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Fast Flux Test Facility Thermal and Pressure Transient Events During Cycle II

J.D. Aardal, 2/28/2018

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ABSTRACT

FFTF THERMAL AND PRESSURE TRANSIENT EVENTS
DURING CYCLE 11

This report documents the thermal and pressure transients experienced by the Reactor Heat Transport System (RHTS) during Cycle 11 which included Cycles 11A, 11B-1, 11B-2 and 11C (i.e. 4 startups and 4 shutdowns). Cycle 11 consisted of a refueling period that began on March 14, 1989 and power operation which began on May 3, 1989 and ended on October 27, 1990. Transients resulted from secondary pump starts/stops while at refueling conditions. The major causes of transients at power were five unplanned reactor scrams from 100% power and problems with Loop 2 DHX Fan Controls During 11A.

At the end of Cycle 11, the cumulative total effect of the thermal and pressure transients experienced by the RHTS did not exceed nor was in jeopardy of exceeding that for the specified Design Transients. The log of thermal transients, log of pressure transients, and log of DHX temperature difference events experienced by the RHTS will be updated each cycle so that future reports will utilize the data presented in this report to maintain a cumulative total effect.

The 10 Year Design lifetime components in the inlet and outlet plenum groups in the reactor are approaching their assigned lifetime total normal shutdown transients. The Components were evaluated by the Component Stress Analysis group. See Reference 29. Their finding was that an unlimited number of shutdown transients may be applied without altering the existing shutdown schedule.

In addition to RHTS transients, a discussion of thermal transients affecting other non-HTS FFTF sodium systems is included in this report.

1.0 INTRODUCTION

This report documents the number of thermal and pressure transients experienced by the Reactor Heat Transport System (RHTS) during Cycle 11, March 14,1989 through March 19, 1991. For the purpose of this report, the RHTS includes the Heat Transport System (HTS) sodium pressure boundary, the reactor vessel, the reactor vessel head and the reactor vessel internals.

Throughout this report the term recordable thermal transient will be used. A recordable thermal transient is defined as one of the following:

a. With the system temperature below 500°F (260°C), a temperature change which exceeds 50°F (28°C) in any six hour period.

b. With system temperature between 500°F (260°C) and 800°F (425°C) a temperature change which exceeds 45°F (25°C) peak-to-peak variation in six hours or less.

c. With system temperature between 800°F (427°C) and 1050°F (565°C) a temperature change which exceeds 21°F (12°C) peak-to-peak variation in six hours or less.

d. Any event which results in a primary cold leg temperature mismatch of greater than 50°F (28°C).

e. Any events for which temperature differences between reactor head heater zones exceeds 100°F (56°C).

DHX module outlet thermal transients have been specifically examined and assessed as being negligible at temperatures below 500°F (260°C) for any temperature change <50°F (28°C) or <60°F (33°C) at a rate <4°F/min (2.2°C/min).

To evaluate recorded thermal transients, the maximum rate of change of temperature was determined and a design transient (from Reference 3) was selected with this rate of change of temperature or greater. The fraction of a design transient is determined by comparing the peak-to-peak ΔT of the actual transient to the ΔT for the design transient. This is conservative (see Reference 1 for justification) because for equal ramp rates, the relationship between fatigue damage and the ΔT is not linear but to a high power. Therefore, if the actual ΔT is half of the design ΔT, the fatigue damage is considerably less than half.

A recordable pressure transient is defined as any pressure change which results in a pressure greater than 182 psi (12.8 kg/cm^2) for the primary system or 211 psi (14.8 kg/cm^2) for the secondary system, as indicated on the pump outlet pressure indicator.

A recordable DHX outlet temperature difference event is one where the outlet temperatures for adjacent DHX modules differ by more than 70°F (39°C) at temperatures below 500°F (260°C), or by 40°F (22°C) at temperatures above 500°F (260°C). Structural damage to the DHX outlet mixing tee is determined as described in Reference 4.

The bases for these limits are discussed in References 6 through 11 and in the FFTF Technical Specifications.

In general, the occurrence of RHTS transient events is determined from the FFTF Operations Logs and review of plant work requests. The weekly Trend Analysis Computer Data packages are also reviewed at the end of each operating cycle for the occurrence of recordable thermal transients. The occurrence of non-HTS events is determined through discussions with the system cognizant engineers and/or review of plant work requests which document these events.

A log of transient events experienced during Cycle 11 is presented in this report as well as a log of cumulative effects which will be updated on a periodic basis as required by FSAR Technical Specifications 17.3/4.2.2., 17.3/4.1.12 and 17.3/4.9.1C for thermal transients (includes DHX outlet temperature difference events), and 17.3/4.2.11 for pressure transients.

2.0 EVALUATION

The evaluation of Cycle 11 transients is summarized in the following four sections:

- HTS thermal transients,
- HTS pressure transients,
- DHX outlet temperature difference events, and
- Non-HTS thermal transients.

2.1 HTS Thermal Transients

Significant Cycle 11 events contributing to recordable thermal transients include:

- Secondary loop transition to natural circulation during refueling/maintenance
- Controlled plant power ascents and descents
- Reactor Scrams
- DHX Fan Control Problems

These are discussed in the following paragraphs.

a. Secondary Loop Natural Circulation Testing
Recordable thermal transients occurred in the primary and secondary cold legs due to securing the secondary loop pony motors for maintenance (transition to secondary loop natural circulation).

b. Controlled Plant Ascents and Descents
Cycle 11, which included Cycles 11A, 11B-1, 11B-2, and 11C, power operation included startups, shutdowns, and smaller power changes.

For more detailed information on Cycle 11 events refer to Appendix A. The specific thermal transients and the components affected by them during Cycle 10 are listed in Tables I and II, assigned design transient fractions in Table A-1, and logged with the cumulative thermal transients in Table III.

