UNITED STATES
NUCLEAR REGULATORY COMMISSION
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MEMORANDUM FOR: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

FROM: Carlyle Michelson, Director
Office for Analysis and Evaluation
of Operational Data

SUBJECT: GENERIC CONCERNS ASSOCIATED WITH THE GINNA STEAM GENERATOR TUBE RUPTURE EVENT

In response to your memorandum of May 3, 1982, this office has compiled the enclosed list of generic concerns and implications associated with the January 25, 1982 steam generator tube rupture at Ginna. This response is based, in a large part, upon our review of, and participation in, the work leading to NUREG-0909, "NRC Report on the January 25, 1982 Steam Generator Tube Rupture at R. E. Ginna Nuclear Power Plant."

In general we have not identified specific requirements, but have attempted to identify significant generic concerns and implications likely to result in such requirements. We recognize that additional analysis and evaluation is necessary to properly structure the requirements and establish suitable priorities.

Our assessment activities are ongoing in some of these areas. As this work is completed, we will forward the results of our studies, together with the supporting findings and any recommendations.

If you need clarification or additional assistance on this subject, please contact myself or Wayne Lanning of this office.

Carlyle Michelson

Carlyle Michelson, Director
Office for Analysis and Evaluation
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Enclosure:
As stated

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Generic Concerns Associated with the Ginna Steam Generator Tube Rupture Event

The following generic concerns and implications reflect AEOD's review of, and participation in, the work leading to NUREG-0909, "NRC Report on the January 25, 1982 Steam Generator Tube Rupture at R. E. Ginna Nuclear Power Plant." These concerns were selected as sufficiently significant to warrant additional analysis as potential generic requirements for licensee action. Some of these items continue under AEOD study.

1. PLANT SYSTEM RESPONSE

1.1 Reactor Coolant Pump Trip and Restart Criteria

Priority should be given to re-evaluating reactor coolant pump trip and restart criteria. Continued pump operation appears prudent for non-LOCA and some LOCA events, such as steam generator tube ruptures (SGTR). For the SGTR event, tripping all reactor coolant pumps enhances steam formation in the reactor coolant system and delays depressurization which, in turn, can prolong leakage from the system. In the event that RCPs are tripped, analyses should be performed to determine the criteria for restarting the pumps with abnormal operating conditions, e.g., pressurizer level offscale high (system solid or with steam formations), non-availability of seal injection or seal cooling, or reduced primary-to-secondary heat transfer.

1.2 Pressurized Thermal Shock Potential

The potential for pressurized thermal shock (PTS) occurring during a SGTR event, and other events where reactor coolant loop flow is reduced with safety injection actuation, should be incorporated into the ongoing PTS assessment. Consideration should be given to minimizing the PTS potential, e.g., realignment of safety injection flow, and throttling safety injection and charging flows.

1.3 Reliability and Use of Pressurizer PORV

With regard to using the pressurizer PORV to depressurize the RCS, two areas require additional evaluation. First, the advisability of using the PORV when other methods of RCS depressurization and cooldown are available should be evaluated and analyzed. Second, operating requirements for PORVs for repeated cycles of operation and two-phase flow should be ascertained.

Although the PORV is not safety related, its use during a SGTR event and for over-pressure protection transients emphasizes the need for reliable operation. The PORV test programs applicable to both pressurizer and steamline PORVs should include tests representative of expected operation and conditions.

1.4 SGTR Design Basis Event Conditions

Modifications of the SGTR design basis event should be considered to account for conditions encountered during the Ginna event, such as flooding of the steamline, stuck-open pressurizer PORV, steam formations, and leaking steamline safety valve. Important aspects for assessment include steamline and support integrity for static and dynamic loading, liquid rather than gaseous releases, criteria for terminating safety injection, inadvertent isolation of any steamline, and blowdown of reactor coolant outside containment.

