AUG 1 3 1985

MEMORANDUM FOR: Robert M. Bernero, Director
Division of Systems Integration

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

SUBJECT: SCHEDULE FOR RESOLVING AND COMPLETING GENERIC ISSUE NO. 99 - RCS/RHR SUCTION LINE INTERLOCKS ON PWRs

The technical resolution for Generic Issue No. 99, "RCS/RHR Suction Line Interlocks on PWRs" is assigned a "HIGH" priority ranking based on the evaluation provided in Enclosure 1. This memorandum directs you to take the actions necessary to resolve this issue.

In accordance with NRR Office Letter No. 40, "Management of Proposed Generic Issues," the resolution of this issue will be monitored by the Generic Issue Management Control System (GIMCS). The information needed for this system is indicated on the enclosed GIMCS information sheet (Enclosure 2). Your schedule for resolving and completing this generic issue should be commensurate with the priority nature of the work and consistent with the NRR Operating Plan. Normally, as stated in the Office Letter, the information needed should be provided within six weeks.

The enclosed prioritization evaluation will be incorporated into NUREG-0933, "A Prioritization of Generic Safety Issues," and is being sent to the regions and other offices, the ACRS, and the PDR for comments on the technical accuracy and completeness of the prioritization evaluation. Any changes as a result of comments will be coordinated with you. However, the schedule for the resolution of this issue should not be delayed to wait for these comments.

The information requested should be sent to the Safety Program Evaluation Branch, DST. Should you have any questions pertaining to the contents of this memorandum, please contact Louis Riani (24563).

Original Signed by
H. R. Denton

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

RD-10-1
PWR

Enclosures:
1. Prioritization Evaluation
2. Generic Issue Management Control System

cc: See next page

OFFICE	SPEB:DST	SPEB:DST	AD/T:DST	D:DST	D:PPAS	DD:NRR	D:NRR
SURNAME	LRiani:slm	WMinners	FRowsome	TSpeis	JFunches	DEisenhut	HDenton
DATE	8/7/85	8/7/85	8/7/85	8/8/85	8/7/85	8/9/85	8/12/85

AUG 1 3 1985

cc w/o Enclosure 2:
V. Stello, DEROGR
R. Minogue, RES
J. Taylor, IE
C. Heltemes, Jr., AEOD
J. Davis, NMSS
T. E. Murley, Reg. I
J. N. Grace, Reg. II
J. G. Keppler, Reg. III
R. D. Martin, Reg. IV
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cc w/Enclosure 2:
K. Pulsifer
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F. Rosa
T. Dunning

Distribution
Central File
SPEB R/F
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LRiani (2)
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ENCLOSURE 1

PRIORITIZATION EVALUATION

GENERIC ISSUE ISSUE NO. 99

"RCS/RHR SUCTION LINE INTERLOCKS ON PWRs"

ISSUE 99: RCS/RHR SUCTION LINE INTERLOCK ON PWRs

DESCRIPTION

Historical Background:

A memorandum from T. Dunning to R. Mattson, dated April 17, 1984, on the subject RHR Interlocks for Westinghouse plants (Ref. A) describes a staff concern that the design basis for the RHR interlocks has been misunderstood. Further, that concerns related to the RHR interlocks in recent reviews were not adequately pursued. In an August 27, 1984, memorandum entitled, "RCS/RHR Suction Line Valve Interlock on PWRs," from Houston to Rowsome (Ref. B), DSI requested DST to prioritize this concern as a generic safety issue. Interlocks are provided to assure that there is a double barrier (two closed valves) between the RCS and the RHR system when the plant is at normal operating conditions, i.e., pressurized and not in the RHR cooling mode. A related issue (GI 96) has to do with assuring that both series RHR isolation valves are closed during normal power operation. This issue is concerned with the inadvertent closing of these valves when the RHR system is in use.