When examining Table III the following should be noted: Module E-5 was the component tested at Liquid Metal Engineering Center (LMEC) in 1975 and was subjected to upset transients during that test program. Module E-8 has experienced dry preheating/cooling (N1) transient usage approaching the design basis. However, these transients result in small damage fractions and further N1 transient usage is fairly unlikely.

2.2 HTS Pressure Transients

No recordable pressure transients occurred during Cycle 11. Refer to Table IV for the cumulative total of HTS pressure transients which have occurred through Cycle 11.

2.3 DHX Outlet Temperature Difference Events

During Cycle 11 there were several DHX Outlet Temperature Difference Events. During June and July of 1989 during Cycle 11A Loop 2 experienced reportable events due to fan control problems. Most were minor with the worst case being 4.3 (10^{-4}) Lifetime Consumption. The others were in the 10^{-6} range. For more information see Appendix C. For a listing of the cumulative effect of events through Cycle 11 refer to Table V.

2.4 Non-HTS Thermal Transients

No significant non-HTS thermal transients occurred during Cycle 11. For a listing of the cumulative effects of non-HTS thermal transients, refer to Table VI. When examining this table, note that only the reactor vessel makeup nozzle has experienced any significant events to date. Its total damage fraction is well below the allowable. Additional events similar to that experienced on 12-19-81 are not expected since operating procedures have been revised to preclude a repeat event.

3.0 CONCLUSION

During Cycle 11, thermal and pressure transients experienced by the Reactor Heat Transport System were such that the cumulative effects to date are well below that allotted for the specified Design Transients. The cumulative damage or loss of service lifetime is considered acceptable.

4.0 REFERENCES

1. Memo, L. W. Bartholf to D. R. Rector, "Stress Concerns-Thermal Transient Report, January-March 1979," July 2, 1979.

2. Memo, P. A. Edwards to W. J. McShane, B. H. Noordhoff, "Evaluation of HTS Pressure Events," July 13, 1979.

3. Report, FFP-664, "Design Thermal Transients for FFTF Reactor Plant," November 12, 1975.

4. Memo, T. M. Burke to P. A. Edwards, "Tracking of DHX Mixing Tee Lifetime," SSE:170, September 23, 1981.

5. Memo, B. V. Winkel to T. M. Burke," Tech Spec Upgrade Item 21-b - DHX Outlet Transients," SSA:BVW;gb/2, January 25, 1984.

6. Memo. B. V. Winkel to T. M. Burke, "Stress Evaluation of the New DHX Standby Option," SSA:BVW:gb/4, February 2, 1984.

7. Memo, B. V. Winkel to T. M. Burke, "Basis for Eight Hour Thermal Transient Monitoring Period," SSA:BVW:gb/6, April 30, 1984.

8. Memo, B. V. Winkel, to P. A. Edwards, "Negligible Thermal Transients for MHTS," CSA:BVW:gv/14, May 4, 1978.

9. Memo, B. V. Winkel to W. L. Knecht, "Negligible Thermal Transients Above 800'F," CSA:BVW:gv/17, July 26, 1978.

10. Memo, B. V. Winkel to T. M. Burke, "Reactor Inlet/Mixed Mean Plenum Temperature Difference," SSA:BVW:gb/3, January 31, 1984.

4.0 REFERENCES (continued)

11. TC-1343, "FFTF Thermal Transient Events for Period Ending December 31, 1978," March 16, 1979.

12. TC-1451, "FFTF Thermal Transient Events During January - March 1979 and DHX Testing at LMEC," June 1979.

13. TC-1509, "FFTF Thermal Transient Events During April - June 1979," September 1979.

14. TC-1662, "FFTF Thermal Transient Events During July - December 1979 and HTS Pressure Events," March 1980.

15. TC-1775, "FFTF Thermal and Pressure Transients Events During January - June 1980," September 1980.

16. TC-2037, "FFTF Thermal and Pressure Transient Events During July - December 1980," September 1981.

17. HEDL - TC-2130, "FFTF Thermal and Pressure Transients Events During January - June 1981," January 1982.

18. HEDL - TC-2193, "FFTF Thermal and Pressure Transient Events During July - December 1981," April 1982.

19. HEDL - TC-2313, "FFTF Thermal and Pressure Transient Events During Cycle 1," January 1983.

20. HEDL-TC-2488, "FFTF Thermal and Pressure Transient Events During Cycle 2," November, 1983.

4.0 REFERENCES (continued)

21. HEDL-TC-2504, "FFTF Thermal and Pressure Transient Events During Cycle 3," June, 1984.

22. HEDL-TC-2603, "FFTF Thermal and Pressure Transient Events During Cycle 4," August, 1984.

23. HEDL-TC-2674, "FFTF Thermal and Pressure Transient Events During Cycle 5," April, 1985.

24. HEDL-TC-2722, "FFTF Thermal and Pressure Transient Events During Cycle 6, "September, 1985.

25. HEDL-TC-2895, "FFTF Thermal and Pressure Transient Events During Cycle 7," December, 1986.

26. WHC-SP-0207, "FFTF Thermal and Pressure Transient Events During Cycle 8", January 1988.

27 WHC-SP-0208, "FFTF Thermal and Pressure Transient Events During Cycle 9", January, 1988.

28 WHC-SP-0657, "Fast Flux Test Facility Thermal and Pressure Transient Events During Cycle 10", February 1991.

29 Memo, H. H. Ziada to D. F. Hicks, "Conversion Factor Assessment for Actual FFTF Reactor Scram and Startup/Shutdown Thermal Transient; Reactor and Piping System," CSA:HHZ:ggb:91/5

30 WHC-SD-FF-ER-043, "FFTF Closure Head Shutdown Evaluation"

5.0 ABBREVIATIONS

DHX - Dump Heat Exchanger: A heat exchanger which cools the plant sodium by dumping the heat to ambient air.

HTS - Heat Transport System: The primary and secondary sodium systems which provide reactor cooling, refers to all three cooling loops.

