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Date: Mon, Oct 31, 2005 3:35 PM
Subject: Flow Sensor Tier 2 Changes

Attached is a file of the Tier 2 changes associated with the RCS flow sensor change. The figures at the end of the changes (Loop Layout, P&ID, and Functional diagram) will be sent separately

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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), 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.

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 1A~~ Flow Sensor	RCS-101A	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS ~~Cold Leg 1A~~ Flow Sensor	RCS-101B	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS ~~Cold Leg 1A~~ Flow Sensor	RCS-101C	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS ~~Cold Leg 1A~~ Flow Sensor	RCS-101D	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS ~~Cold Leg 1B~~ Flow Sensor	RCS-102A	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS ~~Cold Leg 1B~~ Flow Sensor	RCS-102B	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS ~~Cold Leg 1B~~ Flow Sensor	RCS-102C	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS ~~Cold Leg 1B~~ Flow Sensor	RCS-102D	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg ~~2A~~ **1A Bend Delta P** ~~Flow~~ Sensor	RCS-171~~103A~~	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg ~~2A~~ **1B Bend Delta P** ~~Flow~~ Sensor	RCS-172~~103B~~	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg 2A **Bend Delta P** ~~Flow~~ Sensor	RCS-173~~103C~~	-	Yes	-	Yes/Yes	No	-/-	-	-
RCS Cold Leg ~~2A~~ **2B Bend Delta P** ~~Flow~~ Sensor	RCS-174~~103D~~	-	Yes	-	Yes/Yes	No	-/-	-	-

Note: Dash (-) indicates not applicable.

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	-/-	-	-

Replace Sheet 22 and 23 of Table 3.2-3 with the following:

TABLE 3.2-3 (SHEET 22 OF 65)

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

Tag Number	Description	AP1000 Class	Seismic Category	Principal Construction Code	Comments
Reactor Coolant System (Continued)					
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 1~~A~~ Flow ~~Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V101B	~~Cold~~**Hot** Leg 1~~A~~ Flow ~~Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V101C	~~Cold~~**Hot** Leg 1~~A~~ Flow ~~Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V101D	~~Cold~~**Hot** Leg 1~~A~~ Flow ~~Meter~~ Instrument Root	B	I	ASME III-2	
RCS PL V101E	~~Cold~~**Hot** Leg 1~~A~~ 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 ~~1B~~**2** Flow ~~Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V102B	~~Cold~~**Hot** Leg ~~1B~~**2** Flow ~~Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V102C	~~Cold~~**Hot** Leg ~~1B~~**2** Flow ~~Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V102D	~~Cold~~**Hot** Leg ~~1B~~**2** 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-V**171A**~~10~~ ~~3A~~	Cold Leg ~~2A~~ **1A** ~~Flow Meter~~ **Bend** Instrument Root	B	I	ASME III-2	
RCS-PL-V**171B**~~10~~ ~~3B~~	Cold Leg ~~2A~~ **1A** ~~Flow Meter~~ **Bend** Instrument Root	B	I	ASME III-2	
RCS-PL-V**172A**~~10~~ ~~3C~~	Cold Leg ~~2A~~ **1B** ~~Flow Meter~~ **Bend** Instrument Root	B	I	ASME III-2	

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
Reactor Coolant System (Continued)					
RCS-PL-V**172B**~~10 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-V**173A**~~10 4A~~	Cold Leg ~~2B~~ **2A Bend** ~~Flow Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V**173B**~~10 4B~~	Cold Leg ~~2B~~ **2A Bend** ~~Flow Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V**174A**~~10 4C~~	Cold Leg 2B **Bend** ~~Flow Meter~~ Instrument Root	B	I	ASME III-2	
RCS-PL-V**174B**~~10 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	

Replace Sheet 12 of Table 3.11-1 with the following:

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)**
TRANSMITTERS					
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 ~~Cold~~**Hot** Leg 1~~A~~ Flow	RCS JE FT 101A	1	RT	Note 3	E
RCS ~~Cold~~**Hot** Leg 1~~A~~ Flow	RCS JE FT 101B	1	RT	Note 3	E
RCS ~~Cold~~**Hot** Leg 1~~A~~ Flow	RCS JE FT 101C	1	RT	Note 3	E
RCS ~~Cold~~**Hot** Leg 1~~A~~ Flow	RCS JE FT 101D	1	RT	Note 3	E
RCS ~~Cold~~**Hot** Leg ~~1B~~**2** Flow	RCS JE FT 102A	1	RT	Note 3	E
RCS ~~Cold~~**Hot** Leg ~~1B~~**2** Flow	RCS JE FT 102B	1	RT	Note 3	E
RCS ~~Cold~~**Hot** Leg ~~1B~~**2** Flow	RCS JE FT 102C	1	RT	Note 3	E
RCS ~~Cold~~**Hot** Leg ~~1B~~**2** Flow	RCS JE FT 102D	1	RT	Note 3	E
~~RCS Cold Leg 2A Flow~~	~~RCS JE FT 103A~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
~~RCS Cold Leg 2A Flow~~	~~RCS JE FT 103B~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
~~RCS Cold Leg 2A Flow~~	~~RCS JE FT 103C~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
~~RCS Cold Leg 2A Flow~~	~~RCS JE FT 103D~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
~~RCS Cold Leg 2B Flow~~	~~RCS JE FT 104A~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
~~RCS Cold Leg 2B Flow~~	~~RCS JE FT 104B~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
~~RCS Cold Leg 2B Flow~~	~~RCS JE FT 104C~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
~~RCS Cold Leg 2B Flow~~	~~RCS JE FT 104D~~	~~1~~	~~RT~~	~~Note 3~~	~~E~~
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 +

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 and fifth 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.