Two basic features are incorporated in the interlock design. The first is an automatic closure signal on high RCS pressure (typically 600 psig). The second is a block of the manual open signal at a lower RCS pressure (typically 425 psig). The autoclosure setpoint is generally set higher than the design pressure of the RHR system. However, overpressure protection of the RHR system during RHR cooling is provided by relief valves and not by the slow acting RHR suction valves. The block setpoint is lower than the RHR system design pressure to preclude opening of either RHR suction valve when the RCS is at a higher pressure.

In the Westinghouse design, two interlock channels are provided such that one channel is used to interlock the operation of one RHR suction valve and the other channel is used for the other valve. The same interlock configuration is used in Westinghouse plants for designs that have one or two RHR drop lines from the RCS. When either channel is in a tripped state its associated suction valve will automatically close if it is open. Since the relays used for this interlock are deenergized to initiate valve closure, a loss of the instrument bus used for either channel will result in a loss of RHR cooling due to inadvertent closure of one of the suction valves.

Safety Concern

The loss of one instrument bus, or disablement of one logic channel will result in the automatic closure of one of the RHR suction line isolation valves. When in the RHR cooling mode, such closure gives rise to the potential for RHR pump damage and loss of decay heat removal by the RHR system. This safety concern applies to all Westinghouse reactors.

Possible Solutions

One proposed resolution to this issue which was assumed for cost estimation purpose is:

1. Review and document the design basis for the RHR suction valve interlock.

2. Develop interim operating procedures until changes to the logic and control for the RHR system can be implemented.

3. Change the logic configuration that controls the valves from a one-of-one configuration to a two-of-two configuration. Improvements in detecting and alarming of the loss of RHR coolant flow would be made.

4. Changes to the plants technical specifications.

PRIORITY DETERMINATION

Frequency Estimate

An NSAC report, NSAC-52 (Ref. C), lists 27 losses of RHR flow due to suction valve closure up through 1981. This tabulation lists twenty-seven events. Included are two events which occurred as the result of a pressure rise in the primary system. The other twenty-five events resulted from causes other than an actual pressure rise. These twenty-five events occurred during 206 reactor years of operating experience at pressurized water reactors. This experience results in a frequency of 0.12 unplanned RHR suction valve closures per plant year. Of these closures, twenty-two events involved the closure of only one valve and three events resulted in the closure of both valves. Thus, 88 percent of the reported events were independent channel failure events and twelve percent can be potentially classified as common cause related.

When in the refueling mode and the water level is 23 feet above the core, only one RHR train must be operable. Closing the suction valve could cause cavitation and damage to the pump and leave no RHR train operable. However, it would take many hours for the level to boil down and uncover the core. RHR cooling could be restored in a few hours. In addition, the fuel pool cooling system could be used. Therefore, this case would have a small associated risk.

Changing the logic system from one-of-one system to two-of-two system will reduce the independent failure frequency contribution of one valve closure from 0.12/py to 0.003/py. With the common mode contribution remaining the same, 0.015/py, the revised frequency of incorrect valve closures reduces to 0.018 by the revised logic configuration. Improved procedures and alarms are assumed to reduce the human error of failing to reopen the RHR isolation valves from 0.04 to 0.02 per event. The changes in failure rates reduce the expected core melt frequency from an RHR valve being closed to (0.018)(0.02)(1.0)(0.01) or approximately 3.6E-07 core melts per plant year. This is a reduction of 4.4E-06 core melts per plant year.

Consequence Calculations

The expected radiological consequences from this issue are expressed in whole body man-rem dose based upon the radioactive release categories described in the Reactor Safety Study, WASH-1400 (Ref. 16). The computer program CRAC2 applied to a typical midwest site meteorology (Braidwood) was used for the dose calculation (Ref. 64). An average population density of 340 persons per square mile was used over an area which extended from an exclusion zone of one-half mile about the reactor out to a 50 mile radius about the reactor.

