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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

August 8, 1989

Mr. Roger A. Newton, Chairman
Westinghouse Owners Group
2310 W. Michigan Avenue
Milwaukee, Wisconsin 53201

Dear Mr. Newton:

SUBJECT: ACCEPTANCE FOR REFERENCING WCAP-11736 REV. O.O, 'RESIDUAL HEAT
REMOVAL SYSTEM AUTOCLOSURE INTERLOCK (ACI) REMOVAL REPORT" IN PLANT
SPECIFIC SUBMITTALS

We have completed our review of the subject topical report submitted with your letter of April 22, 1988. We have concluded that the information in this report can be used to supplement plant specific requests to remove the ACI from the Westinghouse plants covered by this report. However, the attached SER does not grant permission to remove the ACI for any plant; such permission must be requested on a plant-specific basis.

We do not intend to repeat our review of the matters described in the reports and found acceptable when the reports appear as references in license applications except to assure that the material presented is applicable to the specified plant involved. Our acceptance applies only to the matters described in the reports.

In accordance with procedures established in NUREG-0390, it is requested that Westinghouse publish accepted proprietary and non-proprietary versions of this topical report within 3 months of receipt of this letter. The accepted versions should incorporate this letter and the enclosed evaluation between the title page and the abstract. The accepted versions shall include an -A (designated accepted) following the report identification symbol.

Should our criteria or regulations change, such that our conclusions as to the acceptability of the reports are invalidated, Westinghouse and/or the licensees referencing the topical reports will be expected to revise and resubmit their respective documentation, or submit justification for the continued effective applicability of the topical reports with a revision of their respective documentation.

Sincerely,

Ashok Thadani, Assistant Director
for Systems
Division of Engineering & Systems Technology
Office of Nuclear Reactor Regulation

Enclosure:
Safety Evaluation
WCAP-11736

cc w/enclosure:
J.A. Triggiani, Westinghouse

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ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATING TO REMOVAL OF AUTO CLOSURE INTERLOCK FUNCTION

WESTINGHOUSE OWNERS GROUP
WCAP-11736, VOLUME I AND II

1.0 INTRODUCTION

By letters dated April 22, 1988 and January 3, 1989 (References 1, 2) the Westinghouse Owners Group (WOG) requested that the staff review WCAP-11736 Volume I and II, "Residual Heat Removal System Auto Closure Interlock Removal Report." The staff review of this issue has focused on assuring that this generic report is consistent with the staff position on the removal of the autoclosure interlock, as set forth in the staff's safety evaluation for Diablo Canyon (Reference 3).

2.0 EVALUATION

2.1 WCAP-11736 Summary

WCAP-11736 was written with the support and funding of WOG. It provides an evaluation of the removal of the autoclosure interlock (ACI) from suction/isolation valves in the residual heat removal system (RHRS) at four reference plants: Salem Unit 1, Callaway Unit 1, North Anna Unit 1, and Sileron Harris Unit 1. The WOG plants participating in the program were categorized into one of four groups based on RHRS configuration and design characteristics that were similar to one of the four reference plants. The plants listed by group are:

8908210137

7pp XA

Group 1 - Salem Unit 1

Salem Unit 2
 D.C. Cook Units 1 & 2
 Indian Point Unit 3
 McGuire Units 1 & 2
 Sequoyah Units 1 & 2
 Watts Bar Units 1 & 2
 Zion Units 1 & 2

Group 3 - North Anna Unit 1

H.B. Robinson Unit 2
 Turkey Point Units 3 & 4
 Beaver Valley Unit 1
 Prairie Island Units 1 & 2
 North Anna Unit 2

Group 2 - Callaway Unit 1

Braidwood Units 1 & 2
 Byron Units 1 & 2
 Catawba Units 1 & 2
 Comanche Peak Units 1 & 2
 Trojan Unit 1
 Seabrook Unit 1
 Vogtle Units 1 & 2
 Wolf Creek Unit 1
 Millstone Unit 3
 South Texas Units 1 & 2

Group 4 - Shearon Harris Unit 1

Farley Units 1 & 2
 Beaver Valley Unit 2
 V.C. Summer Unit 1

The choice of the four particular reference plants was intended to provide the maximum number of the other WOG members with the best possible fit should they choose to delete the ACI in the future and reference WCAP-11736. It is expected that, should a plant desire to delete the ACI, a plant-specific analysis would still be required, but that substantially less resources would need to be expended to produce and review this analysis if reference were made to WCAP-11736.

