PUBLIC SERVICE ELECTRIC AND GAS COMPANY
HOPE CREEK PROJECT

SAFETY EVALUATION

No. PSE-SE-Z-023

TITLE: SIMPLIFICATION OF TEST NUMBER 32, REACTOR WATER CLEANUP SYSTEM

Date: OCT 15 1985

1.0 PURPOSE

The purpose of this Safety Evaluation is to determine if the proposed deletion of the RWCU non-regenerative heat exchanger flow test in the blowdown mode, the bottom head flow rate calibration, and pump available NPSH test from the power ascension test program impacts safety systems or involves any unreviewed safety questions.

2.0 SCOPE

The scope of this Safety Evaluation is to determine the adequacy of the power ascension program with respect to the proposed RWCU test deletions.

3.0 REFERENCES

1. NRC Regulatory Guide 1.68, Revision 2, August 1978
2. General Electric Startup Test Specification 23A4137, Revision 0
3. FSAR Chapter 14, Section 14.2.12.3.32

4.0 DISCUSSION

Regulatory Guide 1.68, Revision 2, Appendix A, paragraph 4.r requires the demonstration of the operability of reactor coolant system purification and cleanup systems during low power testing. Test Number 32 demonstrates the operation of the RWCU system. Process variables are recorded with the reactor at rated temperature and pressure during steady state operation of the RWCU system in three modes: hot standby, normal, and blowdown. In addition, the RWCU pump available net positive suction head (NPSH) is determined and the bottom head drain flow calibration is verified during the hot standby mode of operation. It is proposed to delete the RWCU non-regenerative heat exchanger (NRHX) flow test in the

blowdown mode, as well as, the bottom head flow indicator calibration from the power ascension testing program, and to perform the RWCU pump NPSH test under cold conditions during preoperational testing. It is also proposed to perform the NRHX flow test in the normal mode during Test Condition 1 instead of during Test Condition Heatup.

The present test procedure specifies that process variables will be measured and compared to acceptance criteria which define required system performance. These criteria are provided in GE Test Specification 23A4137, Revision 0. They require that the temperature at the tube side outlet of the NRHX not exceed specified limits when the RWCU is in the blowdown or normal mode of operation. Also, the outlet temperature and cooling water supply of the NRHX shall be within specified limits. Further, the RWCU pump vibration in any mode and available NPSH during the hot standby mode shall be within specified limits. Finally, bottom head and RWCU flow indications shall agree within specified limits.

The RWCU flow test for the NRHX provides information concerning cooling water flow that will be useful during operation of the system. However, performance of this test in the blowdown mode is not necessary to prove that the heat exchange capabilities of the NRHX meet design. During the normal operating mode of the RWCU system, temperature and flow measurements will be obtained to demonstrate the heat exchange capability of the units. From these data, the performance of the heat exchangers in the blowdown mode of operation will be shown to be within the limits of flow and temperature imposed by the design. Also, the RWCU flow test for the NRHX will be performed at Test Condition 1 rather than at Test Condition Heatup. Test Condition 1 is a more representative operating condition since feedwater heaters will be in service.

The determination of the RWCU pump available NPSH is currently being performed as part of the system's preoperational test. However, since the system preoperational test is being performed under cold conditions, calculational methods will be employed to determine the NPSH at the limiting condition (hot standby) using this cold test data as the basis for extrapolation.

The bottom head flow rate calibration is not required because differences between bottom head and RWCU flow indications do not result in any problems in the operating modes of the RWCU system. Because this test and the resulting information do not impact upon any safety conditions, it can be performed at any time following the power ascension test program. Flow rate differences exceeding 25 gpm will be recorded and used as a basis for later calibration.