Reactor Trip on Reactor Coolant pump Underspeed

The reactor coolant pump underspeed trip provides a direct measurement of the parameter of interest. It permits the plant to ride through many postulated voltage **or frequency** dip transients without reactor trip if safety limits are not violated. Selection of the underspeed trip setpoint and time response provide for the timely initiation of reactor trip during the complete loss of flow accident and the limiting frequency decay event, consistent with the analysis results reported in Chapter 15.

Revise the 12th entries of Table 7.2-2, sheet 1 of 2, as follows:

Table 7.2-2 (Sheet 1 of 2)

REACTOR TRIPS

Reactor Trip(1)	**No. of Channels**	**Division Trip Logic**	**Bypass Logic**	**Permissives and Interlocks (See Table 7.2-3)**
Low Reactor Coolant Flow	16 (4/cold leg)	2/4 in ~~any single cold~~ **either hot** leg	Yes(2)	P-8
		2/4 ~~in 2/4 cold~~ **both** legs	Yes(2)	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.

Replace Sheets 2, 3, and 5 of Table 9A-2 with the following:

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 Leg 2A Flow~~			~~FT-103B~~	~~FT-103D~~
		~~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		

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		
		~~Cold~~**Hot** Leg 1~~A~~ Flow	FT-101A	FT-101C		
		~~Cold~~**Hot** Leg ~~1B~~**2** 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		

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 1~~A~~ Flow			FT-101B	FT-101D
		~~Cold~~**Hot** Leg ~~1B~~**2** 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

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 f~~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:

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**.

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

Table 15.0-4a (Sheet 1 of 2)

PROTECTION AND SAFETY MONITORING SYSTEM SETPOINTS AND TIME DELAY ASSUMED IN ACCIDENT ANALYSES

Function	Limiting Setpoint Assumed in Analyses	Time Delays (seconds)
Reactor trip on low reactor coolant flow in ~~any cold~~ **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 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:

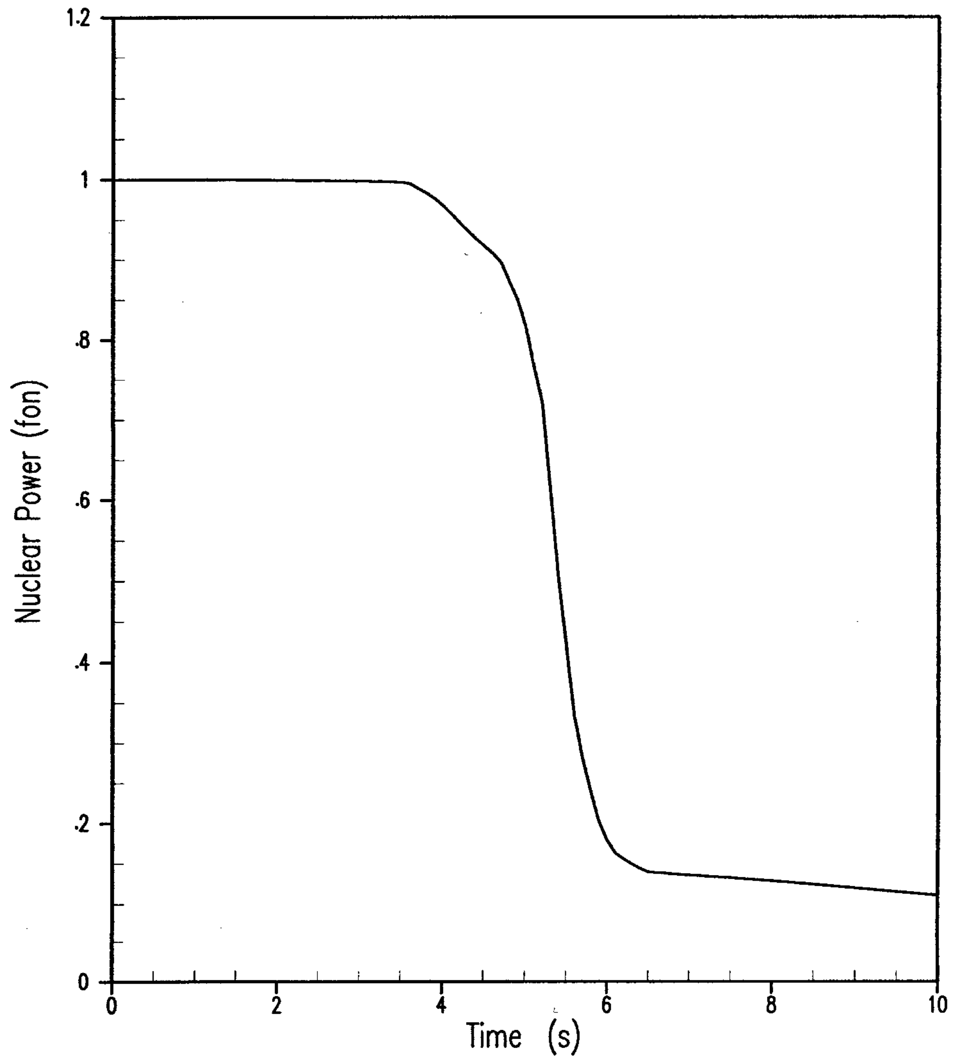
Revise Table 15.3-1 as shown below.