A core melt resulting from the loss of the RHR system would result in an accident similar to the T(1)MLU sequence described in the Oconee RSSMAP analysis (Ref. 54). The release given a core melt occurs in the following categories with the respective probability and dose:

Category	Probability	Dose (man-rem)
3	0.5	5.4E+06
5	0.0073	1.0E+06
7	0.5	2.3E+03

In all other modes two RHR trains are required to be operable, while only one is usually operating. If the RHR valves close causing cavitation and damage to the operating RHR pump, the other RHR train will still be operable. The N[illegible]a show that the operator successfully immediately reopened the [illegible] closed valves in all but one event. In this event at Dav[illegible] it took 2.5 hours to restore RHR cooling because of the need to refill and vent the system. Yet in this lenghtly delay no substained damage occurred to the system components. However, this event, due to the long time interval involved before restoring RHR cooling was counted as an RHR system failure. Thus an unavailability of 0.04 is assumed but believed to be overly conservative. If the valve can not be reopened either the steam generators or the charging pumps could be used as alternate means of cooling.

Based upon engineering judgment the unavailability of the main and/or auxiliary feedwater during RHR operation is estimated to be 0.1 and the unavailability of the charging pumps is estimated to be 0.01. These may be overly optimistic since there is no tech spec requirement for the availability of these systems in the cold shutdown modes. Further, maintenance and testing is often performed on these systems during the RHR cooling modes. Thus, the unavailability of core cooling is estimated to be the product of

(0.12 events/py)(0.04)(0.1)(0.01) or 4.8E-06/py which,

assuming no further actions are taken becomes the expected frequency of core melt per reactor year resulting from an inadvertent closure of one or both RHR suction valves.

An accident frequency reduction of 4.4E-06 core melts/py results in a dose reduction of 12 man-rem/py. For the 30 existing reactors with an average remaining life of 27.7 years and 28 new plants with an expected life of 30 years the total risk reduction for the issue amounts to 20E+03 man-rem.

Cost Estimate

Industry: The cost estimate addresses the four actions proposed as the resolution of this issue. The review and documentation of the design basis of the RHR suction valve interlocks is expected to require four person-weeks, which at $2,270 per person-week results in a cost of $9,080/plant. The development of interim operating procedures and operator training is estimated to total five person-weeks per plant, or $11,350/plant. Hardware costs to modify the logic system and install the RHR flow alarms is estimated to be $4,000. An additional six person-weeks will be required for engineering and installation costs, or $13,620. The total hardware modification costs is estimated to be $17,600. Technical specification changes are estimated to take four person-weeks, or $9,080. Thus, the estimated costs for issue resolution is estimated as $47,200/plant. Plants not having an operating license are expected to have a lesser cost, but due to the advanced stages of construction, the reduction is not expected to be significantly less. Modifications to plant hardware is expected to be performed during a refueling outage which would obviate the need to include replacement fuel costs. No significant additional maintenance costs over the currently existing configuration is envisioned. Thus, for the entire fifty-eight plants the total industry cost is estimated as $2,700,000.

NRC Costs: It is estimated that NRC costs associated with this safety issue resolution can be accommodated in a total of eight person-weeks, or $38,000.

Other Considerations

The analysis did not consider the possible increase in the chance of an interfacing systems LOCA which migh result because the logic changes reduced the reliability of the interlock function. It is presumed that the reliability of a one-out-of-one logic is the same as a two-out-of-two logic.

The occupational dose exposure is estimated as 2.25 man-rem/plant for work involved with hardware modifications inside the containment. This would result in a total worker dose of 176 man-rem. The accident avoidance occupational dose reduction is estimated to be 146 man-rem.

The industry cost savings due to accident avoidance is calculated as 4.4E-06 accidents/py)($1.65E+09/accident) or $7260 per plant year.

Consideration also should be given those cost savings which result from the prevention of incidents producing long interval RHR inoperability but do not result in damage to the core. Such an incident may result in plant shutdown longer than anticipated to investigate the causes of the inoperability and to assure the adequate corrective actions have been taken. Assuming that the outage extention lasts two weeks, the replacement power costs, based upon $500,000/day costs, amounts to $7 million. At the current frequency of long interval outage events the per plant savings resulting from incident avoidance amounts to $90,000.