N - Normal Transient, e.g., N4/Normal Startup

U - Upset Transient, e.g, U1/Reactor Scram

MIST - Maximum Isothermal System Temperature

MOTA - Materials Open Test Assembly

NSD - Normal Shutdown

NSU - Normal Start-up

OSP - Operations Special Procedure

PHL - Primary Hot Leg

PCL - Primary Cold Leg

RTD - Resistance Temperature Detector

SHL - Secondary Hot Leg

SCL - Secondary Cold Leg

TABLE I

DESCRIPTION OF THERMAL TRANSIENT EVENTS

- CYCLE 11 -

Transient No.	Event No.	Date (1989)	Description
412	N/R**	3/20	Cooldown of secondary HTS Loop 1 due to natural circulation
413	1	3/29	Cooldown of secondary HTS Loop 2 due to transition to natural circulation
414	2	3/30	Secondary Loop 2 Transient due to starting P-5A
415	3	3/31	Exceed 40° ΔT between DHX module outlet temperatures in Loop 2 due to starting Preheater Q-7
416	N/R**	4/01	Cooldown of secondary HTS Loop 2 due to transition to natural circulation
417	4	4/1	Loop 2 Transient due to starting P-5A
418	5	4/3	Exceeded 40°F ΔT between DHX module outlet temperatures in loop 2 due to starting preheater Q-7
419	6	4/4	Cooldown of HTS Loop 1 due to transition to natural circulation.
420/421	7*	4/5 - 4/6	Cooldown of secondary HTS Loop 3 due to natural circulation and HTS Loop 3 transient due to starting P-6A
422/423	8*	4/22	Cooldown of secondary HTS Loop 3 due to natural circulation and HTS Loop 3 transient due to starting P-6A
424	9	5/3 - 5/6	Cycle 11A startup

* Note: Cooldown to Natural Circulation and recovery were listed as separate transient numbers, but were calculated as one event for this report.

** Not Recordable: Examination of the PDS indicated these transients are not recordable

TABLE I (Continued)

DESCRIPTION OF THERMAL TRANSIENT EVENTS

- CYCLE 11 -

Transient No.	Event No.	Date (1989)	Description
425	N/R**	5/8	Power and flow decrease to 75%for fuel feedback characterization test and restoration
426	10	5/15 - 5/16	Shutdown for MIP insertion
427	11	5/21 - 5/23	Startup after MIP insertion
428	12	6/2	Shutdown for MIP removal
429	13	6/14	Startup after MIP removal
430	14	6/19	Loop 2 transient due to fault with E-9 fan control
431	15	7/10	Exceeded 40°F ΔT between DHX module outlet temperatures in loop 2 due to E-8 fan increase
432	16	5/10	Exceeded 40°F ΔT between DHX module outlet temperatures in loop 2 due to E-8, E-10, and E-11 overspeed
433	17	9/17 - 9/18	Cycle 11A shutdown
434	N/R**	10/3	Exceeded 40°F ΔT between DHX module outlet temperatures in loop 2 due to starting Q-7
435	N/R**	10/3	Exceeded 40°F ΔT between DHX module outlet temperatures in loop 3 due to starting Q-12
436	N/R**	10/9	Temperatures went from 410°F to 365°F during performance of SC-51-5

* Note: Cooldown to Natural Circulation and recovery were listed as separate transient numbers, but were calculated as one event for this report.

** Not Recordable: Examination of the PDS indicated these transients are not recordable

TABLE I (Continued)

DESCRIPTION OF THERMAL TRANSIENT EVENTS

- CYCLE 11 -

Transient No.	Event No.	Date (1989-90)	Description
437	N/R**	10/11	Exceeded 40°F ΔT between DHX module outlet temperatures in loop 3 due to starting P-6A
438	N/R**	10/20 - 10/21	Temperatures went from 410°F to 357°F during performance of SC-51-5
439	N/R**	10/22	Perform SN-90-5
440	N/R**	10/25	Cooldown of secondary HTS Loop 1 due to transition to natural circulation
441	N/R**	10/27	Secondary HTS loop 1 transient due to starting P-4A
442	N/R**	11/2	Cooldown of secondary loop 3 due to transition to natural circulation
443	N/R**	11/3	Loop 3 transient due to starting P-6A
444	18	11/4 - 12/20	Reactor head ΔT >100°F due to work on FTP#2
445	19	1/4/90 - 1/8/90	11B-1 Startup
446	20	3/7	Scram from 100% power
447	21	3/8 - 3/10	Power increase to 100%
448	22	3/23	Shutdown to hot standby
449	23	3/24 - 3/26	Power increase to 100%
450	24	4/7	Shutdown at end of cycle 11B-1
451	25	5/1	Cooldown of secondary loop 1 due to transition to natural circulation

* Note: Cooldown to Natural Circulation and recovery were listed as separate transient numbers, but were calculated as one event for this report.

** Not Recordable: Examination of the PDS indicated these transients are not recordable

TABLE I (Continued)

DESCRIPTION OF THERMAL TRANSIENT EVENTS

- CYCLE 11 -

Transient No.	Event No.	Date (1990)	Description
452	N/R**	5/2	Loop 1 transient due to starting P-4A
453	26	5/8	Cooldown of secondary loop 3 due to transition to natural circulation
454	N/R**	5/9	Loop 3 transient due to starting P-6A
455	27	5/14	Exceeded 40°F ΔT between DHX module outlet temperatures in loop 1
456	N/R**	5/15	Cooldown of loop 2 due to natural circulation
457	N/R**	5/17	Loop 2 transient due to starting P-5A
458	28	5/29 - 56/3	Cycle 11B-2 Startup
459	29	5/31	E-9 Fan lost control
460	30	6/12	Reactor Scram from 100% power
461	31	6/12	Exceeded 40° ΔT between DHX module outlet temperatures
462	32	6/22 - 6/24	Power increase to 100%
463	33	8/1	Exceeded 40° ΔT between DHX module outlet temperatures.
464	34	9/7 - 9/8	Reactor Scram from 100% power
465	35	9/8 - 9/10	Power increase to 100% power
466	36	9/14	Reactor Scram from 100% power

* Note: Cooldown to Natural Circulation and recovery were listed as separate transient numbers, but were calculated as one event for this report.