Table 15.3-1

TIME SEQUENCE OF EVENTS FOR INCIDENTS THAT RESULT IN A DECREASE IN REACTOR COOLANT SYSTEM FLOW RATE

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	~~0.60~~**1.61**
	Rods begin to drop	~~2.06~~**3.06**
	Minimum DNBR occurs	~~3.90~~**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	Rotor on one pump locks	0.00
	Low-flow trip point reached	~~0.03~~**0.10**
	Rods begin to drop	~~1.48~~**1.55**
	Maximum reactor coolant system pressure occurs	2.30
	Maximum cladding temperature occurs	~~3.80~~**3.90**
– One locked rotor with four pumps running without offsite power available	Rotor on one pump locks	0.00
	Low-flow trip point reached	~~0.03~~**0.10**
	Rods begin to drop, loss of offsite power occurs	~~1.48~~**1.55**
	Maximum reactor coolant system pressure occurs	2.30
	Maximum cladding temperature occurs	~~3.80~~**3.90**

Replace 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

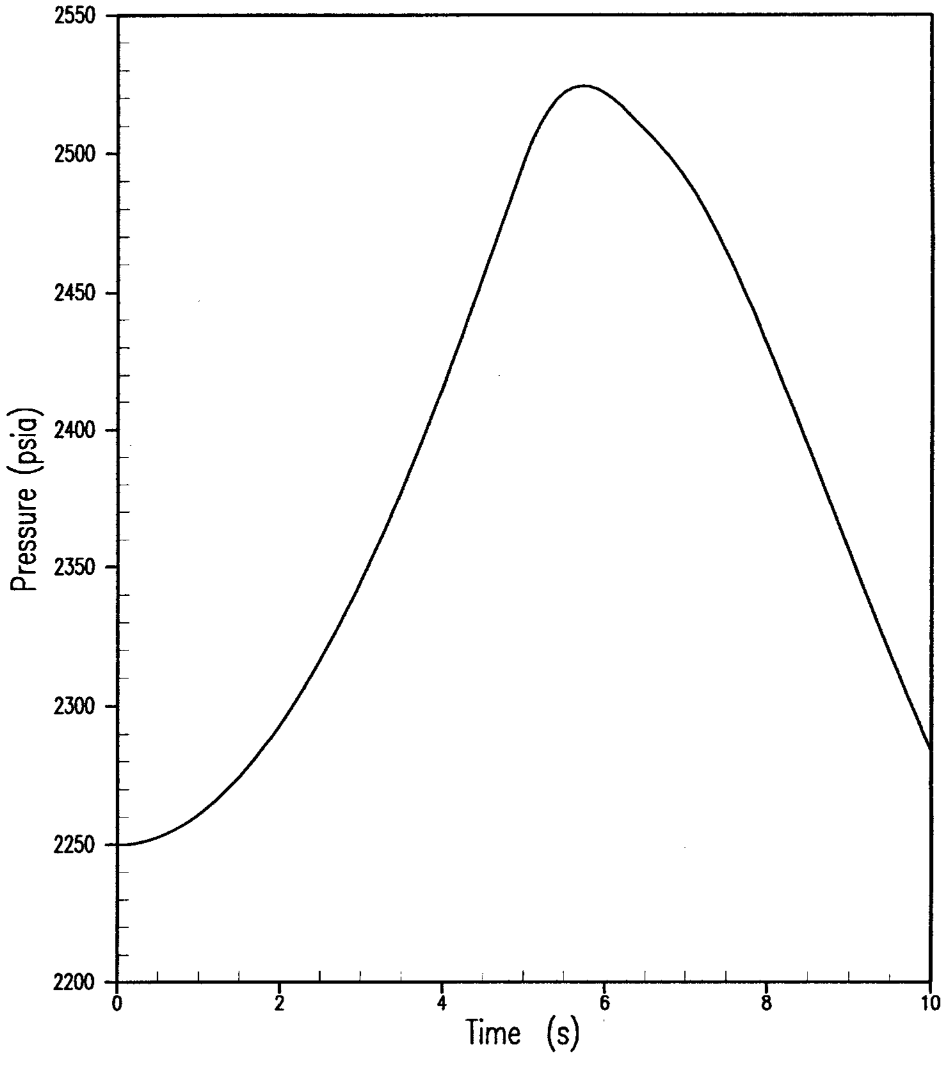


Figure 15.3.1-3

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

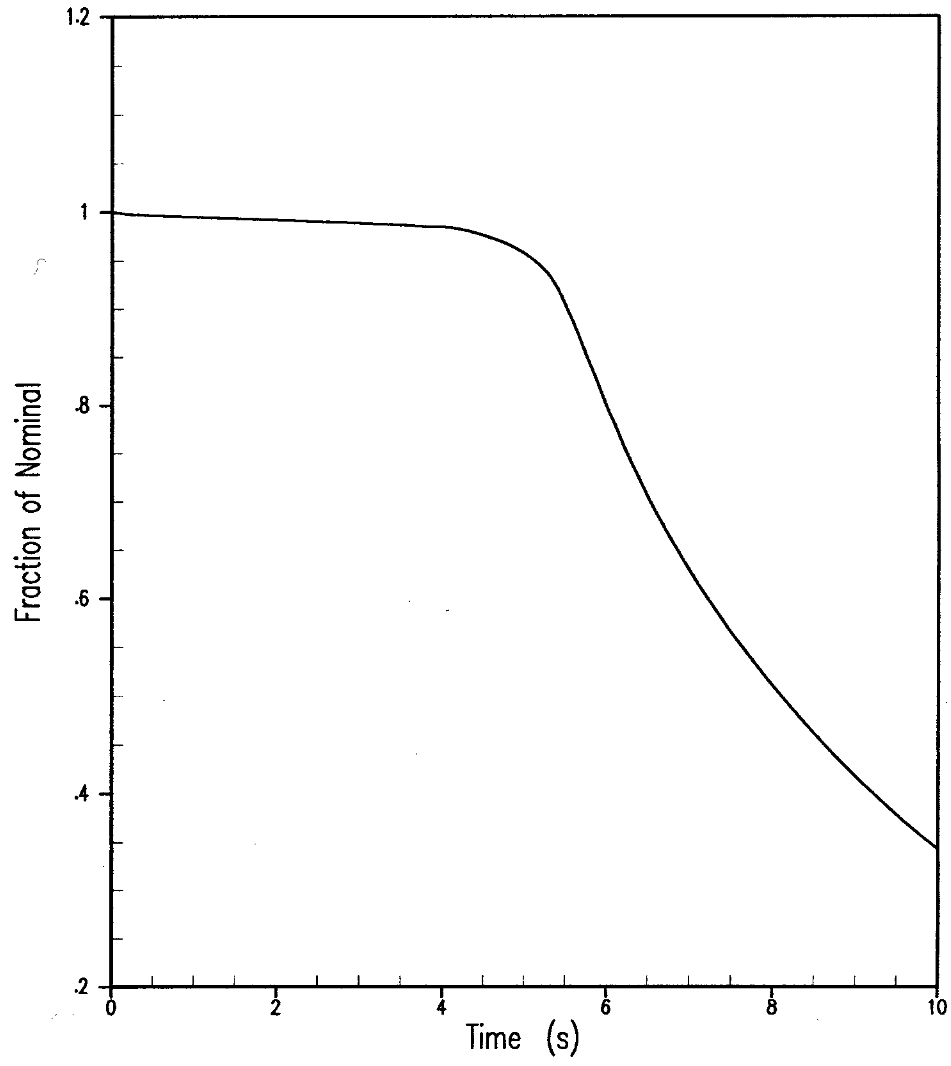


