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ACTION PLAN # 5, 6 & 7

TITLE: LOW STEAM GENERATOR LEVEL TRIP OF SFRCS

We will need independent analyses on this one

REV	DATE	REASON FOR REVISION	BY	CHAIRMAN TASK FORCE
0	6/22/85	Initial Issue	L. Stalter F. Miller K. Yarger	

TITLE: Low Steam Generator Level Trip of SFRCS

REPORT BY: L. Stalter, F. Miller, K. Yarger PLAN NO.: 5,6 & 7

DATE PREPARED: June 22, 1985 PAGE 1 of 4

INTRODUCTION:

This report has been prepared in accordance with the "Guidelines to Follow When Troubleshooting for Performing Investigative Actions into the Root Causes Surrounding the June 9, 1985 Reactor Trip", Rev. 4.

On June 9, 1985 a low Steam Generator (SG) level full trip of the Steam and Feedwater Rupture Control System (SFRCS) occurred when the main turbine tripped. This information was observed from the alarm log of the event. Additional SG low level half trips have recently occurred on June 2, 1985 and on April 24, 1985. At the time of these trips, the time-averaged SG levels were at least 70 inches above the low level trip setpoint. No previous spurious low SG level trips have occurred at Davis-Besse (DB) prior to the 1984 Refueling Outage.

SUMMARY OF DATA

A detailed review of all of the available data from the June 9, 1985 event indicated that a full SFRCS trip occurred at 1:35:31 at the same time the main turbine stop valves closed. This full SFRCS trip occurred for a very short duration and it resulted in only the two Main Steam Isolation Valves (MSIVs) closing. At 1:35:31 the computer recorded a Channel 2 SG level trip. This alarm could have been caused by a full or a half trip of the SG level strings. No positive data is available to indicate which SG caused this alarm. Alarms were also recorded on the computer at 1:35:31 that indicated that SFRCS had sent trip signals to the main turbine and to the Anticipatory Reactor Trip System (ARTS) to trip the reactor. However, both the reactor and main turbine had been previously tripped after Reactor Protection System (RPS) actuation.

Review of past experience indicates the following:

1. Prior to the 1984 refueling outage, many turbine trips occurred that did not cause spurious SFRCS trips.

2. On April 24, 1985, a half trip of Channel 2 low SG level occurred when the main turbine tripped. No full trip was recorded during this event.

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3. On June 2, 1985, a half trip of Channel 2 low SG level also occurred when the main turbine tripped. An SFRCS full trip alarm also was recorded on the computer at this time. No devices were actuated by this event and the SFRCS did not attempt to trip the main turbine.

Subsequent to the June 9, 1985 trip transient, it was determined from discussion with B&W that earlier testing at TMI-1 shows that SG startup range level transmitter output oscillates widely for about 10 seconds

after a main turbine trip from 100%. This information was taken using high speed recorders, and shows oscillations of 1.2 - 1.3 cycles/second. No similar data exist for DB, but the SGs are essentially identical and the same phenomenon could be expected to occur.

MAINTENANCE AND SURVEILLANCE/TESTING HISTORY

The following is a listing of maintenance and surveillance test activities performed since the 1984 refueling outage:

1. Surveillance Test ST 5031.14 was performed on all channels for each input parameter once each month. No abnormalities were found, no drifting of components was noted since the 1984 refueling outage.

2. The apparent spurious trip of the SGLIC Channel 2 was checked out by MWO 1-85-1444-00 dated 4/24/85. This MWO called for running the monthly surveillance test while checking for anomolies. No anomolies were found.

3. A relay driver board was replaced in the SFRCS logic Channel 1 for relay K201A (MWO 1-85-1552-00 dated 5/4/85).

4. A power supply was replaced in SFRCS logic Channel 2 (MWO 1-85-1843-00 dated 5/27/85).

5. The status light socket for K602A relay in the SFRCS logic channel was replaced (MWO 1-85-1860-00 dated 5/29/85).

6. Troubleshooting was performed on SFRCS alarm logic Q963 (MWO 1-85-1877-00 dated 6/2/85). This MWO called for testing the alarm logic to determine why a full SFRCS alarm occurred on a half trip. In the process of checking, a connection was reterminated and the problem cleared. Testing on both SFRCS channel 2 and channel 4 was completed per section 6.4 of ST 5031.14. No drifting of setpoints or other anomalies were found.