** Not Recordable: Examination of the PDS indicated these transients are not recordable

TABLE I (Continued)

DESCRIPTION OF THERMAL TRANSIENT EVENTS

- CYCLE 11 -

Transient No.	Event No.	Date (1990-91)	Description
467	37	9/15 - 9/17	Power increase to 100% power
468	38	10/27 - 10/28	Shutdown at end of cycle 11B-2
469	39	10/31	Cooldown of Loop 2 due to transition to natural circulation
470	N/R**	10/31	Loop 2 transient due to restarting P-5A
471	N/R**	11/6	Cooldown of loop 1 due to transition to natural circulation
472	N/R**	11/9 - 11/10	Loop 1 transient due to restarting P-4A
473	N/R**	11/12	Cooldown of loop 3 due to transition to natural circulation
474	N/R**	11/21	Loop 3 transient due to restarting P-6A
475	N/R**	11/27	Cooldown of loop 2 due to transition to natural circulation
476	N/R**	11/28	Loop 2 transient due to restarting P-5A
477	40	12/20 - 12/27	Cycle 11C Startup
478	41	12/29	Primary Hot Leg temperature loop 2 changed by <21°F in six hours while performing SC-31-1
479	42	2/11 - 2/12/91	Unplanned Reactor Shutdown
480	43	2/13 - 2/15	Restart
481	44	3/19 - 3/20	Unplanned manual reactor shutdown and cooldown to refueling temperatures

* Note: Cooldown to Natural Circulation and recovery were listed as separate transient numbers, but were calculated as one event for this report.

** Not Recordable: Examination of the PDS indicated these transients are not recordable

TABLE II - COMPONENT/SECTION AFFECTED BY THERMAL TRANSIENTS - CYCLE 10*

EVENT NO. (TABLE I)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Reactor Head									X	X	X	X	X				X	X	X
Reactor Vessel									X	X	X	X	X				X		X
PHL Loop 1									X	X	X	X	X				X		X
PCL Loop 1						X		X	X	X	X	X	X				X		X
SHL Loop 1									X	X	X	X	X				X		X
SCL Loop 1						X		X	X	X	X	X	X	X			X		X
PHL Loop 2									X	X	X	X	X	X			X		X
PCL Loop 2		X		X					X	X	X	X	X	X			X		X
SHL Loop 2									X	X	X	X	X	X			X		X
SCL Loop 2	X			X					X	X	X	X	X				X		X
PHL Loop 3									X	X	X	X	X				X		X
PCL Loop 3							X		X	X	X	X	X				X		X
SHL Loop 3									X	X	X	X	X				X		X
SCL Loop 3							X		X	X	X	X	X				X		X
DHX E-4									X	X	X	X	X				X		X
DHX E-5									X	X	X	X	X				X		X
DHX E-6									X	X	X	X	X				X		X
DHX E-7									X	X	X	X	X				X		X
DHX E-8									X	X	X	X	X	X	X	X	X		X
DHX E-9									X	X	X	X	X	X		X	X		X
DHX E-10			X		X				X	X	X	X	X	X		X	X		X
DHX E-11									X	X	X	X	X	X		X	X		X
DHX E-12									X	X	X	X	X				X		X
DHX E-13									X	X	X	X	X				X		X
DHX E-14									X	X	X	X	X				X		X
DHX E-15									X	X	X	X	X				X		X

TABLE II - COMPONENT/SECTION AFFECTED BY THERMAL TRANSIENTS - CYCLE 10* (continued)

EVENT NO. (TABLE I)	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Reactor Head	X	X	X	X	X				X		X		X		X	X	X	X	X
Reactor Vessel	X	X	X	X	X				X		X		X		X	X	X	X	X
PHL Loop 1	X	X	X	X	X				X		X		X		X	X	X	X	X
PCL Loop 1	X	X	X	X	X				X		X		X		X	X	X	X	X
SHL Loop 1	X	X	X	X	X				X		X		X		X	X	X	X	X
SCL Loop 1	X	X	X	X	X	X			X		X		X		X	X	X	X	X
PHL Loop 2	X	X	X	X	X				X		X		X		X	X	X	X	X
PCL Loop 2	X	X	X	X	X				X		X		X		X	X	X	X	X
SHL Loop 2	X	X	X	X	X				X		X		X		X	X	X	X	X
SCL Loop 2	X	X	X	X	X				X		X		X		X	X	X	X	X
PHL Loop 3	X	X	X	X	X				X		X		X		X	X	X	X	X
PCL Loop 3	X	X	X	X	X				X		X		X		X	X	X	X	X
SHL Loop 3	X	X	X	X	X				X		X		X		X	X	X	X	X
SCL Loop 3	X	X	X	X	X		X		X		X		X		X	X	X	X	X
DHX E-4	X	X	X	X	X			X	X		X		X		X	X	X	X	X
DHX E-5	X	X	X	X	X				X		X		X	X	X	X	X	X	X
DHX E-6	X	X	X	X	X				X		X		X		X	X	X	X	X
DHX E-7	X	X	X	X	X				X		X		X		X	X	X	X	X
DHX E-8	X	X	X	X	X				X		X	X	X		X	X	X	X	X
DHX E-9	X	X	X	X	X				X	X	X		X		X	X	X	X	X
DHX E-10	X	X	X	X	X				X		X		X		X	X	X	X	X
DHX E-11	X	X	X	X	X				X		X		X		X	X	X	X	X
DHX E-12	X	X	X	X	X				X		X		X		X	X	X	X	X
DHX E-13	X	X	X	X	X				X		X		X		X	X	X	X	X
DHX E-14	X	X	X	X	X				X		X		X		X	X	X	X	X
DHX E-15	X	X	X	X	X				X		X		X		X	X	X	X	X