The staff agrees with this approach and gives some guidance by summarizing the WOG position on what is expected in the plant-specific response.



2.2 Hardware Changes

WCAP-11736 proposes to remove the ACI function from the RHR suction valves. The open permissive interlock will remain intact. An alarm will be added to each valve which will actuate if the valve is open. The setpoint for the alarm is a plant-specific concern. A general rule for establishing the alarm setpoint, is that the setpoint pressure be greater than the open permissive setpoint and less than the RHR system design pressure minus the RHR pump head pressure. In addition, the status lights on the operator's panel, which indicate that these valves are open or closed, will remain functional after power has been removed from these valves.

V.C. Summer has separate monitor lights apart from valve indicators to show if valves are open.

2.3 Procedural Changes *We do not see this requirement necessary.*

WCAP-11736 proposes the following for generic procedural requirements:

Each plant will be expected to review its operating procedures to determine the continued applicability of the procedures and to make any changes necessary, to ensure continued safe operation without the ACI. Plant operating procedures should be reviewed to determine the effect of removing the ACI and installing a control room alarm. Listed below are a few of the general procedures that may require modification.

- RHRS operating procedure
- Plant startup from cold shutdown operating procedure(s)
- Plant shutdown from hot standby operating procedure(s)
- Alarm surveillance procedures (to include the new alarm)
- Leak rate testing procedures (caution regarding alarms and power removal from RHR suction valves)

In addition, the alarm response procedure used during plant startup should be modified to reflect the appropriate (new) alarm recognition and responses for the added alarm. The procedure should be revised to direct the operator to take the necessary actions to close the open RHR suction valve(s), if they are not closed following alarm actuation during normal startup operations. If this is not possible, the operator should be instructed to not pressurize further and return to the safe-shutdown mode of operation.

The staff agrees with this generic guidance assuming a surveillance procedure for the RHR suction valve alarms is added to ensure these alarms remain operable, but in addition, the staff believes that further protection can be achieved by removing power from the RHR suction valves before they are leak-checked in order to ensure that they remain in the tested configuration. If this is not feasible for a particular plant, the reasons for not performing this procedure should be justified in the plant-specific submittal.

