

Mr. Bernard Thomas
INES Coordinator
Division of Nuclear Safety
International Atomic Energy Agency
Wagramerstrasse 5
P.O. Box 100
A-1400 Vienna
Austria

MAY 31 1994

Dear Mr. Thomas:

Enclosed is a completed Event Rating Form for an event at Salem, Unit 1. The event involved a plant transient, which was initiated by excessive marsh grass/debris in the Delaware river causing some circulating water pumps to trip off. The transient included an automatic reactor trip and two safety injections, with some additional complications. The event was considered to be a "Level 1" based on the guidance contained in Part III of the INES User's Manual.

Sincerely,

original signed by

Ken E. Brockman, Chief
Incident Response Branch
Division of Operational Assessment
Office for Analysis and Evaluation
of Operational Data

Enclosure:
INES Rating Form

9406210123 940608
PDR ADOCK 05000272
P PDR

INTERNATIONAL NUCLEAR EVENT SCALE (INES) EVENT RATING FORM

To be sent to: IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400, Vienna, Austria
TELEX: 1-12645, Cable: INATOM Vienna, Facsimile: 43-1-2309723, Telephone: 43-1-2360-2685

EVENT TITLE	PLANT TRANSIENT INITIALLY CAUSED BY THE LOSS OF CIRCULATING WATER PUMPS DUE TO HIGH MARSH GRASS/DEBRIS CONCENTRATIONS						EVENT DATE	04/07/94						
RATING PROVISIONAL <input type="checkbox"/> FINAL <input checked="" type="checkbox"/>	RATING DATE	OUT OF SCALE	BELOW SCALE	ON SCALE							SAFETY ATTRIBUTE	DEGRADATION OF DEFENSE IN-DEPTH	<input checked="" type="checkbox"/>	
	05/16/94			0	1	2	3	4	5	6	7		ON-SITE IMPACT	
													OFF-SITE IMPACT	
COUNTRY	USA			FACILITY NAME	SALEM 1			FACILITY TYPE	1106 Mw(e) PWR					

ASPECTS OF SIGNIFICANCE TO THE PUBLIC: YES NO

- | | | | | |
|---|--|------------------------------------|-------------------------------------|-------------------------------------|
| ACCIDENT <input type="checkbox"/> | INCIDENT <input checked="" type="checkbox"/> | DEVIATION <input type="checkbox"/> | | |
| RADIOACTIVE RELEASES OFF-SITE | | | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| RADIOACTIVE RELEASES ON-SITE | | | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| WORKERS INJURED BY RADIATION | | | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| WORKERS INJURED PHYSICALLY | | | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| PLANT SAFETY IS UNDER CONTROL | | | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| THE EVENT REPORTED IS A DISCOVERY OF A DEFICIENCY BY ROUTINE SURVEILLANCE | | | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| A PRESS RELEASE WAS MADE (IF YES, PLEASE ATTACH IT) | | | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

A SHORT DESCRIPTION OF THE EVENT:

Salem Unit 1 was operating at 73% power when excessive marsh grass/debris in the Delaware river caused some of the main condenser circulating water pumps to trip off due to high differential pressure. Operators manually initiated a power reduction to 7% power which, upon going below 10%, automatically re-instated the low power trip setpoints of 25%. The operator subsequently withdrew rods to restore RCS (reactor coolant system) temperature to its normal band. This resulted in a power increase to 25% and an automatic reactor trip.

Immediately thereafter, an automatic safety injection occurred on a high steam flow coincident with low RCS temperature signal. The steam line high steam flow bistables actuated on a short
(continued on next page)

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*PLEASE ATTACH ADDITIONAL INFORMATION ON JUSTIFICATION OF THE EVENT RATING AND DIFFICULTIES ENCOUNTERED, IF NEEDED

duration pressure pulse which was generated when the turbine stop valves closed in response to the reactor trip. The pressure pulse was not of sufficient duration to actuate both trains of the safety injection logic. As a result, several automatic actions associated with a full safety injection did not occur, including:

- two of the four main steam isolation valves failed to close
- the main feedwater isolation valves failed to close
- the main feed pumps failed to trip

Operators manually completed these actions.

A second safety injection later occurred on low pressurizer pressure. The pressure reduction was due to the cooldown of the RCS when two steam generator safety relief valves lifted. The two safety injections resulted in the pressurizer filling, and discharging to the PRT (pressurizer relief tank) via the power operated relief valves. The PRT rupture disc blew, as designed, to prevent overpressurization of the tank. Essentially no water was discharged from the PRT due to the blown rupture disc.

Operators subsequently re-established the pressurizer bubble and performed an orderly cooldown of the plant to Cold Shutdown. The unit has remained shutdown for repairs while the event was being investigated, and is preparing for restart.