5.0 CONCLUSION

Performance of the NRHX is adequately demonstrated by a flow test in the normal operating mode during Test Condition 1. Testing of the RWCU pump available NPSH at cold conditions and performing calculations to determine the NPSH at limiting conditions based on the cold test data satisfies one of the objectives of Regulatory Guide 1.68, Appendix A. The difference between the bottom head flow and the RWCU flow indication does not impact upon any safety conditions. Therefore, the proposed changes and deletions will not adversely affect any safety systems or the safe operation of the plant and as such do not involve an unreviewed safety question. Regulatory Guide 1.68, Appendix A, paragraph 4.r objectives are still met with the remaining RWCU testing. FSAR Section 14.2.12.3.32 will require revision to reflect the deletion of the bottom head flow calibration.

6.0 DOCUMENTS GENERATED

None

7.0 RECOMMENDATIONS

Revision to Hope Creek's FSAR and startup test procedures shall be made to reflect the simplification of the RWCU test as described above.

8.0 ATTACHMENTS

None

9.0 SIGNATURES

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Date

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ATTACHMENT 2

TEST NO. (22)	TEST NAME	OPEN VESSEL	HEAT UP	1	2	3	4	5	6	WARRANTY
1	Chemical and Radiochemical	X	X	X		X		X	X	
2	Radiation Measurement	X	X	X		X			X	
3	Fuel Loading	X								
4	Full Core Shutdown Margin	X								
5	Control Rod Drive	X	X	X(2)	X(2)	X(2)			X(2)	
6	SRM Performance	X								
8	IRM Performance		X	X						
9	LPRM Calibration		X	X		X			X	
~~10~~	~~APRM Calibration~~		~~X~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	
11	Process Computer	X	X	X(3)		X		X		
12	RCIC		X	X						
13	HPCI		X			X				
14	Selected Process Temp		X			X	X(4)		X(4)	
14	Water Level Ref Leg Temp		X			X			X	
15	System Expansion	X	X	X		X			X	
16	TIP Uncertainty					X			X	
17	Core Performance			X	X	X	X	X	X	X
18	Steam Production									X
19	Core Pwr-Void Mode Response						X	X		
20	Pressure Regulator			X	X	X	X	X	X	
21	Feed Sys-Set point Changes		X	X	X	X	X	X	X	
21	Feed Sys-Loss FW Heating								X(5)	
21	Feedwater Pump Trip								X(6)	
21	Max FW Runout Capability								X(7)	
22	Turbine Valve Surveillance					X(8)		X(9)	X(10)	
23	MSIV Functional Test		X	X(11)	~~X(12)~~			~~X(13)~~		
23	MSIV Full Isolation								X	
24	Relief Valves		(S) →	X(20)	~~X~~	X(20)			X(20)	
25	Turbine Trip & Load Rejection				X(15)	X(16)			X(17)	
26	Shutdown Outside CRC				X					
27	Recirculation Flow Control				X(14)			X(18)		
28	Recirc-One Pump Trip					X			X	
28	RPT Trip-Two Pumps					X(19)				
28	Recirc System Performance				X	X	X		X	
28	Recirc Pump Runback					X				
28	Recirc Sys Cavitation					X				
30	Loss of Offsite Pwr			X						
31	Pipe Vibration		X	X	X	X			X	
29	Recirc Flow Calibration					X			X	
32	RWCU		~~X~~	X						
33	RHR				X				X(21)	
34	Drywell & Steam Tunnel Cooling		X	X		X			X	
35	Gaseous Radwaste			X		X			X	
38	SACS Performance					X			X	
40	Confirmatory In-Plant Test				X					

(1) Test conditions refer to plant conditions on Figure 14.2-4

(2) Perform Test 5, timing of 4 slowest control rods, in conjunction with expected scrams

(3) Dynamic System Test Case to be completed between test conditions 1 and 3

(4) After recirculation pump trips (natural circulation)

(5) Between 80 and 90 percent thermal power, and near 100 percent core flow

(6) Max FW Runout Capability & Recirc Pump Runback must have already been completed