Figure 15.3.1-4

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

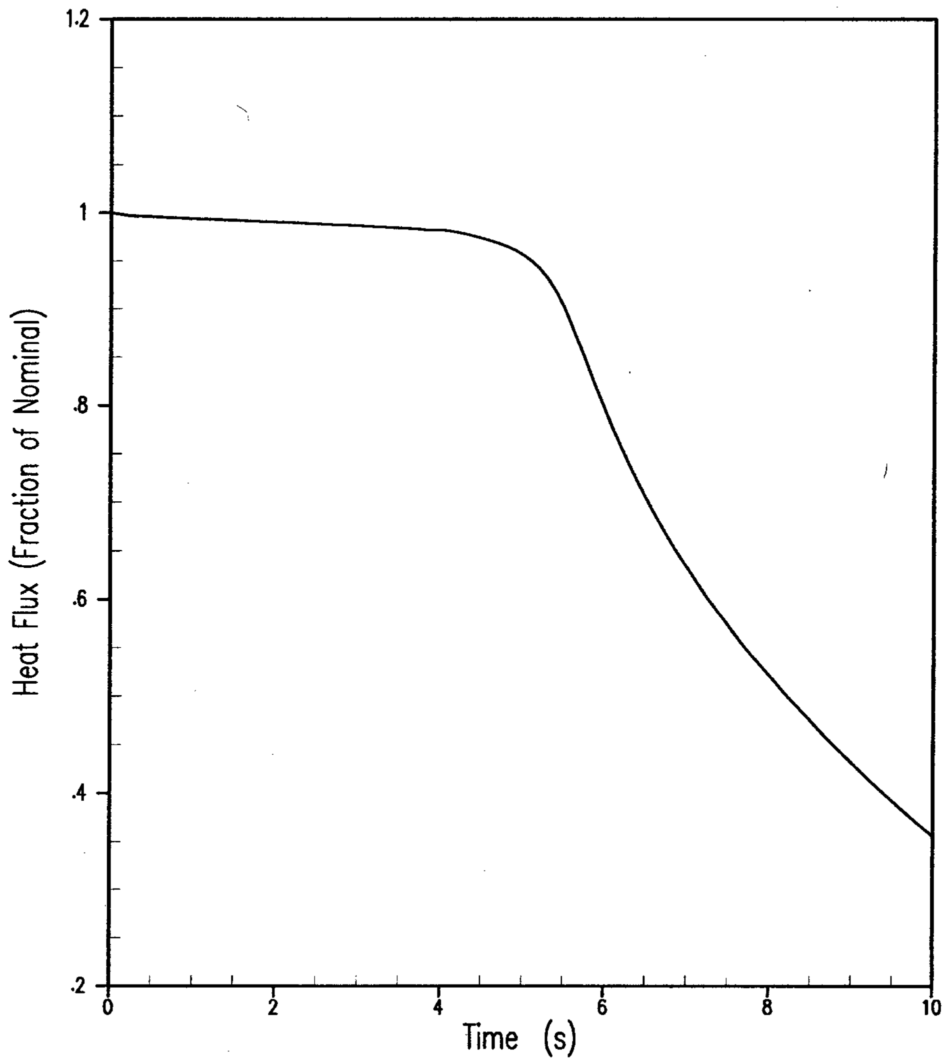


Figure 15.3.1-5

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

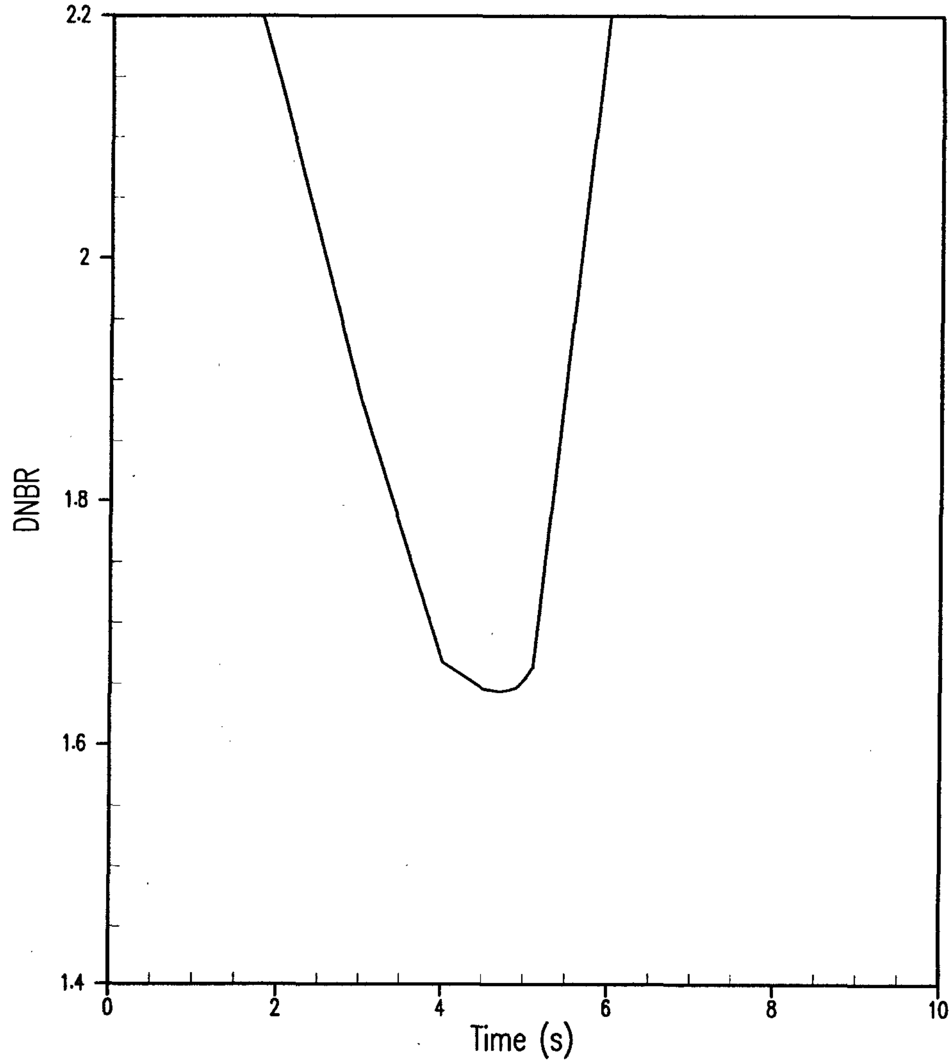


Figure 15.3.1-6

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

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

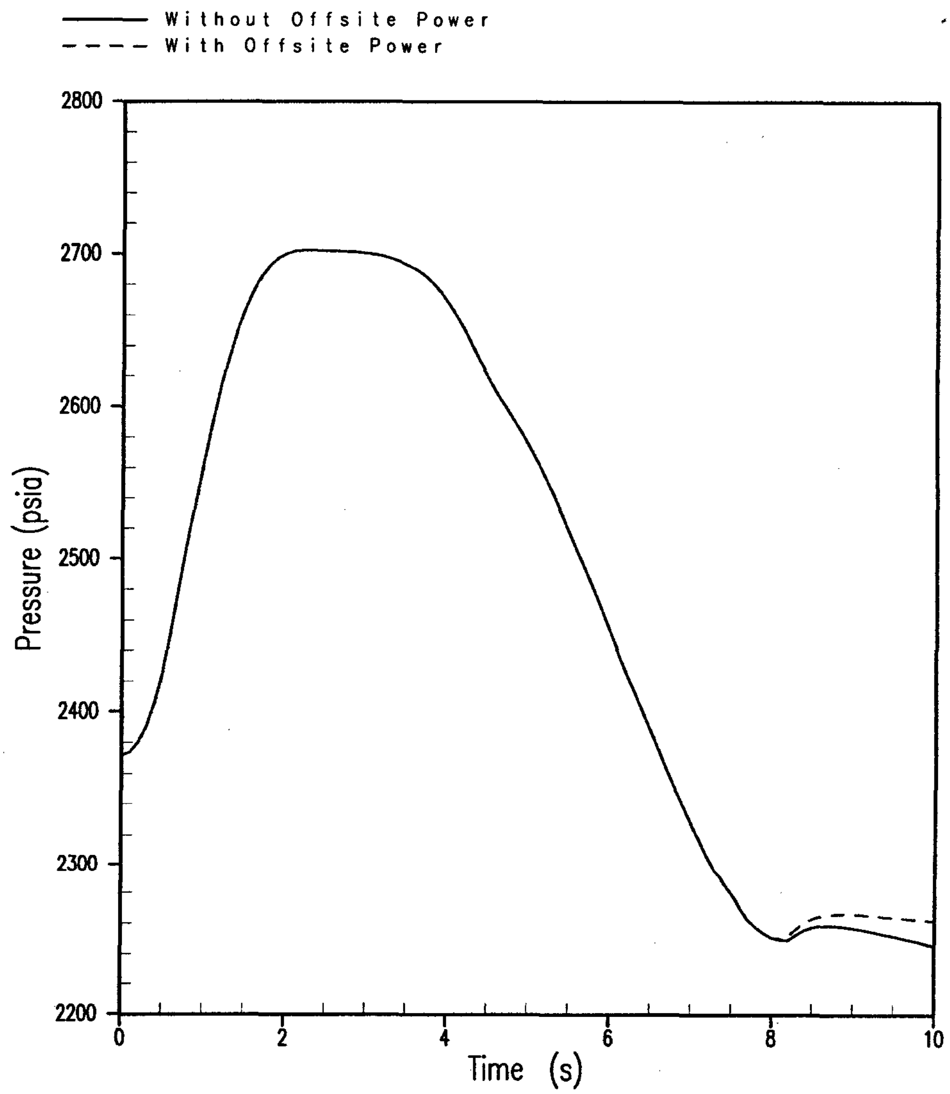


Figure 15.3.3-3

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

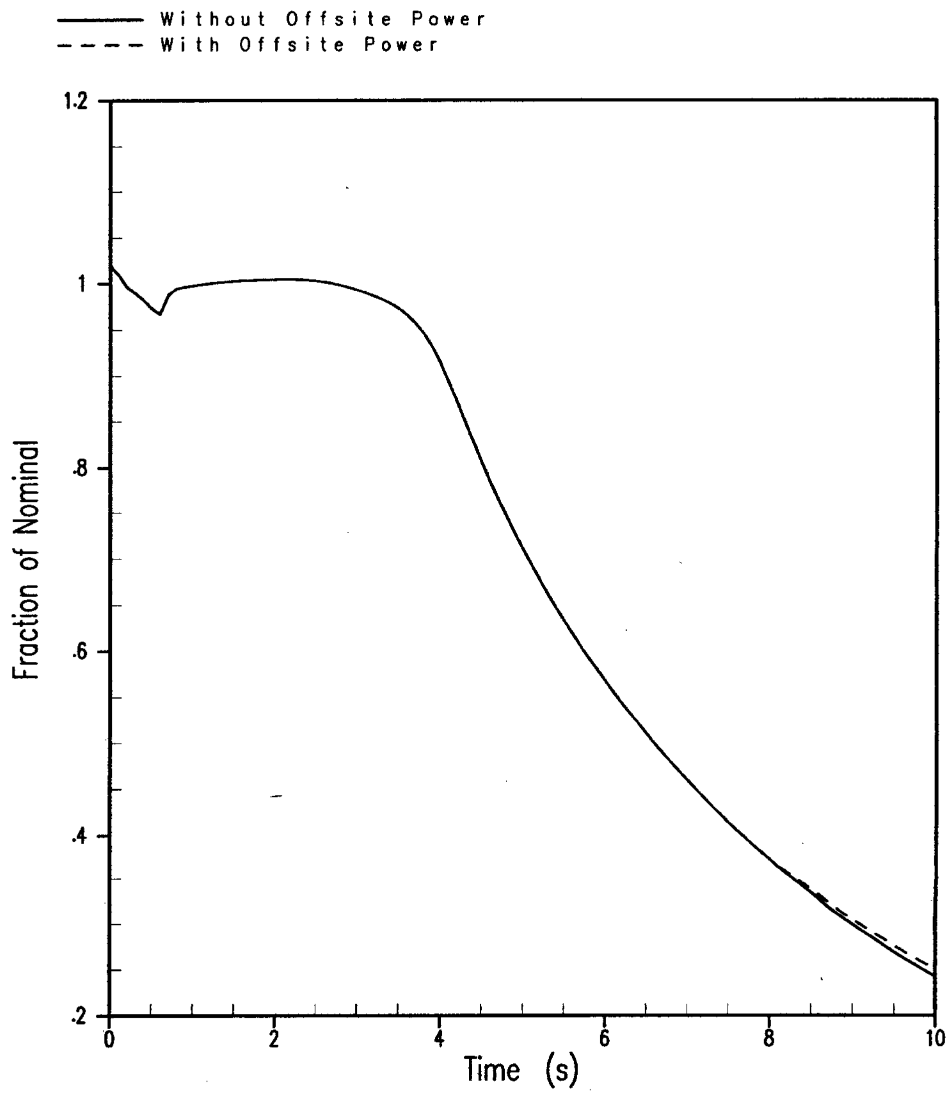


Figure 15.3.3-4

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

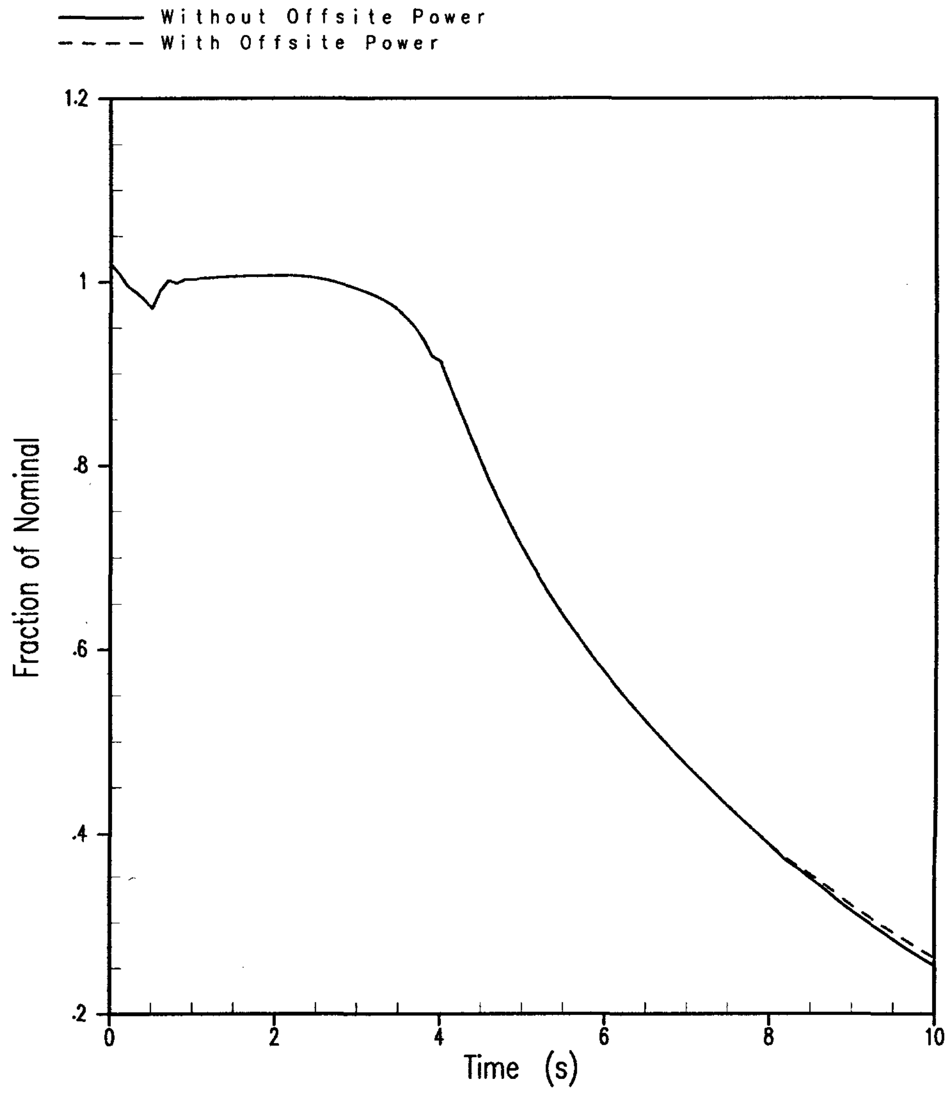


Figure 15.3.3-5

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

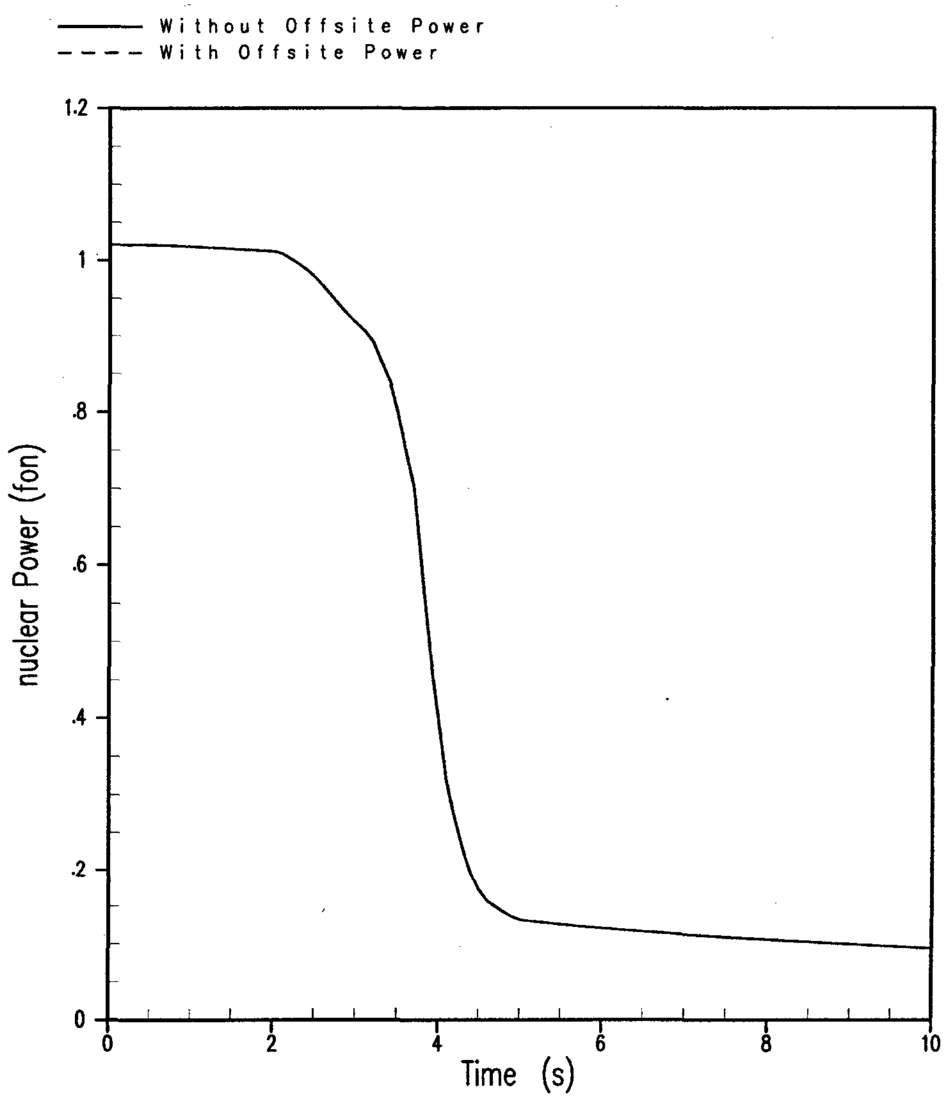


Figure 15.3.3-6

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

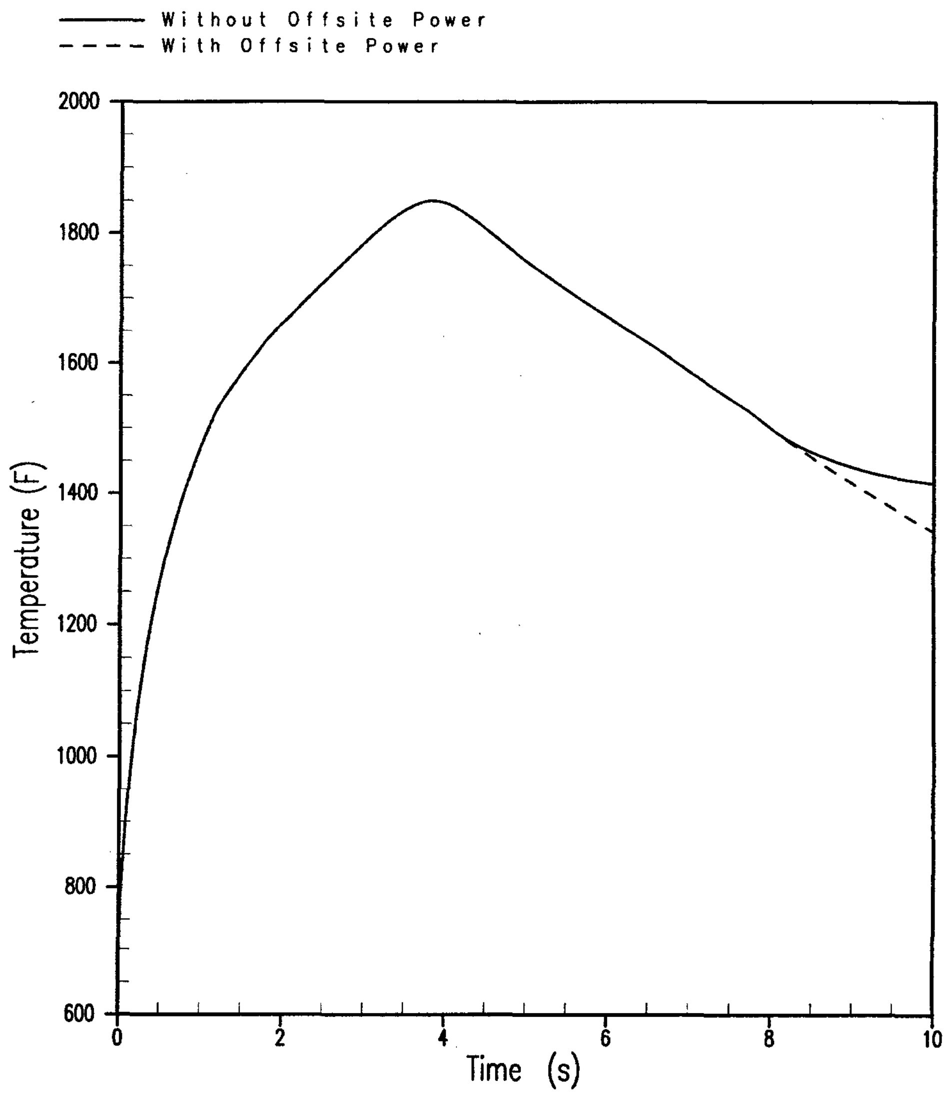


Figure 15.3.3-7

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

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 ~~Cold~~**Hot** Leg	1(g)	4 per ~~cold~~**Hot** leg	L	SR 3.3.1.1 SR 3.3.1.6 SR 3.3.1.8 SR 3.3.1.11		≥ [87]%(i)