A review of the maintenance and surveillance/testing activities indicates that they did not affect the functional operation of the SFRCS.

CHANGE ANALYSIS:

The following changes were completed during or after the 1984 refueling outage.

1. All SFRCS/steam generator level transmitter amplifier and calibration boards were replaced to continue to meet the environmental qualification requirements (MWO 1-84-1269-00).

   All transmitters were calibrated and response time tested by surveillance tests (ST-5031.16). All acceptance criteria were met.

2. The level transmitters providing startup level indication on the control panel connected to the same sensing line as the SFRCS level sensing transmitter were changed from BY to Rosemount transmitters.

3. The Steam Generator Level Indication and Control (SGLIC) circuits were modified by FCR 80-110 which installed new analog - bistable units to add the steam generator high level trip capability. This required that the original bistables used for low level trip also be replaced to gain cabinet space. These units are now a composite unit in that the analog and bistable functions are contained in one unit as compared to separate analog and bistable units previously used for the low level trip function.

   All modules were calibrated and response time tested by surveillance tests (ST-5031.15) and all acceptance criteria was met.

4. The SFRCS actuation channels 1 and 2 were modified to provide for blocking of the steam generator high level trip by FCR 80-110. This change was tested by surveillance test (ST-5031.14 Section 6.1) and Section 6.14. This verified that the installation was correct and that the level set points for both the high trip and the low trip were set properly.

5. The SFRCS actuation Channels No. 1 & 2 were modified by FCR 81-178 to provide for the additional opening of steam supply valves (MS106A & MS107A) to the auxiliary feedwater pump turbines on steam generator high or low level, high steam generator feedwater differential pressure and loss of all four reactor coolant pumps.

6. The addition of the valve actuation logic by FCR 81-178 was defeated by FCR 81-178 Rev. A as it may have caused pipe hanger damage to occur in the steam lines to the auxiliary feedwater pump turbines. FCR 81-178A was tested by TP 580.00 and all acceptance criteria were met.

7. The SFRCS actuation channels No. 1 & 2 were modified to allow operation of the steam generator blowdown valves HV 603 and HV 611 for modes 4, 5, and 6 operation. This change was completed and tested (TP 520.81 and ST 5030.18) during the 1984 refueling outage.

The only changes listed above that could affect the response time of the steam generator level instrument strings were changes 1, 2 and 3. None of the others had any effect on the response time of the SFRCS.

HYPOTHESES

The cause of the half trips of SFRCS appears to be the SG startup range level transmitter output oscillations due to pressure oscillations from the main turbine trip. The modifications that were performed in the SG level instrument string used by SFRCS during the last refueling outage may have made the string's response time faster so that steam generator pressure oscillations are now detectable. This may account for the spurious SG level trips that have occurred since the 1984 refueling outage.

It is postulated that on June 9, 1985 1/2 SG low level trips occurred within each half of an SFRCS actuation channel with the following results:

1. They overlapped long enough to allow the following alarms to occur:

   a. Q963 SFRCS FULL TRIP; this alarm requires that both halves of an SFRCS be tripped simultaneously.

   b. Q777 ARTS TRIP (Anticipatory Reactor Trip System); this alarm indicates that the ARTS was tripped. Since no other ARTS input alarms occurred, the only way that this alarm could have actuated would be due to an SFRCS trip of ARTS.

   c. X044 T-G MN STM (Turbine-Generator Main Steam) and FW TURB TRIP (Feedwater Turbine Trip); this trip indicates that the SFRCS sent a trip signal to the main turbine. However, the main turbine had already been tripped by the reactor trip.

2. Each half trip occurred long enough to allow the electrically operated solenoid valves and the air pilot valves in the MSIV air system to trip. These half trips overlapped long enough to allow the "seal-in" circuits to drop out, and thus, the MSIVs stayed closed after the half trips automatically reset.

3. These half trips did not overlap long enough to pick up and seal-in the starters on any SFRCS actuated motor operated valves (MOV). This would explain why we did not start the auxiliary feedwater pumps during this spurious full trip of SFRCS. In the past, when we were experiencing spurious high reverse delta pressure main feedwater trips, on some occasions only the MSIVs closed and MOVs did not operate.