Value/Impact Assessment

The value/impact score (S) is calculated to be

$$S = \frac{20,000 \text{ man-rem}}{(\$2.4+0.04) \text{ million}} = 8000 \frac{\text{man-rem}}{\$ \text{ Million}}$$

Conclusion

Based upon the averted public risk and the value impact score, this issue is rated a HIGH priority. The public risk may be underestimated if the feedwater and injection alternatives are not as available as predicted.

References:

A. Memorandum for R. Mattson from T. Dunning "RHR Interlocks for Westinghouse Plants," April 17, 1984.

B. Memorandum for Frank Rowsome from R. Wayne Houston, "RCS/RHR Suction Line Valve Interlock on PWRs," August 27, 1984.

C. NSAC-52, "Residual Heat Removal Experience Review and Safety Analysis; Pressurized Water Reactor," Nuclear Safety Analysis Center, January 1983.

16. WASH-1400 (NUREG-75/014), "Reactor Safety Study, An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," U.S. Nuclear Regulatory Commission, October 1975.

54. NUREG/CR-1659, "Reactor Safety Study Methodology Application Program," U.S. Nuclear Regulatory Commission, 1981.

64. NUREG/CR-2800, "Guidelines for Nuclear Power Plant Safety Issue Prioritization Information Development," U.S. Nuclear Regulatory Commission, February 1983.

NUREG/CR-2800, Supplement 1, "Guidelines for Nuclear Power Plant Safety Issue Prioritization Information Development," U.S. Nuclear Regulatory Commission, May 1983.

NUREG/CR-2800, Supplement 2, "Guidelines for Nuclear Power Plant Safety Issue Prioritization Information Development," U.S. Nuclear Regulatory Commission, December 1983.

GENERIC ISSUE MANAGEMENT CONTROL SYSTEM

The Generic Issues Management Control System (GIMCS) provides appropriate information necessary to manage safety related and environmental generic issues through technical resolution and completion. For the purpose of this management control system technically resolved is defined as the point where the staff's technical resolution has been issued. Generally, speaking, this occurs when the technical resolution has been incorporated into one or more of the following:

(a) Commission policy statement/orders
(b) NRC Regulations
(c) Standard Review Plan
(d) Regulatory Guide
(e) Generic Letter

GIMCS is part of an integrated system of reports and procedures that would manage generic safety issues, TMI-related issues, and proposed new generic issues through the stages of prioritization, technical resolution, development of new criteria, review and approval, public comments, and incorporation into the Standard Review Plan (SRP), as appropriate. NUREG-0933 provides an evaluation for a recommended priority listing based on the potential safety significance and cost of implementation for each issue; NRR Office Letter Number 40 provided procedures and criteria for adding new generic issues to the system; and GIMCS provides proposed scheduling for resolving and completing issues on the prioritized listing. GIMCS will provide information to manage and control issues that are ranked High-priority generic issues, Medium-priority generic issues, issues for which possible resolution has been identified for evaluation, issues for which a technical resolution is available (as documented by memorandum, analysis, NUREG, etc.), and issues designated by the Director of NRR as issues for which resources have been made available for resolution and completion. Issues ranked as either "Low" or "Dropped" are not allocated resources. Therefore, there is no resolution to be tracked by GIMCS.

Some new generic issues prioritized and processed in accordance with NRR Office Letter No. 40 may not have resources allocated for resolution and completion. These issues will be listed in GIMCS as inactive issues. These will generally be Medium priority issues that have no safety deficiency demanding high-priority attention, but there is a potential for safety improvements or reduction in uncertainty of analysis that may be substantial and worthwhile. Efforts for resolution of these issues will be planned, over the next several years, but on a basis that will not interfere with the resolution of High-priority generic issue work or other high priority work. Thus, some (Medium) generic issues will be inactive until such time as resources become available to resolve the various issues. As resource allocations are directed at issue resolution, they will become active. The detailed schedule for resolving and completing the generic issue will be developed and monitored by the management control system.