Basis for INES Rating of the Salem Unit 1 Alert on 4/7/94

BACKGROUND:

Salem Unit 1 was operating at 73% power (power was reduced at both Units due to high concentrations of marsh grass/debris in the Delaware River) when some circulating water pumps were lost on high differential pressure. Operators initiated a power reduction, eventually lowering reactor power to less than 10%. This automatically re-instated the low power trip setpoints (25%). Because reactor power was lowered at a faster rate than turbine power, operators then encountered a low RCS (reactor coolant system) temperature condition.

In response to RCS average temperature being below the program value, operators withdrew rods in order to restore RCS temperature. Reactor power increased above the 25% low power reactor trip setpoint, and an automatic reactor trip occurred. Immediately thereafter, an automatic safety injection signal on high steam flow coincident with low-low average temperature occurred. The steam line high steam flow bistables actuated on a short duration pressure pulse in the main steam lines, caused by the closure of the turbine stop valves in response to the reactor trip. The pressure pulse was not of sufficient duration to actuate the "B" train safety injection logic and in fact, caused only a partial actuation of the "A" train safety injection logic. Several automatic actions which normally occur as a result of a full safety injection signal did not complete due to differences in the response of the actuation circuitry to the short duration pressure pulse, including:

- 2 of 4 MSIV's (main steam isolation valves) did not close
- the main feed pumps did not trip
- the main feedwater isolation valves did not close

Operators took manual actions to complete these actions.

Upon resetting the safety injection signal per emergency procedures, decay heat and reactor coolant pump operation caused the RCS temperature to increase. The increasing RCS temperature and safety injection charging flow resulted in the pressurizer filling to a solid condition. The pressurizer PORVs (power operated relief valves) cycled, as designed, to prevent overpressurization. The PORV's discharged to the PRT (pressurizer relief tank). Continued discharge via the PORVs to the PRT caused the PRT rupture disc to blow. The PRT reached a level of approximately 82%, and only about a gallon of water was discharged (condensation) when the rupture disc ruptured.

Subsequently, two safety valves for the No. 11 steam generator lifted several times. The lifting of the steam generator safety valves caused RCS temperature and pressure to drop rapidly. This resulted in a second automatic safety injection signal on low pressurizer pressure (due to the RCS cooldown associated with the lifting steam generator relief valves). Since the pressurizer was solid at this time,

The licensee declared a precautionary ALERT to ensure proper technical staff was available. Operators then re-established the pressurizer bubble, and initiated an orderly plant cooldown. The plant entered a cold shutdown condition about 12 hours after the initial event.

RATING BASIS:

The event is rated in accordance with the INES User's Manual under the defence in depth criteria. Per paragraph III.2.2 of the Manual, the following potential initiators were identified:

- 1) The reactor trip at 25% power due to the lowered reactor protection system setpoints (startup protection) when the operator withdrew rods to restore RCS temperature.
- 2) The first safety injection (low Tavg with high steam flow)
- 3) The No. 11 steam generator safety valves cycling
- 4) The second safety injection (low pressurizer pressure caused by low Tavg, due to the steam generator safety valves that opened
- 5) The blowing of the PRT rupture disc on high pressure

Utilizing the initiator frequency table (Appendix III.a of the Manual), all of the initiators fall under the "expected" in the lifetime of the plant category. Considering the safety function availability, in accordance with paragraph III.2.3 of the Manual, there was full availability for each of the initiators at the time of the event. Thus, utilizing Table III.2 of the Manual, the event would be rated as a level 0.

Considering classification of the event without an actual initiator (Table III.1) also leads to a rating of level 0. While the "failure" of some of the components (MSIVs, main feed pump trips and feedwater isolation) to completely actuate is of concern, the reason for these "failures" is significant. The cause of the steam flow portion of the first safety injection signal was due to a pressure pulse generated by the turbine stop valves closing in response to the reactor trip. A "true" high steam flow condition due to a leak did not occur. Also, the signal that was generated was of such a short duration that it was not picked up by both channels of the protection logic, resulting in a partial actuation. Subsequent testing showed that if a valid signal were to have been generated, it would have resulted in a complete actuation. Therefore, there was full safety function availability throughout the event, again yielding a rating of level 0.

Section III.5 of the User's Manual contains guidance for the consideration of additional factors. It provides for upgrading the rating by one level based on common cause failures, procedural inadequacies and safety culture deficiencies. As discussed above, some components did not complete their required actions for the first safety injection, although they would have functioned as designed had it been an actual high steam flow condition. The operators have since received guidance that if a partial safety injection (one channel) occurs, they are to complete the actuation by actuating the other channel. The event is also being addressed from a procedural guidance standpoint. Clarification to provide better guidance under low power operating conditions is being provided. This is specifically related to the decision to withdraw rods to restore temperature, which ended up causing the automatic reactor trip because the high power setpoints had been lowered to reflect startup conditions.

Based on the combination of personnel errors and the contributing factors of equipment problems and inadequate procedural guidance, the event is upgraded one level to a "Level 1" per Section III.5 of the User's Manual.