4. Each half trip occurred long enough to allow the electrically operated solenoid valves in the Main Feedwater Startup Control Valve (SP7A, SP7B) air system to trip. However, these half trips did not overlap long enough to allow the "seal-in" circuits to drop out, and therefore, the Main Feedwater Startup Control Valves remained open.

Special tests are needed to determine the trip and trip reset response times for the components in the MSIV and the Main Feedwater Startup Control Valve control circuits.

Other less likely hypotheses might be possible. The action plan has been designed to preserve the equipment status should the above hypothesis prove false.

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DATE PREPARED	PREPARED BY
6/20/85	L.C. Stalter

TITLE

Low Steam Generator Level Trip of SFRCS

SPECIFIC OBJECTIVE

STEP NUMBER	ACTION STEPS	PRIME RESPONSIBILITY	ASSIGNED TO	START DATE	TARGET DATE	DATE COMPLETED
	All steps of this Action Plan are to be performed in accordance with the latest revision of "Guidelines to Follow When Trouble-shooting or Performing Investigative Actions into the Root Causes Surrounding the June 9, 1985 Reactor Trip".					
	The following steps may be performed in any sequence. Substeps of any step should be performed in the order listed.					
1	Review available data on the effects on the steam generator startup level from a turbine trip. Use available information from previous transient at Davis-Besse, and data from TMI-1 supplied by B&W for this review.	L. Stalter				
	A. Use the data from 1 to verify the hypothesis.	F. Miller				
	B. Use data from 1 and work with Bechtel and CCC (SFRCS vendors) to establish an appropriate response time for the	L. Stalter				

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DATE PREPARED	PREPARED BY
6/20/85	L.C. Stalter

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Low Steam Generator Level Trip of SFRCS

SPECIFIC OBJECTIVE

STEP NUMBER	ACTION STEPS	PRIME RESPONSIBILITY	ASSIGNED TO	START DATE	TARGET DATE	DATE COMPLETED
	Steam Generator Level Indicator and Control (SGLIC) bistables to prevent inadvertant actuation of SFRCS following a turbine trip, and still meet the required overall response time for SFRCS actuation on steam generator level.					
2	Determine why the Main Steam Isolation Valve (MSIV) closed and other SFRCS actuated equipment did not change status.	F. Miller				
	A. Perform tests to determine the specific component trip response times and seal in response times of MSIV and Main Feedwater Startup Control Valves.	K. Yarger				
	B. Analyze the data from step 2A to verify that only the MSIV would close upon a full SFRCS trip of short time duration, and other equipment would not actuate.	F. Miller				

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TITLE

Low Steam Generator Level Trip of SFRCS

DATE PREPARED	PREPARED BY
6/20/85	L.C. Stalter

SPECIFIC OBJECTIVE

STEP NUMBER	ACTION STEPS	PRIME RESPONSIBILITY	ASSIGNED TO	START DATE	TARGET DATE	DATE COMPLETED
3	Test the time delay relay (TED shown on drawing E-42B, sheet 54)	K. Yarger				
	in the SFRCS "full trip" reset logic to verify the total time					
	the SFRCS full trip was in effect.					
	A. Determine the length of time the full SFRCS trip was in the	F. Miller				
	tripped condition by combining this time with the sequence					
	of events data.					
	B. Analyze this data for verification of the hypothesis.	F. Miller				
4	A. Visually inspect each steam generator starting level	K. Yarger				
	transmitter for loose connections, cleanliness.					
	B. Verify the response time of each Steam Generator startup	K. Yarger				
	level transmitter.					

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Low Steam Generator Level Trip of SFRCS

DATE PREPARED	PREPARED BY
6/20/85	L.C. Stalter

SPECIFIC OBJECTIVE

STEP NUMBER	ACTION STEPS	PRIME RESPONSIBILITY	ASSIGNED TO	START DATE	TARGET DATE	DATE COMPLETED
	C. Verify the calibration of each steam generator startup level transmitter.	K. Yarger				
	D. Analyze this data and check for anomolies.	L. Stalter				

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6/20/85	L.C. Stalter

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	A. Perform tests to determine the specific component trip response times and seal in response times of MSIV and Main Feedwater Startup Control Valves.	K. Yarger				
	B. Analyze the data from step 2A to verify that only the MSIV would close upon a full SFRCS trip of short time duration, and other equipment would not actuate. Need to look + list all equipment that did not actuate + all that did. + ~~[illegible]~~ prove hypotheses.	F. Miller				

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