1.5 Process Computer Assessibility and Reliability and Other Data System Requirements

Efforts should be undertaken to improve the reliability of existing process computers. This and other events have indicated that increased reliability and capability of process computers should be achieved in order to ensure that they are available; not necessarily for mitigation, but for post event assessment to improve future safety of plants. The computers should be located where they are readily assessible under all conditions and emphasis placed on immediately restoring them to operable status should they fail. Important lessons can be learned from operating events only when data from the event are available. As evidenced by the Ginna event, the process computer provided important data to ascertain plant conditions and parameters of the event during the post-event analyses. Additional data were lost when the process computer was unavailable. In addition, the loss of the process computer required the operators to manually obtain important system parameters and resulted in the Technical Support Center (TSC) resorting to telephone communications with the control room to obtain system information. In addition, emphasis should be focused on ensuring that important system parameters are identified and recorded for a permanent record. Although the process computer was available during most of the Ginna event, system data had to be requested by a terminal operator during the event to establish permanent data trends. If the reliability of the process computer is not improved, a data recorder such as a reactimeter is needed at operating plants to record primary and secondary system responses during an event.

1.6 Atmospheric Relief Valve Redundancy and Reliability

Although not safety related, priority should be placed on increasing the reliability of the atmospheric relief valves and assessing the need for redundant relief valves, particularly for those plants which employ one relief valve per steamline. The availability of the atmospheric relief valve is important when the main condenser is not available or the non-ruptured steam generator is isolated. Operation of the atmospheric relief valves is the preferred mode of decreasing steamline pressure since each relief valve has a block valve; and relief valve use reduces challenges to the safety valves. Consideration should also be given to increasing the reliability and diversification of electrical power and instrument air supplies for the relief and block valves.

1.7 Code Assessment

The Ginna event produced full-scale data which should be used for assessment of analytical techniques, such as TRAC and RELAP-5. In addition to establishing the codes capability, additional system responses could be ascertained and refined, e.g., leakage rates, mass balances, effects of starting a RCP and thermal stresses.

1.8 Reactor Vessel Inventory Instrumentation

Development and prompt implementation of requirements for reactor vessel inventory (or void instrumentation) is recommended. The Ginna event further emphasizes the need for indication of system inventory. Termination of safety injection and charging flows was delayed and the event prolonged because the operators did not have a reliable indication of system inventory.

1.9 Methods and Procedures for Terminating SGTR Events

Preferred methods and procedures for terminating the SGTR flow and subsequent cooldown of the affected steam generator should be developed. The capability to terminate the SGTR event, assuming additional failures and expected steam generator response, e.g., thermal stratification, should be evaluated.

1.10 Slug Flow of Water in Steam Lines

Consideration should be given as to whether AFW pump turbine drives, valves and piping must be qualified for slug flow. The Ginna event demonstrated that the potential exists for slugs of water to be transported to the steamline and connected piping.

1.11 Control Logic Designs

It should be verified by appropriate sampling of operating plants that control logic designs associated with safety-related equipment preclude loss of safety function under all conditions of operation. For example, in the Ginna event low level in the boric acid storage tanks (BAST) following reset of the SI signal could have caused a loss of all SI pumps due to cavitation.

An appropriate design in such a case would be to provide automatic transfer of suction from the BAST to the RWST on loss of BAST level under all operating conditions.

1.12 Equipment Cyclic Operation Capability

Equipment that would be manually cycled several times during the course of an event should be verified to be capable of such cyclic operation under expected conditions. If such is not the case, the operators must be made aware of the limitations of such equipment or be trained to alternate the use of redundant equipment. In the Ginna event, a single pressurizer PORV was cycled several times (four times within a three-minute period) just prior to its failure. Similarly, the SI pumps were run intermittently during a 23-minute period. In both these cases the capability of the equipment to function under such cyclic operation has not been verified. Repeated equipment operations should be considered in the ongoing review of the feed-and-bleed method of cooling.

1.13 Secondary Side Loose Parts Monitoring

The importance of foreign objects to steam generator tube failure and the need for, and effectiveness and feasibility of, a loose parts monitoring system for the secondary side of the steam generators should be evaluated.

1.14 Charging Pump Trip Requirements

The advisability of tripping the charging pumps on a safety injection signal should be evaluated for affected plants. In addition to providing reactor coolant pump seal injection flow, these charging pumps provide the only capability to make up reactor coolant during events where the RCS pressure exceeds the shut-off head of the safety injection pumps. Although the pumps are not safety related, they can provide additional safety assurance and their continued operation during safety injection appears consistent with the requirement for maintaining seal integrity.