(7) Reactor power between 80 and 90 percent

(8) Reactor power between 45 and 65 percent

(9) Reactor power between 75 and 90 percent

(10) At maximum power that will not cause scram

(11) Perform between test conditions 1 and 3

~~(12) Reactor power between 40 and 55 percent~~

~~(13) Reactor power between 60 and 85 percent~~

(14) Between test conditions 2 and 3

(15) Generator load rejection, within bypass valve capacity

(16) Reactor power between 60 and 80 percent at core flow $\geq$ 95 percent - turbine trip

(17) Load rejection

(18) Between test conditions 5 and 6

(19) >50% power and $\geq$95 core flow, and performed before Turbine Trip & Load Rejection

(20) Check SRV set points during major scram tests

(21) Performed during cooldown from test condition 6

(22) The test number correlates to FSAR Section 14.2.12.3.x where x is the indicated test number.

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TEST SCHEDULE AND CONDITIONS

FIGURE 14.2-6 Amendment 10, 06/85

p. Appendix A, Paragraph 2.e - Compliance with Regulatory Guide 1.56, Maintenance of Water Purity in Boiling Water Reactors, is addressed in Section 1.8.1.56.

q. Appendix A, Paragraph 4.m - Following fuel load, there is no planned startup test of the MSIV leak control system. The preoperational test demonstrates the operability of the system at design conditions. Testing following fuel load does not contribute any additional meaningful data.

PARAGRAPH 4.P - MAIN STEAM SYSTEM RELIEF VALVE TESTING WILL BE PERFORMED AT A POWER LEVEL BETWEEN 10 AND 20% OF RATED THERMAL POWER IN ORDER TO PROVIDE ADEQUATE CONTROL OF SYSTEM PRESSURE.

r. Appendix A, Paragraph 5.j - Rod runback and partial scram testing is not performed because the plant does not have this design feature.

s. Appendix A, Paragraph 5.n - Although there will be no startup test procedure designated loose parts monitoring, additional data to supplement the preoperational program on loose parts monitoring will be taken as stated in Section 14.2.10.

t. Appendix A, Paragraph 5.q - There are no startup tests of the failed fuel detection systems. Preoperational testing and periodic surveillance testing after fuel load ensure the proper operation of radiation monitoring systems used for isolation signals in case of gross fission product release. Data is recorded from these systems and used as baseline data.

u. Appendix A, Paragraph 5.s - Although there will be no startup test procedure designated hotwell level control, operation of the hotwell level control system will be verified using station operating procedures and monitoring hotwell level during Phase III startup testing.

PARAGRAPH 5.Y - THERE WILL BE NO STARTUP TEST PROCEDURE DESIGNATED APRM CALIBRATION, NORMAL PLANT TECHNICAL SPECIFICATION SURVEILLANCE PROCEDURES WILL BE PERFORMED TO ENSURE THE APRM'S ARE PROPERLY CALIBRATED.

v. Appendix A, Paragraph 5.dd - Compliance with Regulatory Guide 1.68.2, Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants, is addressed in Section 1.8.1.68.2.

w. Appendix A, Paragraph 5.gg - The ATWS subsystems are thoroughly checked out logically and functionally during the preoperational test program, as described in Sections 14.2.12.1.2.c.6, 14.2.12.1.3.c.3, 14.2.12.1.4.c.4, 14.2.12.1.8.c.9, 14.2.12.1.9.c.7, and 14.2.12.1.10.c.4. Portions of ATWS governed by Technical Specifications will be functionally checked just prior to fuel load using station surveillance and calibration procedures. Additionally, the recirculation pump trips (RPT), which are ATWS related, are accomplished during Phase III testing, as discussed in Section 14.2.12.3.28.c.

x. Appendix A, Paragraph 5.LL - Hope Creek design does not incorporate the recirculation flow control valve; however, the runback of the reactor recirculation pumps for cavitation protection and loss of feedwater pump is accomplished during phase III testing, as discussed in Section 14.2.12.3.28.c.