TABLE II - COMPONENT/SECTION AFFECTED BY THERMAL TRANSIENTS - CYCLE 10*(CONTINUED)

EVENT NO. (TABLE I)	39	40	41	42	43	44
Reactor Head		X	X	X	X	X
Reactor Vessel		X	X	X	X	X
PHL Loop 1		X	X	X	X	X
PCL Loop 1		X	X	X	X	X
SHL Loop 1		X	X	X	X	X
SCL Loop 1		X	X	X	X	X
PHL Loop 2		X	X	X	X	X
PCL Loop 2		X	X	X	X	X
SHL Loop 2		X	X	X	X	X
SCL Loop 2	X	X	X	X	X	X
PHL Loop 3		X	X	X	X	X
PCL Loop 3		X	X	X	X	X
SHL Loop 3		X	X	X	X	X
SCL Loop 3		X	X	X	X	X
DHX E-4		X	X	X	X	X
DHX E-5		X	X	X	X	X
DHX E-6		X	X	X	X	X
DHX E-7		X	X	X	X	X
DHX E-8		X	X	X	X	X
DHX E-9		X	X	X	X	X
DHX E-10		X	X	X	X	X
DHX E-12		X	X	X	X	X
DHX E-13		X	X	X	X	X
DHX E-14		X	X	X		X
DHX E-15		X	X	X		X

TABLE III

CUMULATIVE THERMAL TRANSIENTS THROUGH CYCLE 10

TYPES OF TRANSIENTS	COMPONENT GROUPS								SPECIFIED NUMBER
	PHL HTS LOOP 1	PCL HTS LOOP 1	SHL HTS LOOP 1	SCL HTS LOOP 1	DHX MODULE E-4	DHX MODULE E-5	DHX MODULE E-6	DHX MODULE E-7	
N1/DRY PREHEATING	2.0	2.0	2.0	2.0	7.0	3.0	6.0	5.0	10
N1/Dry Cooling	1.0	1.0	1.0	1.0	6.0	2.0	5.0	4.0	10
N4/Normal Startup (Note 3)	76.3	67.2	73.3	62.5	73.2	72.4	73.3	73.3	843
N4/Normal Shutdown (Note 3)	56.6	49.8	55.6	50.0	56.9	63.7	56.5	56.0	118 (Note 6)
N8/DHX Deisolation at HSB	----	----	----	----	1.0	0	0	2.0	10 Note 4
U/1 Reactor Scram	54.3	60.5	54.4	68.1	72.5	74.3	74.7	75.5	580
U/2 Control Rod Drop	0	0	0	0	0	0	0	0	20
U3/Loss of Electrical Power to One Primary Pump	0	0	0	0	0	0	0	0	7 Note 1
U4/Loss of Electrical Power to One Sec. Pump	0	0	0	0	0	0	0	0	7 Note 1
U5/Loss of Airflow Through One DHX Module									
Failed Module:	0	0	0	0	.8	4.4	0	1.4	7 Note 2
Intact Module:	0	0	0	0	0	1.0	0	0	20 Note 2
U6/Loss of airflow through All DHX's in One Loop	0	0	0	0	0.6	1.5	0.6	1.1	7 Note 1
U7/Closure of DHX Isolation Valve	0	0	0	0	1.0	1.0	0	0	7 Note 2
U8/Primary Pump Motor Failure	0	0	0	0	0	0	0	0	7 Note 1
U9/Scram with Excess Airflow in One DHX Module	0	0	0	0.3	1.0	3.4	0	0.6	20 Note 5
U/10 Reactivity Insertion	0	0	0	0	0	0	0	0	20

TABLE III (page 2)

CUMULATIVE THERMAL TRANSIENTS THROUGH CYCLE 10

TYPES OF TRANSIENTS	PHL HTS LOOP 2	PCL HTS LOOP 2	SHL HTS LOOP 2	SCL HTS LOOP 2	SCL MODULE E-8	DHX MODULE E-9	DHX MODULE E-10	DHX MODULE E-11	SPECIFIED NUMBER
	COMPONENT GROUPS								
N1/DRY PREHEATING	1.0	1.0	1.0	1.0	9.5	3.0	7.0	4.3	10
N1/Dry Cooling	0	0	0	0	8.5	2.0	6.0	3.3	10
N4/Normal Startup (Note 3)	73.1	64.5	73.0	61.6	73.6	73.7	63.6	64.5	843
N4/Normal Shutdown (Note 3)	55.1	49.1	55.3	50.8	68.0	58.0	57.9	57.9	118 (Note 6)
N8/DHX Deisolation at HSB	----	----	----	----	1.0	1.0	0	0	10 Note 4
U/1 Reactor Scram	52.1	60.2	52.0	65.6	69.9	69.8	66.5	75.1	580
U/2 Control Rod Drop	0	0	0	0	0	0	0	0	20
U3/Loss of Electrical Power to One Primary Pump	0	0	0	0	0	0	0	0	7 Note 1
U4/Loss of Electrical Power to One Sec. Pump	0	0	0	0	0	0	0	0	7 Note 1
U5/Loss of Airflow Through One DHX Module									
Failed Module:	0	0	0	0	0	1.0	0.9	0	7 Note 2
Intact Module:	0	0	0	0	1.5	0.5	1.7	1.5	20 Note 2
U6/Loss of airflow through All DHX's in One Loop	0.4	0.4	0.4	2.0	2.7	2.5	2.8	2.8	7 Note 1
U7/Closure of DHX Isolation Valve	0	0	0	0	0	0	0	0	7 Note 2
U8/Primary Pump Motor Failure	0	0	0	0	0	0	0	0	7 Note 1
U9/Scram with Excess Airflow in One DHX Module	0	0	0	0.5	0.7	2.2	1.5	0.5	20 Note 5
U/10 Reactivity Insertion	0	0	0	0	0	0	0	0	20

TABLE III (page 3)