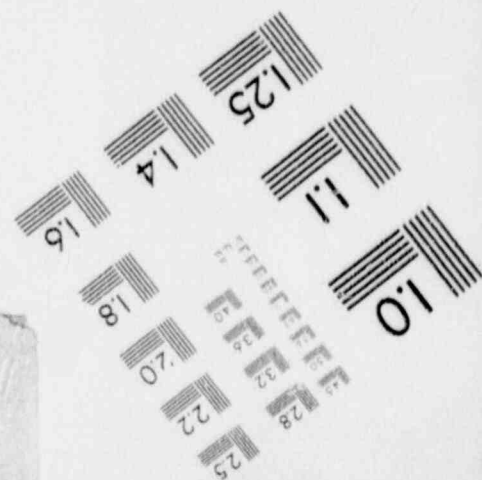
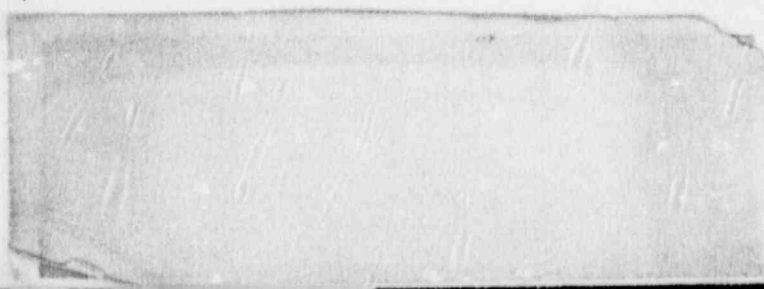
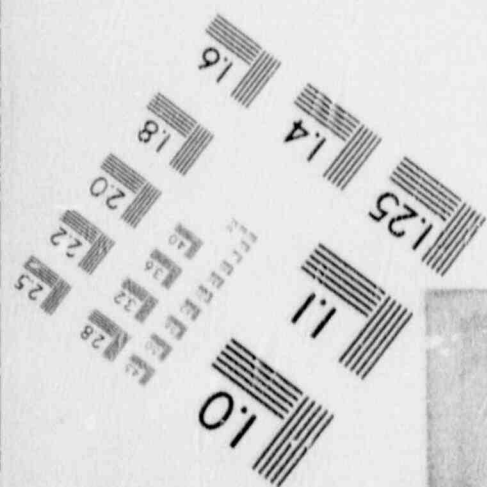
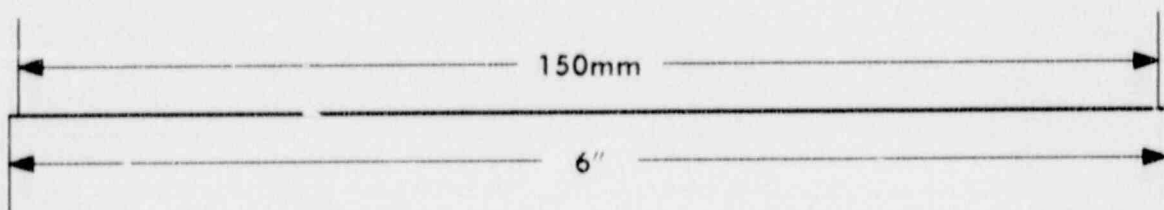
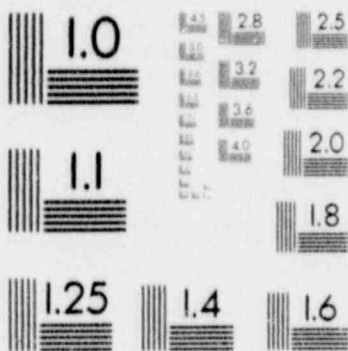
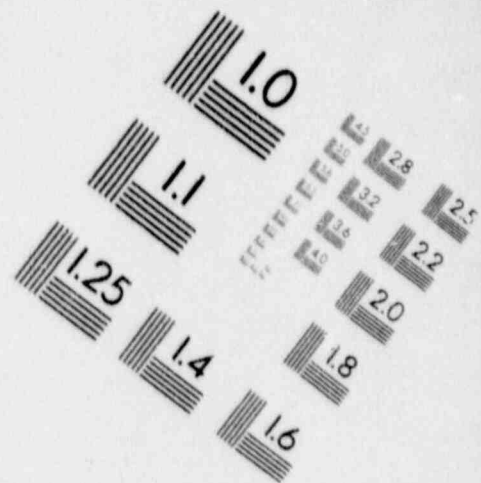
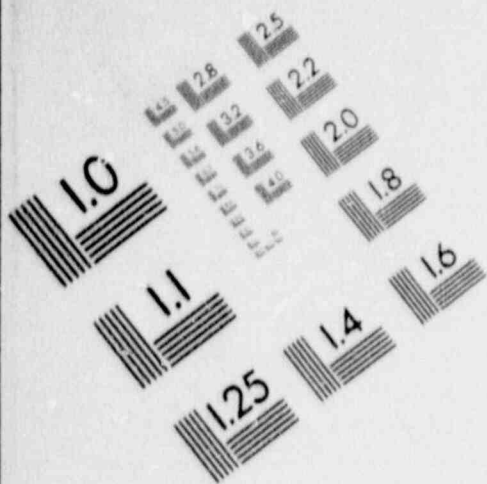
2.4 Reasons for Removing Autoclosure Interlock

The main reasons for removing ACI have been previously elucidated by the staff in the AEOD report, "Decay Heat Removal Problems at U.S. Pressurized Water Reactors" (Reference 4). This report points out that of the 130 loss-of-RHR events that were documented at U.S. pressurized water reactors (PWRs) between 1976 and 1983, 37 were caused by the automatic closure of the suction/isolation valves. The AEOD report also quotes a Sandia Laboratory study (Reference 5) that evaluated the competing risks associated with RHR suction/isolation valve closure and Event V. Sandia concluded that:

"The lowest core melt frequency due to the combination of loss of RHR suction during cold shutdown and V-LOCAs is obtained when there are no autoclosure interlocks on the RHR suction valves...removing the overpressure interlocks from the RHR suction valves gives the best RHR suction arrangement for PWRs based upon this analysis.