b. ~~Two Cold~~**Both Hot** Legs	1(h)	4 per ~~cold~~**Hot** leg	K	SR 3.3.1.1 SR 3.3.1.6 SR 3.3.1.8 SR 3.3.1.11		≥ [87]%(i)

Revise Technical Specification (Section 16.1) 3.4.1 as follows:

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.1.4	- NOTE - Not required to be performed until 24 hours after ≥ 90% RTP. Verify ~~by precision heat balance~~ that RCS total flow rate is ≥ [301,670] gpm and greater than or equal to the limit specified in the COLR.	24 months

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

BASES

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 ~~Cold~~**Hot** 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 ~~any~~**either** RCS ~~cold~~**hot** 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 cold~~**either 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.

BASES

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.

Revise Technical Specification (Section 16.1) Bases 3.4.1 as follows:

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.1 RCS Pressure, Temperature, and Flow Departure from Nucleate Boiling (DNB) Limits

BASES

BACKGROUND

The RCS flow rate normally remains constant during an operational fuel cycle with all pumps running. The minimum RCS flow limit corresponds to that assumed for DNB analyses. **At the beginning of the first fuel cycle, precision (calorimetric) flow measurements, augmented by hydraulic measurements in the reactor coolant loop and pump performance, provide a value for comparison with the limit. The reactor coolant flow and pump head channels are normalized to these test measurements for 100-percent indication and are frequently monitored to determine flow degradation.** ~~At the beginning of each fuel cycle, precision (calorimetric) flow measurements provide a value for comparison to the limit. The cold leg flow rate channels are normalized to the calorimetric flow measurement for 100% indication and are frequently monitored to determine flow degradation.~~ A lower RCS flow will cause the core to approach DNB limits.