CUMULATIVE THERMAL TRANSIENTS THROUGH CYCLE 10

TYPES OF TRANSIENTS	COMPONENT GROUPS								SPECIFIED NUMBER
	PHL HTS LOOP 3	PCL HTS LOOP 3	SHL HTS LOOP 3	SCL HTS LOOP 3	DHX MODULE E-12	DHX MODULE E-13	DHX MODULE E-14	DHX MODULE E-15	
N1/DRY PREHEATING	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	10
N1/Dry Cooling	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	10
N4/Normal Startup (Note 3)	75.9	65.6	73.0	61.4	72.2	72.2	72.2	72.5	843
N4/Normal Shutdown (Note 3)	57.9	51.6	56.4	51.1	57.0	56.1	57.0	57.0	118 (Note 6)
N8/DHX Deisolation at HSB	----	----	----	----	0	0	0	0	10 Note 4
U/1 Reactor Scram	56.3	65.6	51.8	73.5	81.5	78.1	78.5	78.2	580
U/2 Control Rod Drop	0	0	0	0	0	0	0	0	20
U3/Loss of Electrical Power to One Primary Pump	0	0	0	0	0	0	0	0	7 Note 1
U4/Loss of Electrical Power to One Sec. Pump	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	7 Note 1
U5/Loss of Airflow Through One DHX Module									
Failed Module:	0	0	0	0	1.5	2.7	0	0	7 Note 2
Intact Module:	0	0	0	0	0	0	0	0	20 Note 2
U6/Loss of airflow through All DHX's in One Loop	0	0	0	3.1	5.4	3.8	3.8	3.8	7 Note 1
U7/Closure of DHX Isolation Valve	0	0	0	0	0	0	0	0	7 Note 2
U8/Primary Pump Motor Failure	0	0	0	0	0	0	0	0	7 Note 1
U9/Scram with Excess Airflow in One DHX Module	0	0	0	0.6	1.2	2.3	0.6	0.6	20 Note 5
U/10 Reactivity Insertion	0	0	0	0	0	0	0	0	20

TABLE III (page 4)

CUMULATIVE THERMAL TRANSIENTS THROUGH CYCLE 10

TYPES OF TRANSIENTS	CORE COMPONENT GROUPS				SPECIFIED
	Reactor Head	Reactor Vessel	Reactor Vessel Inlet Plenum*	Reactor Vessel Outlet Plenum*	
N1/DRY PREHEATING	1.0	1.0	1.0	1.0	10
N1/Dry Cooling	0	0	0	0	10
N4/Normal Startup (Note 3)	77.1	84.1	67.7	74.1	843
N4/Normal Shutdown (Note 3)	61.1	56.3	51.5	56.7	118 (Note 6)
U/1 Reactor Scram	56.9	61.7	66.6	56.4	580
U/2 Control Rod Drop	0	0	0	0	20
U3/Loss of Electrical Power to One Primary Pump	0	0	0	0	7 Note 1
U4/Loss of Electrical Power to One Sec. Pump	0	0	0	0	7 Note 1
U6/Loss of airflow through All DHX's in One Loop	0	0	0	0	7 Note 1
U8/Primary Pump Motor Failure	0	0	0	0	7 Note 1
U9/Scram with Excess Airflow in One DHX Module	0	0	0	0	20 Note 5
U/10 Reactivity Insertion	0	0	0	0	20

*The Inlet Plenum and Outlet Plenum include components that have 20 year and 10 year design lifetimes. The twenty year components are allotted the specified number of thermal events shown, but the 10 year components were originally allotted half the specified number of events. During Cycle 11 the 10 year components were approaching their allotted 59 shutdown transients. The 10 year components were specifically analyzed by Component Stress Analysis on EDT-125256 for effect of the normal shutdown transient. The maximum stress associated with a shutdown transient is less than the endurance limit of the material, so the transients may be increased as required without increasing creep fatigue damage. The 10 year components will no longer have a limit on normal shutdowns.

Inlet Plenum Group	
Core Basket	20 Years
Core Support Structure	20 Years
Inner Radial Shielding	10 Years
Outer Radial Shielding	20 Years
Inner Core Restraint Module	20 Years
Outer Core Restraint Module	20 Years

Outlet Plenum Group	
Instrument Tree	10 Years
Low Level Flux Monitor	10 Years
Post Irradiation Open Test Assembly	10 Years
Control Rod Drive - Line	10 Years
Temperature Liquid Level Monitor	20 Years
In-Vessel Handling Machine	10 Years
Suppressor Plate	20 Years

Notes for Table III

1. The specified number is for each loop. Total specified for the plant is 20.

2. The specified number is for each DHX module. Total specified for the plant is 80.

3. System fill and drain cycles are included in the normal startup/shutdown listing to be consistent with Reference 3.

4. The N5 design transient was defined in Reference 3 as a Controlled Operating Power Level Change; consequently, the DHX Deisolation at Hot Standby event defined as an N5 event in the Cycle 2 report has been redesignated as an N8 event.

5 The specified number is for each component (Reference 7)

6. For the MHTS the number of shutdown transients may be increased by exchanging for an equal number of scram transients as long as the total number of shutdown transients does not exceed the total number of 823 specified for the 20 year lifetime.(See Reference 29)

TABLE IV

CUMULATIVE PRESSURE TRANSIENTS THROUGH CYCLE 11

EVENT SPECIFIED	COMPONENT GROUP			No.
	Primary P-1, 2, 3	Secondary Loop 1 P-4	Secondary Loop 2 P-5	Secondary Loop 3 P-6
UP1/Primary Pump 25 Overspeed	1	-	-	-
UP2/Secondary Pump 21 Overspeed	-	0	1	1
UP3/Secondary Pump 4 Overspeed with one DHX Module Isolated	-	0	0	0