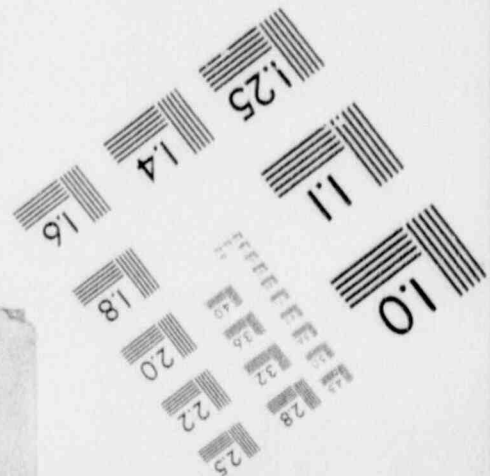
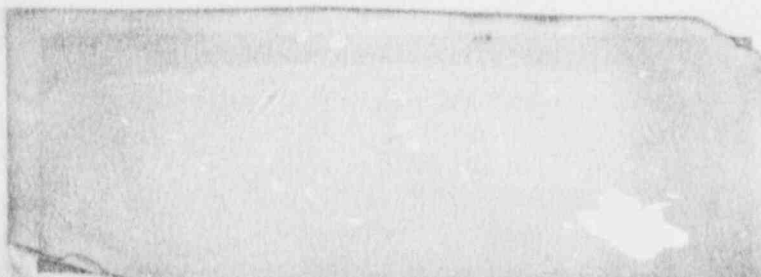
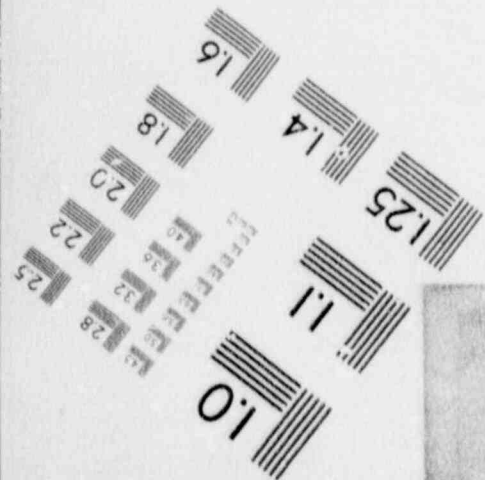
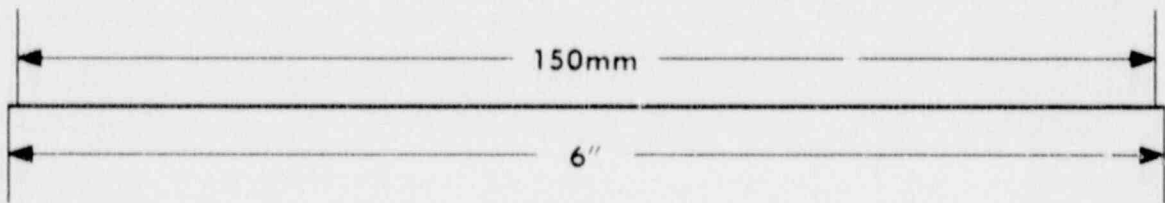
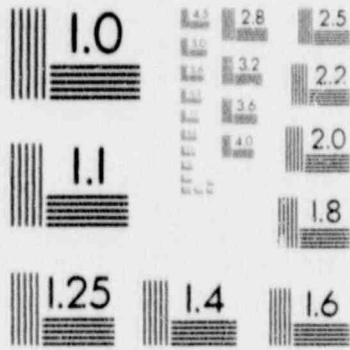
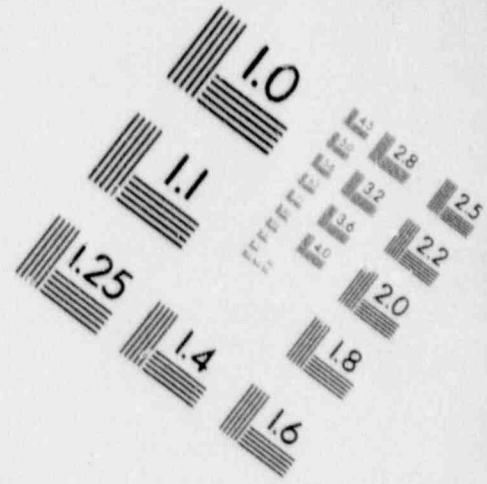
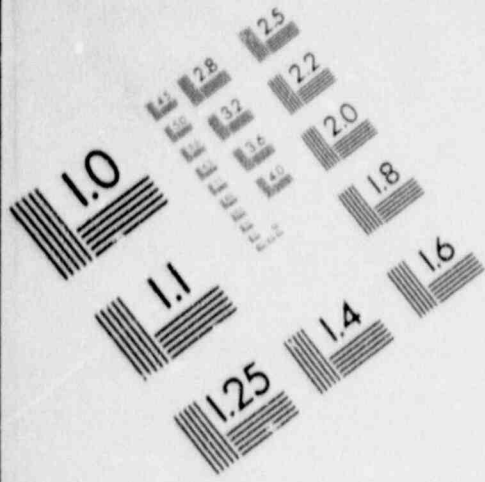
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IMAGE EVALUATION TEST TARGET (MT-3)