PARAGRAPH 5.m.m-IF AN INADVERTENT FULL ISOLATION OF THE MAIN STEAM LINE ISOLATION VALVES OCCURS BETWEEN 70 AND 100% POWER, THE RESULTS OF THIS TRANSIENT, IF ACCEPTABLE, MAY BE SUBSTITUTED FOR PERFORMANCE OF THIS TEST AT 100% POWER.

1.8.1.68.1 Conformance to Regulatory Guide 1.68.1, Revision 1, January 1977: Preoperational and Initial Startup Testing of Feedwater and Condensate Systems for Boiling Water Reactor Power Plants

HCGS complies with the intent of Regulatory Guide 1.68.1. For further discussion of the initial test program, see Section 14.

1.8.1.68.2 Conformance to Regulatory Guide 1.68.2, Revision 1, July 1978: Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants

HCGS complies with the intent of Regulatory Guide 1.68.2

For further discussion of the initial test program, see Chapter 14.

3.9.2.1.2 Piping Vibration

3.9.2.1.2.1 Preoperational and Startup Vibration Testing of Recirculation Piping

The purpose of the preoperational vibration test phase is to verify that operating vibrations in the recirculation piping and residual heat removal (RHR) suction piping are within acceptable limits. This phase of the test uses visual observation to supplement remote measurements. If, during steady-state operation, visual observation indicates that vibration is significant, measurements are made with a hand-held vibrograph. Visual observation and manual and remote measurements are made during the following steady-state conditions:

a. Minimum flow

b. 50% of rated flow

c. 75% of rated flow

d. 100% of rated flow

e. RHR suction piping at 100% of rated flow in the shutdown cooling mode.

3.9.2.1.2.2 Preoperational Vibration Testing of Small Attached Piping

During visual observation of each of the above test conditions, a. through e., attention is given to small attached piping and instrument connections to ensure that they are not in resonance with the recirculation pump motors or flow-induced vibrations. If the operating vibration acceptance criteria are not met, corrective action such as modification of supports is taken.

3.9.2.1.2.3 Operating Transient Loads on Main Steam ~~and Recirculation Piping~~

The purpose of the operating transient test phase is to verify that pipe stresses are within ASME B&PV Code limits. The amplitude of displacements and number of cycles per transient of the main steam ~~and recirculation piping~~ are measured and displacements compared with acceptance criteria. The deflections are correlated with stresses to verify that the pipe stresses remain within ASME B&PV Code limits. Remote vibration and deflection measurements are taken during the following transients:

~~a. Recirculation pump start~~

~~b. Recirculation pump trip at 100% of rated flow~~

a. Turbine main stop valve closure at 100% power

b. Manual discharge of each safety/relief valve (SRV) at 1000 psig and at planned transient tests that result in SRV discharge.

3.9.2.1.3 Dynamic Effects Testing of Main Steam and Recirculation Piping Systems

To verify that snubbers are adequately performing their intended function during the plant operation, a program for dynamic testing as a part of the initial startup operation testing is conducted. The main purpose of this program is to ensure the following:

a. The vibration levels from the various dynamic loadings during transient and steady-state conditions are below the predetermined acceptable limits.

b. Long-term fatigue failure does not occur due to underestimating the dynamic effects caused by cyclic loading during plant transient operations.

The purpose of dynamic testing is to account for the acoustic wave due to the SRV lift (RV1), SRV loads resulting from air clearing (RV2), and turbine main stop valve closure loads (TSVC). The maximum stress developed in the piping from the RV1, RV2, and TSVC transients is used as a basis for establishing criteria that

14.2.12.3.10 Average Power Range Monitor Calibration

a. Objective

The test objective is to calibrate the APRM.

b. Prerequisite

The core is in a steady-state condition at the desired power level and core flow rate. Instrumentation used to determine core thermal power has been calibrated.

c. Test Method

A heat balance is taken at selected power levels. Each APRM channel reading is adjusted to agree with the core thermal power as determined from the heat balance. In addition, the APRM channels are calibrated at the frequency required by the Technical Specifications.

d. Acceptance Criteria

Level 1:

1. The APRM channels must be calibrated to read equal to or greater than the actual core thermal power.

2. Technical specification limits on APRM scram and rod block must not be exceeded.

3. In the startup mode, all APRM channels must produce a scram at less than or equal to the thermal power setpoint required by technical specification.

