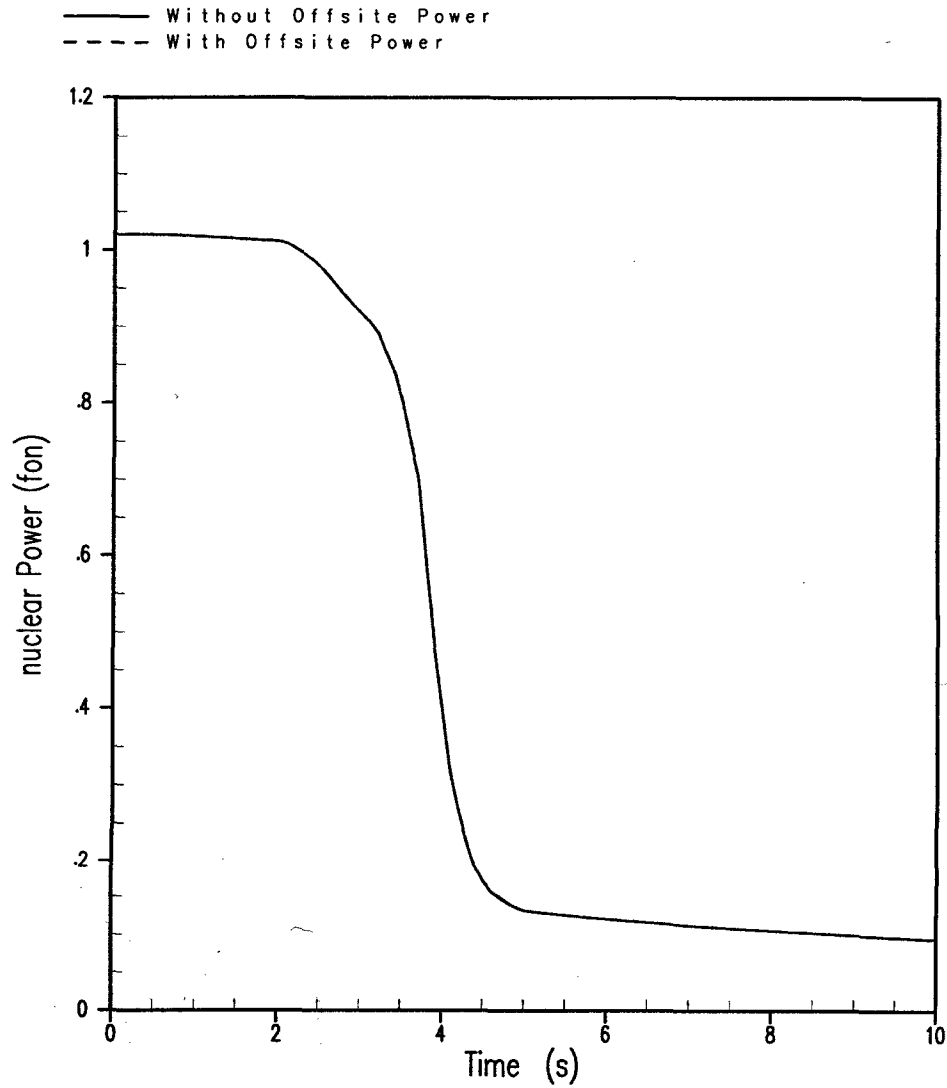


Figure 15.3.3-6

**Nuclear Power Transient for  
Four Cold Legs in Operation, One Locked Rotor**

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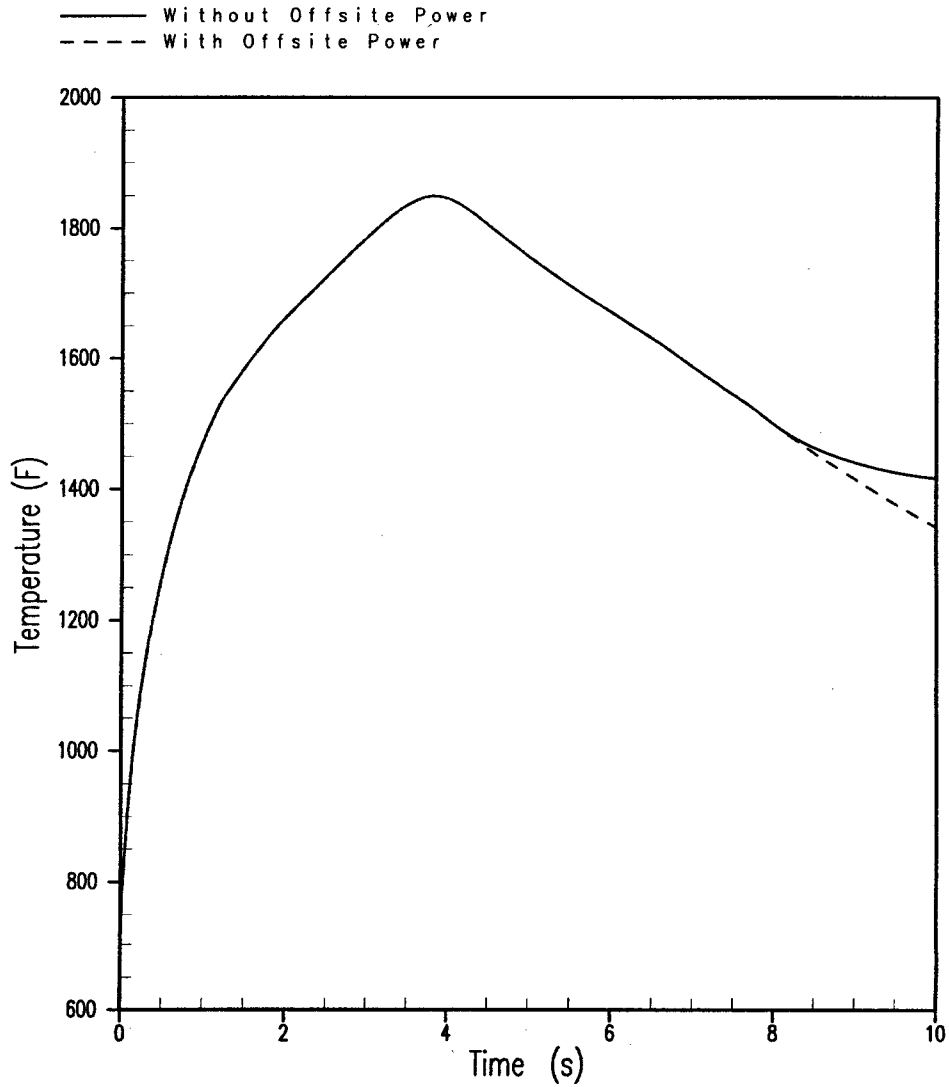


Figure 15.3.3-7

**Cladding Inside Temperature Transient for  
Four Cold Legs in Operation, One Locked Rotor**

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**Tier 2 Technical Specification Table 3.3.1-1** Revise Technical Specification (Section 16.1) Table 3.3.1-1 (page 2 of 5) as follows:

Table 3.3.1-1 (page 2 of 5)  
 Reactor Trip System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE	TRIP SETPOINT
10. Reactor Coolant Flow – Low						
a. Single ColdHot Leg	1 <sup>(g)</sup>	4 per coldHot leg	L	SR 3.3.1.1 SR 3.3.1.6 SR 3.3.1.8 SR 3.3.1.11		≥ [87]% <sup>(i)</sup>
b. Two ColdBoth Hot Legs	1 <sup>(h)</sup>	4 per coldHot leg	K	SR 3.3.1.1 SR 3.3.1.6 SR 3.3.1.8 SR 3.3.1.11		≥ [87]% <sup>(i)</sup>

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Revise Technical Specification (Section 16.1) Bases 3.3.1 as follows:

**BASES**

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**APPLICABLE SAFETY ANALYSES, LCOs, and APPLICABILITY (continued)**

16. Reactor Trip System Interlocks

b. Power Range Neutron Flux, P-8

The Power Range Neutron Flux, P-8 interlock is actuated at approximately 48% power as determined by the respective PMS power range detector. The P-8 interlock automatically enables the Reactor Coolant Flow – Low (Single ColdHot Leg) and RCP Bearing Water Temperature – High (Single Pump) reactor trips on increasing power. The LCO requirement for this trip Function ensures that protection is provided against a loss of flow in anyeither RCS coldhot leg that could result in DNB conditions in the core when greater than approximately 48% power. On decreasing power, the reactor trip on low flow in any-coldeither hot leg is automatically blocked

c. Power Range Neutron Flux, P-10

The Power Range Neutron Flux, P-10 interlock is actuated at approximately 10% power as determined by the respective PMS power-range detector. The LCO requirement for the P-10 interlock ensures that the following functions are performed:

(1) on increasing power, the P-10 interlock automatically enables reactor trips on the following Functions:

- Pressurizer Pressure – Low,
- Pressurizer Water Level – High 3,
- Reactor Coolant Flow – Low (~~Two Cold~~Both Hot Legs),
- RCP Bearing Water Temperature – High (Two Pumps), and
- RCP Speed – Low.

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**BASES**

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**ACTIONS (continued)**

K.1.1, K.1.2, and K.2

- Condition K applies to the following reactor trip Functions:
- Pressurizer Pressure – Low;
- Pressurizer Water Level – High 3;
- Reactor Coolant Flow – Low (~~Two Cold~~Both Hot Legs);
- RCP Bearing Water Temperature – High (Two Pumps); and
- RCP Speed – Low.

**Tier 2 Figures 5.1-3, 5.1-5 (Sheet 1 of 3), 5.1-5 (Sheet 3 of 3), and 7.2-1 (Sheet 5 of 20) Revise these figures as shown on the following pages.**