1.15 Secondary Safety Valve Testing

Secondary safety valve testing programs should be initiated and include those conditions experienced during the Ginna SGTR event, e.g., cyclic operation with a change in fluid phase, particularly liquid (including the possibility of slug flow).

1.16 Reliability of Non-Safety-Related Equipment

More rigid quality assurance and equipment qualification programs to improve reliability are recommended for non-safety related equipment expected to operate during transients and accidents. The non-safety-related equipment employed during the Ginna event has been identified in the Ginna Report.

2. HUMAN FACTORS CONSIDERATIONS

2.1 Criteria for Natural Circulation Determination

Suitable criteria to be used by reactor operators to determine and thereby claim that natural circulation has been achieved should be developed and uniformly incorporated into procedures. As evidenced by the Ginna event, this is an area for potential misinterpretation or misunderstanding during an event wherein it may be important to quickly communicate the plant status to the licensee staff and the NRC in unambiguous terms.

2.2 Operator Training and Procedures for Multiple Failures or a Combination of Events

As evidenced by the Ginna event, improvements are neessary in operator training and procedures to mitigate events involving multiple failures or a combination of events. Symptom-oriented procedures properly developed and implemented are essential for these improvements in operational safety. In this regard, it appears that the proposed Westinghouse abnormal operating guidelines, which are event oriented, may have difficulty dealing with muliple failure events not considered during their development. When a multiple-failure event occurs which is outside of a specific event category (e.g., a SGTR coincident with steam formations and a stuck-open or leaking secondary safety valve) the reliance on operator understanding for proper mitigation is significantly increased as is the probability of serious operator error.

2.3 Isolation of Atmospheric Relief Valve

The emergency procedures should ensure that the atmospheric relief valves are operable during a SGTR event. The Ginna operators misinterpreted the SGTR procedure and manually isolated the relief valve (see also Recommendation 1.6).

2.4 Mitigating Steam Bubble Formations in the RCS

Additional operator training is required for mitigating events involving steam bubble formations in the reactor coolant system. The Ginna event supports the potential for steam formations and suggests improvements in operators' actions regarding the operation of the safety injection system and reactor coolant pumps when steam bubble formations exist in the RCS.

3. RADIOLOGICAL CONSEQUENCES

3.1 Criteria for and Indication of Secondary Safety and Relief Valve Operation

Increased attention should be given to the implementation of TMI Action Plan, item 2.E.1, "Instrumentation and Controls," as it relates to steamline safety and relief valve operation. Although steamline safety and relief valve position indication was installed at Ginna, the recorders failed to indicate valve openings. It appears that the system had not been subject to approriate surveillance requirements. In addition, the criteria for operation of the system should be based on the opening of the valve, rather than the radiation level in the steamline. This system could alert the operators to a stuck-open safety or relief valve.

3.2 Radiation Monitoring

Since TMI Action Plan item 2.E.1 focused on monitoring noble gas effluents, it should be expanded to include the monitoring of other radionuclides. In addition, radiation monitoring capability should be included at all identified release points (e.g., steam dumps, AFW systems, condensate system) and the reliability of the radiation monitoring system improved.

4. ORGANIZATIONAL RESPONSE

4.1 Consideration of Safety-Related Ongoing Activities During an Emergency

All activities (e.g., maintenance, surveillance testing, fire watches) with a potential safety impact should be addressed in emergency plans and status made known to operators and emergency coordinators during a Site Area Emergency. The concern is whether adequate consideration has been given to such ongoing activities when an emergency or evacuation has been declared. During the Ginna event, a Site Area Emergency was declared which required evacuation of non-essential personnel including fire watch personnel.

Although the probability of a fire coincident with a radiation emergency may not be a significant contributor to risk in general, consideration should be given to this and other activities existing at the time of the site emergency.

4.2 Alternate Evacuation Routes and Sites

The emergency plan should include alternate evacuation routes and sites to preclude evacuating personnel into a contaminated plume.

5. GENERAL RECOMMENDATION

5.1 The TMI Action Plan implementation schedule should be re-evaluated such that the information from the Ginna event is reflected in future program priorities. Some of the lessons learned from TMI-2 were implemented at Ginna which contributed favorably to mitigating the SGTR event. Further, since SGTR events are relatively high-probability occurrences, NRC recommended generic actions and licensee implementation of lessons learned from the Ginna event should be timely.