Level 2:

With the above criteria met, the APRMs are considered accurate if they agree with the heat balance or the minimum value required based on TPF, MLHGR, and fraction of rated power to within the limits specified in the GE startup test specifications.

14.2.12.3.22 Turbine Valve Surveillance

a. Objective

The test objective is to demonstrate the methods to be used and the maximum power level for routine surveillance testing of the main stop, control, and bypass valves.

b. Prerequisite

The plant has been stabilized at the required power level.

c. Test Method

Individual main stop, control, and bypass valves are manually closed and reset at selected power levels. The response of the reactor is monitored and the maximum power level conditions for the performance of this test are determined. The rate of valve stroking and timing of the closed-open sequence are chosen to minimize the disturbance introduced.

d. Acceptance Criteria

Level 2:

Peak heat flux, vessel pressure, and steam flow shall remain below scram or isolation trip settings by a margin consistent with the GE startup test specification.

14.2.12.3.23 Main Steam Isolation Valves

a. Objectives

1. To functionally check the MSIVs at selected power levels, ~~and determine the maximum power level they can be tested at individually~~

2. To determine isolation valves' closure times.

3. To determine reactor transient behavior during and following simultaneous closure of all MSIVs.

b. Prerequisites

The plant has been stabilized at the required power level.

c. Test Method

1. Individual closure of each MSIV is performed at selected power levels to verify functional performance and to determine closure times. ~~The maximum power level is determined for individual closure with ample margin to scram.~~

2. A test of the simultaneous full closure of a MSIVs is performed at about 100% power. Operation of the RCIC and HPCI systems and the relief valves is demonstrated. Reactor parameters are monitored to determine transient behavior of the system during the simultaneous full closure test. The reactor will immediately scram due to the actuation of the MSIV position switches. Recirculation pumps will trip if Level 2 in the RPV is reached. The feedwater control system will prevent the RPV water level from reaching the steam lines.

d. Acceptance Criteria

Level 1:

1. MSIV closure times shall be as specified in the GE startup test specification.

2. Following the full closure of all MSIVs, vessel pressure and heat flux level shall be as specified in the GE startup test specification.

3. The reactor must immediately scram and the ~~f~~eedwater control system must prevent the water from reaching the main steam lines following full closure of MSIVs from high power.

Level 2:

1. Peak neutron flux, vessel pressure, and steam flow shall remain below scram or isolation trip settings by a margin consistent with design requirements when individually testing the MSIVs.

2. The RCIC and HPCI systems shall function in accordance with the GE startup test specification following the MSIV closure from high power.

14.2.12.3.24 Relief Valves

a. Objectives

1. To demonstrate proper operation of the main steam relief valves and determine their capacity

2. To demonstrate their leaktightness following operation.

b. Prerequisites

The reactor is on pressure control with adequate bypass or main steam flow.

c. Test Method

A functional test of each safety relief valve (SRV) shall be made ~~as early in the startup program as practical. This is normally the first time the plant reaches 500 psig. The test is then repeated~~ at rated reactor pressure BETWEEN 10 AND 20% OF RATED THERMAL POWER. Bypass valves (BPV) response ~~is~~ OR ~~monitored during the low pressure test and the~~ electrical output response is monitored during the rated pressure test. The test duration will be about

10 seconds to allow turbine valves and tailpipe sensors to reach a steady state.

The tailpipe sensor responses will be used to detect the opening and subsequent closure of each SRV. The BPV ~~and~~ MWe responses will be analyzed for anomalies indicating a restriction in an SRV tailpipe.