Operation for significant periods of time outside these DNB limits increases the likelihood of a fuel cladding failure in a DNB limited event.

LCO

This LCO specifies limits on the monitored process variables, pressurizer pressure, RCS average temperature, and RCS total flow rate to ensure the core operates within the limits assumed in the safety analyses. These variables are contained in the COLR to provide operating and analysis flexibility from cycle to cycle. However, the minimum RCS flow, usually based on [maximum analyzed steam generator tube plugging], is retained in the TS LCO. Operating within these limits will result in meeting DNBR criterion in the event of a DNB limited transient.

RCS total flow rate contains a measurement error based on performing ~~a~~ precision ~~heat balance~~**flow measurements** and using the result to normalize the RCS flow rate indicators.

The numerical values for pressure, temperature, and flow rate specified in the COLR are given for the measurement location but have been adjusted for instrument error.

SURVEILLANCE REQUIREMENTS

SR 3.4.1.4

Measurement of RCS total flow rate by performance of ~~a~~ precision ~~calorimetric heat balance~~**test measurements** once every 24 months, at the beginning of each fuel cycle, allows the installed RCS flow instrumentation to be normalized and verifies the actual RCS flow is greater than or equal to the minimum required RCS flow rate. **These test measurements may be based on a precision heat balance, or by differential pressure measurements of static elements in the RCS piping (such as elbows) that have been calibrated by previous precision tests, or by a combination of those two methods. In all cases, the measured flow, less allowance for error, must exceed the value used in the safety analysis and specified in the COLR.**

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.

Figure 5.1-3

Reactor Coolant System – Loop Layout

Inside Reactor Containment
Figure 5.1-5 (Sheet 1 of 3)

Reactor Coolant System
Piping and Instrumentation Diagram

Figure 7.2-1 (Sheet 5 of 20)

Functional Diagram
Core Heat Removal Protection