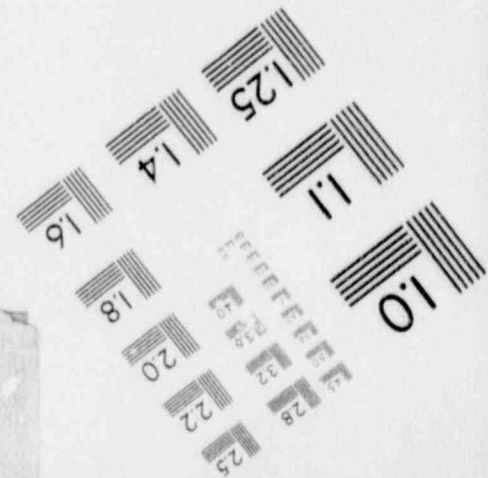
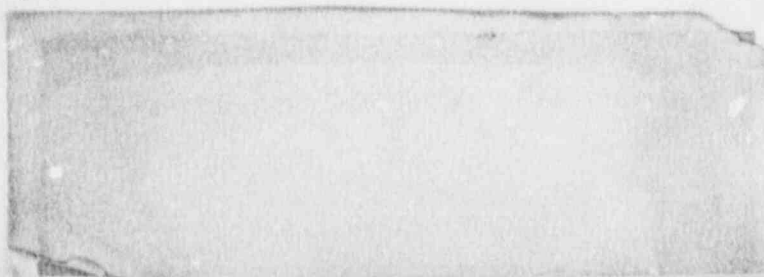
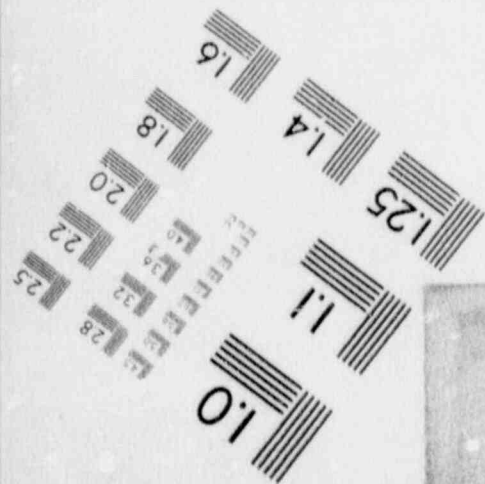
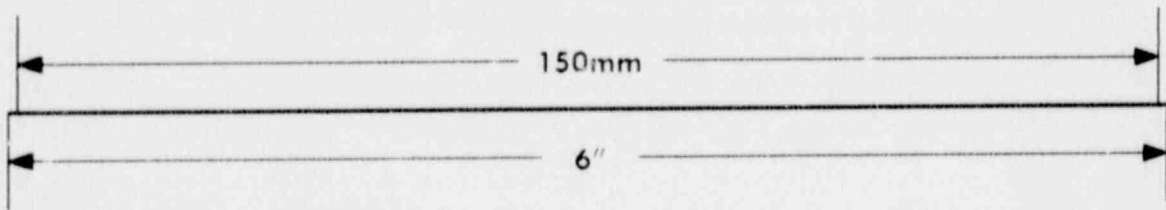
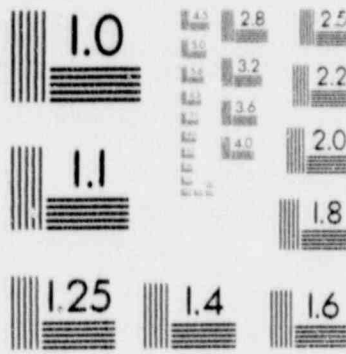
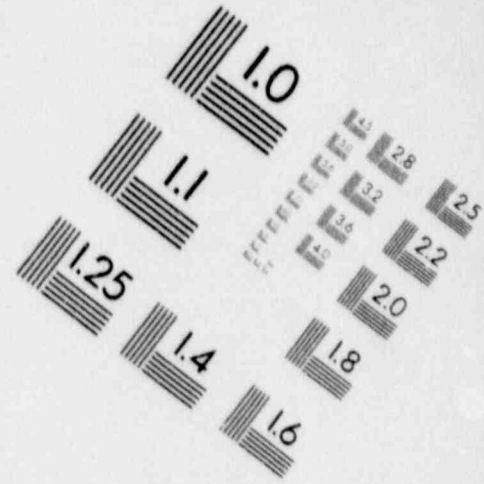
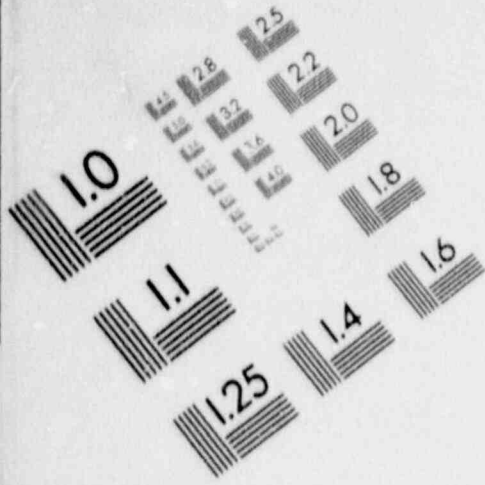
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IMAGE EVALUATION TEST TARGET (MT-3)