Valve capacity will be based on certification by ASME code stamp and the applicable documentation being available in the onsite records. Note that the nameplate capacity/pressure rating assumes that the flow is sonic. This will be true if the back pressure is not excessive. A major blockage of the line would not necessarily be offset and it should be determined that none exists through the BPV response signatures.

Vendor bench test data of the SRV opening responses will be available onsite for comparison with Section 5.2.2. The acoustic monitoring subsystem will be monitored during the relief valve test program to determine that the setpoints do reflect valve open/valve closed conditions.

SRV opening and reclosure setpoint data will be obtained and evaluated during each high power trip test at which an SRV actuation is anticipated.

d. Acceptance Criteria

Level 1:

1. There should be positive indication of steam discharge during the manual actuation of each valve.

2. The vendor bench data for SRV capacity is greater than or equal to the values stated in Section 5.2.2 and the accident analysis.

Level 2:

1. Decay ratio for pressure control variables is as specified in the GE startup test specification.

2. The temperature measured by thermocouples on the discharge side of the valves should return to the temperature recorded before the valve was open as required in the GE startup test specification. The acoustic monitors shall indicate the valve is closed after valve closure.

3. During the ~~reduced and~~ rated pressure functional tests, steam flow through each relief valve as compared to average relief valve flow is as specified in the GE startup test specification.

14.2.12.3.25 Turbine Trip and Generator Load Rejection

a. Objective

The test objective is to demonstrate the proper response of the reactor and its control systems following trips of the turbine and generator.

b. Prerequisites

Power testing has been completed to the extent necessary for performing this test. The plant is stabilized at the required power level.

c. Test Method

This test is performed at three different power levels in the power ascension program. For the turbine trip, the main generator remains loaded for a time so there is no rise in turbine generator speed, whereas, in the generator trip, the main generator output breakers open

b. Prerequisites

The system piping to be tested is supported and restrained properly. Instrumentation for monitoring vibration has been installed and calibrated, where applicable.

c. Test Method

This test is an extension of the preoperational test program. During steady state operation, designated pipes as delineated in Section 3.9.2 will be monitored for vibration. Dynamic vibration measurements will be made on applicable piping following various plant and system transients as specified in Sections 3.9.2.1.2.3, 3.9.2.1.3, and 3.9.2.2.4.

d. Acceptance Criteria

Level 1:

The piping displacements at the established locations shall not exceed the limits specified by the piping designer, which are based on not exceeding ASME Section III Code stress values or ANSI B31.1 values. These acceptable vibration levels will be used as acceptance criteria in the appropriate piping vibration startup test procedures.

14.2.12.3.32 Reactor Water Cleanup System

a. Objective

The test objective is to demonstrate the operation of the RWCU system.

b. Prerequisites

The reactor has been operated at a near rated temperature and pressure long enough to achieve a steady-state condition.

c. Test Method

With the reactor at rated temperature and pressure AND POWER BETWEEN 5 AND 20% OF RATED THERMAL POWER, process variables are recorded during steady-state operation in ~~three modes~~ of operation of the RWCU system; ~~blowdown, hot standby, and normal. The bottom head drain flow indicator will be calibrated by taking flow from the bottom drain only and using the RWCU system inlet flow indicator as a standard to compare against.~~ THE NORMAL MODE

d. Acceptance Criteria

Level 2:

1. The data indicating operation in the ~~listed~~ NORMAL modes shall be acceptable as specified by the GE startup test specification.

~~2. Recalibrate bottom head flow indicator against RWCU flow indicator if the deviation is greater than GE startup test specifications.~~

~~3.~~ 2. Pump vibration as measured on the bearing housing and coupling end shall be less than or equal to GE startup test specifications.

14.2.12.3.33 Residual Heat Removal System

a. Objectives

1. To demonstrate the ability of the RHR system to remove residual and decay heat from the nuclear system, so that refueling and nuclear system servicing can be performed

2. To demonstrate the capability of the RHR system to reduce the suppression pool temperature below the established limit immediately following a blowdown.

ATTACHMENT 3