TABLE V

CUMULATIVE DHX OUTLET TEMPERATURE DIFFERENCE EVENTS

THROUGH CYCLE 11

Allowable Tee Involved Consumed	Time at* 40-100'F (22-56'C)	Time at* >100'F (>56'C)	Fraction of Design Cycles
E-4/E-5	23:32	0:25	7.412×10^{-3}
E-6/E-7	4:23	0:24	1.1×10^{-2}
E-8/E-9	10:04	0:18	2.952×10^{-3}
E-10/E-11	1:29	0:05	5.29×10^{-6}
E-12/E-13	15:28	0:04	5.93×10^{-4}
E-14/E-15	2:44	0	1.93×10^{-5}
(E-12, E-13) (E-14, E-15)	0:54	0	6.52×10^{-6}

*Hr:Min

TABLE VI
CUMULATIVE NON-HTS THERMAL TRANSIENTS THROUGH CYCLE 11

Event	Resulting Damage Fraction	Total Damage Fraction to Date
Reactor Vessel Makeup Nozzle		
- Calculated Design Transients	0.19	0.19
- Makeup Nozzle ΔT 210°F to 250°F (99°C to 121°C) for 9 hrs on 12/19/81	<0.025	0.22

APPENDIX A

HTS THERMAL TRANSIENTS

A.0 HTS THERMAL TRANSIENTS

Recordable thermal transients which occurred during Cycle 11 were discussed in section 2.1 and are listed in table 1.

The design transient fractions assigned to each component or pipe section for these events are provided in Table A-1 as listed in table 1. This information is provided so that it will be available for future reference if it becomes necessary to more precisely analyze these transients.

TABLE A-1
ASSIGNED FRACTION OF THERMAL TRANSIENTS-CYCLE 11

TRANSIENT No. (TABLE I)	COMPONENT	N4U	N4D	U1	OTHER	MIXING TEES
412	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
413	SCL Loop 2			0.7		
414	PCL Loop 2			0.7		
415	E-10 DHX			0.1		
416	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
417	PCL Loop 2			0.5		
	SCL Loop 2			0.7		
418	E-10 DHX				0.1 U5	
419	PCL Loop 1			0.5		
	SCL Loop 1			0.7		
420 & 421	PCL Loop 3			0.6		
	SCL Loop 3			0.75		
422 & 423	PCL Loop 3			0.6		
	SCL Loop 3			0.75		
424	PHL	1.0				
	PCL	1.0				
	SHL	1.0				
	SCL*	1.0				
425	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.b					
426	PHL		1.0			
	PCL		1.0			
	SHL		1.0			
	SCL*		1.0			
427	PHL	1.0				
	PCL	1.0				
	SHL	1.0				
	SCL*	1.0				

*Includes associated DHX modules.

TABLE A-1 (continued)
ASSIGNED FRACTION OF THERMAL TRANSIENTS-CYCLE 11

TRANSIENT No. (TABLE I)	COMPONENT	N4U	N4D	U1	OTHER	MIXING TEES
428	PHL		1.0			
	PCL		1.0			
	SHL		1.0			
	SCL*		1.0			
429	PHL	1.0				
	PCL	1.0				
	SHL	1.0				
	SCL*	1.0				
430	E-8 DHX				0.2 U5 intact	
	E-9 DHX				0.2 U5 failed	
	E-10 DHX				0.2 U5 intact	
	E-11 DHX				0.2 U5 intact	
	PHL Loop 2				0.4 U6	
	PCL Loop 2				0.4 U6	
	SHL Loop 2				0.4 U6	
	SCL Loop 2*				0.4 U6	
	E8 - E9 Mixing Tee					$2.4X10^{-7}$
431	E-8 DHX				0.2 U9	
	E8 - E9 Mixing Tee					$1.2X10^{-6}$
432	E-8 DHX				0.7 U5 Intact	
	E-9 DHX				0.35 U5 Failed	
	E-10 DHX				0.7 U5 Intact	
	E-11 DHX				0.7 U5 Intact	
	E8 - E9 Mixing Tee					$4.3X10^{-4}$
433	PHL		1.0			
	PCL		1.0			
	SHL		1.0			
	SCL*		1.0			
434	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.d					
435	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.d					
436	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.d					

*Includes associated DHX modules.

TABLE A-1 (continued)
ASSIGNED FRACTION OF THERMAL TRANSIENTS-CYCLE 11

TRANSIENT No. (TABLE I)	COMPONENT	N4U	N4D	U1	OTHER	MIXING TEES
437	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.d					
438	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
439	No recordable transient could be found on PDS					
440	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
441	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
442	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
443	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
444	Evaluation of the Reactor Head ΔT >100°F Event indicates the Damage was insignificant. See WHC-SD-FF-ER-043					
445	PHL	1.0				
	PCL	1.0				
	SHL	1.0				
	SCL*	1.0				
446	PHL			1.0		
	PCL			1.0		
	SHL			1.0		
	SCL*			1.0		
447	PHL	0.5				
	PCL	0.5				
	SHL	0.5				
	SCL*	0.5				

*Includes associated DHX modules.

TABLE A-1 (continued)
ASSIGNED FRACTION OF THERMAL TRANSIENTS-CYCLE 11

TRANSIENT No. (TABLE I)	COMPONENT	N4U	N4D	U1	OTHER	MIXING TEES
448	PHL		0.5			
	PCL		0.5			
	SHL		0.5			
	SCL*		0.5			
449	PHL	0.5				
	PCL	0.5				
	SHL	0.5				
	SCL*	0.5				
450	PHL		1.0			
	PCL		1.0			
	SHL		1.0			
	SCL*		1.0			
451	SCL Loop 1			0.8		
452	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
453	SCL Loop 3			0.8		
454	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
455	E-4 DHX				1.0 U5	Intact
	E4 - E5 Mixing Tee					$1.2X10^{-7}$
456	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
457	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
458	PHL	0.7				
	PCL	0.7				
	SHL	0.7				
	SCL*	0.7				

*Includes associated DHX modules.