Management and control indicators used in GIMCS are defined as follows:

1. Item No. - Generic Issue Number.

2. Issue Type - Safety, Environmental or Regulatory Impact High, Note 1 or Note 2 (From NUREG-0933), Medium.

3. Action Level - Degree of management attention needed to process generic issues in accordance with established schedules
   - L1 - No management action is necessary
   - L2 - Division Director action is necessary
   - L3 - Director NRR action is necessary

4. Office/Div/Br - 1st listed has lead responsibility for resolving issue, others listed have input to resolution.

5. Task Manager - Name of assigned individual responsible for schedule updating.

6. Tac Number - Each issue should be assigned a TAC #.

7. Title - Generic Issue Title.

8. Work Authorization - Who or what authorized work to be done on generic issue.

9. Contract Title - Provide Contract Title (if contract issued).

10. Contractor Name/FIN No. - Identify Contractor Name and FIN Number (as appropriate). If contract is not yet issued, indicate whether the contract is included in the FIN plan.

11. Work Scope - Describes briefly the work necessary to technically resolve and complete the generic issue.

12. Affected Documents - Identifies documents that the technical resolution will be incorporated into to identify new criteria.

13. Status - Describes current status of work.

14. Problem/Resolution - Identifies potential problem areas and describes what actions are necessary to resolve them.

15. Technical Resolution - Identifies detailed schedule of milestone dates that are required for completing the issue through the issuance of the SRP revision or other change that documents requirements.

    Milestones - Selected significant milestones. The "original" schedule remains unchanged. Changes in schedule are listed under "Current". Actual completion are listed under "Actual".

TYPICAL MILESTONES

Other Division Involvement	Original	Current	Actual
o Date information requested from Division			
o Date received from Division			
Contractor Information			
o Proposal Solicited			
o Proposal Evaluated and Accepted			
o Contract Schedule, if applicable			
o Testing Schedule, if applicable			
o Draft NUREG/CR report from contractor/consultant			
Staff review of draft NUREG/CR report			
Value Impact Statement prepared (coordinated with SPEB and RRAB as applicable)			
Final report prepared by Division (include SPEB preliminary comments and SRP revision)			
---------- 2 wks			
Final report forwarded to DST for processing			
----------- 2 wks			
CRGR Package to NRR Director for Review			
----------- 1 mo			
OMB Clearance obtained concurrently if applicable			

Review Package to CRGR

----------- 1 mo

CRGR review and EDO approval
completed

----------- 1 mo

Federal Register Notice of
Issuance of SRP for
Public Comment

----------- 3 mo

Division review of public
comments completed

----------- 2 wks

Comments incorporated and
transmitted to DST for
processing

----------- 2 wks

Final CRGR package to
NRR Director for review

----------- 1 mo

Review Package to CRGR

----------- 1 mo

CRGR review and EDO approval
completed

----------- 1 mo

Federal Register Notice of
Issuance of SRP

GENERIC ISSUE MANAGEMENT CONTROL SYSTEM

Issue Number	Issue Type	Action Level	Office/Div/Br	Task Manager	Tac No
		Active-L1	NRR/	TBP	TBP

Title ---------------

Work Authorization --- Memorandum to from H. R. Denton dated

Contract Title ------- To Be Provided.

Contractor Name/
FIN No. ------------ To Be Provided.

Work Scope ----------- To Be Provided.

Affected Documents --- To Be Provided.

Status --------------- To Be Provided.

Problem/Resolution --- To Be Provided.

Technical Resolution - To Be Provided.

Milestones	Original	Current	Actual
New Issues - Schedule To Be Developed			

As of First Quarter FY-84

OFFICE ▸							
SURNAME ▸							
DATE ▸							