TABLE A-1 (continued)
ASSIGNED FRACTION OF THERMAL TRANSIENTS-CYCLE 11

TRANSIENT No. (TABLE I)	COMPONENT	N4U	N4D	U1	OTHER	MIXING TEES
459	E-9 DHX				0.5 U9	
	E8 - E9 Mixing Tee					$2.4X10^{-7}$
460	PHL			1.0		
	PCL			1.0		
	SHL			1.0		
	SCL*			1.0		
461	E-8 DHX			1.2		
	E8 - E9 Mixing Tee					$2.4X10^{-7}$
462	PHL	1.0				
	PCL	1.0				
	SHL	1.0				
	SCL*	1.0				
463	E-5 DHX				0.4 U5 Failed 0.1 U9	
	E4 - E5 Mixing Tee					$2.3X10^{-6}$
464	PHL			1.0		
	PCL			1.0		
	SHL			1.0		
	SCL*			1.0		
	E8 - E9 Mixing Tee					$4.8X10^{-7}$
465	PHL	1.0				
	PCL	1.0				
	SHL	1.0				
	SCL*	1.0				
466	PHL			1.0		
	PCL			1.0		
	SHL			1.0		
	SCL*			1.0		
467	PHL	0.5				
	PCL	0.5				
	SHL	0.5				
	SCL*	0.5				

*Includes associated DHX modules.

TABLE A-1 (continued)
ASSIGNED FRACTION OF THERMAL TRANSIENTS-CYCLE 11

TRANSIENT No. (TABLE I)	COMPONENT	N4U	N4D	U1	OTHER	MIXING TEES
468	PHL		0.7			
	PCL		0.7			
	SHL		0.7			
	SCL*		0.7			
469	SCL Loop 2			0.75		
470	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
471	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
472	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
473	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
474	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
475	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
476	Examination of the PDS indicated this transient was not recordable per EI-078 section 5.2.1.1.c					
477	PHL	0.8				
	PCL	0.8				
	SHL	0.8				
	SCL*	0.8				
478	PHL			0.25		
	PCL			0.25		
	SHL			0.25		
	SCL*			0.25		
479	PHL		1.0			
	PCL		1.0			
	SHL		1.0			
	SCL*		1.0			

*Includes associated DHX modules.

TABLE A-1 (continued)
ASSIGNED FRACTION OF THERMAL TRANSIENTS-CYCLE 11

TRANSIENT No. (TABLE I)	COMPONENT	N4U	N4D	U1	OTHER	MIXING TEES
480	PHL	0.6				
	PCL	0.6				
	SHL	0.6				
	SCL*	0.6				
481	PHL		0.25	1.0		
	PCL		0.25	1.0		
	SHL		0.25	1.0		
	SCL*		0.25	1.0		

*Includes associated DHX modules.

APPENDIX B

HTS PRESSURE TRANSIENTS

B.0 HTS PRESSURE TRANSIENTS

During Cycle 11 there were no events in which the ASME operating pressure was exceeded.

APPENDIX C

DHX OUTLET TEMPERATURE DIFFERENCE EVENTS

C.0 DHX OUTLET DIFFERENCE EVENTS

On June 19, 1989, E-8 / E-9 Mixing Tee experienced an 83°F ΔT when E-9 Fan coasted down. The ΔT was in excess of 40°F for 1 minute 40 seconds. The event is evaluated on F9-1627/W. The resulting mixing tee damage fraction is conservatively calculated to be 1.92 X 10^{-6} per Reference 4.

On July 10, 1989, E-8 / E-9 Mixing Tee experienced a 59°F ΔT when E-8 Fan overspeeded. The ΔT was in excess of 40°F for 10 minutes. The event is evaluated on F9-1925/W. The resulting mixing tee damage fraction is conservatively calculated to be 1.2 X 10^{-6} per Reference 4.

On July 20, 1989, E-8 / E-9 Mixing Tee experienced a 133°F ΔT when E-9 Fan coasted down again. The ΔT was in excess of 40°F for 5.7 minutes. The event is evaluated on F9-1925/W. The resulting mixing tee damage fraction is conservatively calculated to be 2.85 X 10^{-3} per Reference 4.

On May 14, 1990, while cycling valves on E-4 DHX Module, E-4 / E-5 mixing tee experienced a 62°F ΔT. The resulting ΔT was > 40°F for one minute. The event is evaluated on F0-1442/W. The resulting mixing tee damage fraction is calculated to be 1.2 X 10^{-7} per reference 4.

On May 31 1990, E-8 / E-9 Mixing Tee experienced a 72°F ΔT when E-9 Fan control failed. The ΔT was in excess of 40°F for 2 minutes. The event is evaluated on F0-1589/W. The resulting mixing tee damage fraction is conservatively calculated to be 2.4 X 10^{-7} per Reference 4.

On July 12,1990, after a scram DHX E-8 outlet damper malfunctioned causing a 55°F ΔT. The ΔT was in excess of 40°F for 2 minutes. The event is evaluated on F0-1752/W. The resulting mixing tee damage fraction is conservatively calculated to be 2.4 X 10^{-7} per Reference 4.

On August 1, 1990, DHX E-5 CCD damper malfunctioned two times causing a maximum 73°F ΔT. The ΔT was in excess of 40°F for a total of 19 minutes. The event is evaluated on FO-2201/W. The resulting mixing tee damage fraction is conservatively calculated to be 2.3×10^{-6} per Reference 4.

On September 7, 1990, the plant experienced a scram due to a voltage transient on the Bonneville grid. DHX E-8 Damper controler was in manual causing a Mixing Tee ΔT event No PDS was available, but it was very conservatively estimated from the control room logs that the maximum ΔT was less than 60°F for less than 4 minutes. The event is evaluated on FO-2543/W. The resulting mixing tee damage fraction is conservatively calculated to be 4.8×10^{-7} per Reference 4.

APPENDIX D

NON HTS THERMAL TRANSIENTS

B.0 NON HTS THERMAL TRANSIENTS

There were no significant recordable non-HTS transients during Cycle 11 operation.

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	Document Processing and Distribution (2)	L8-15