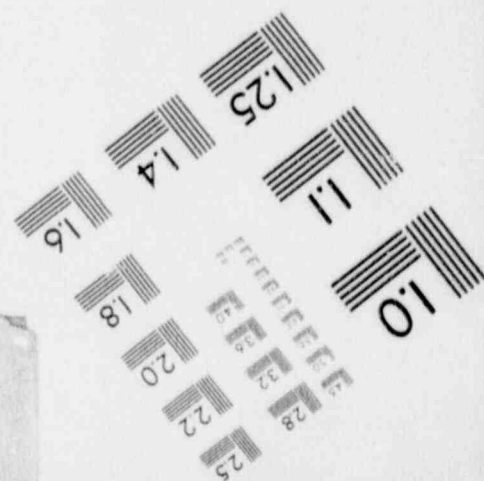
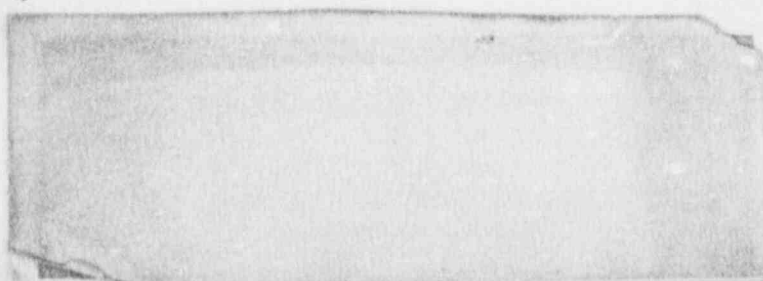
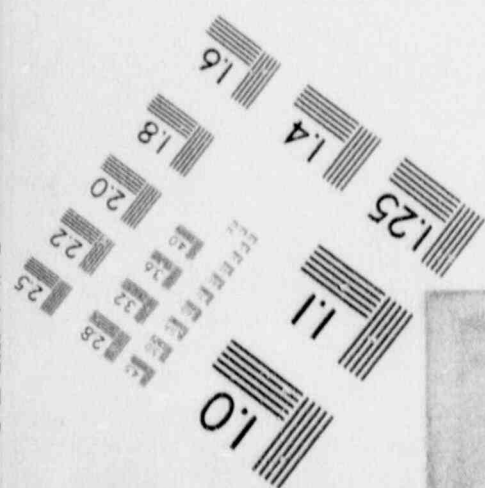
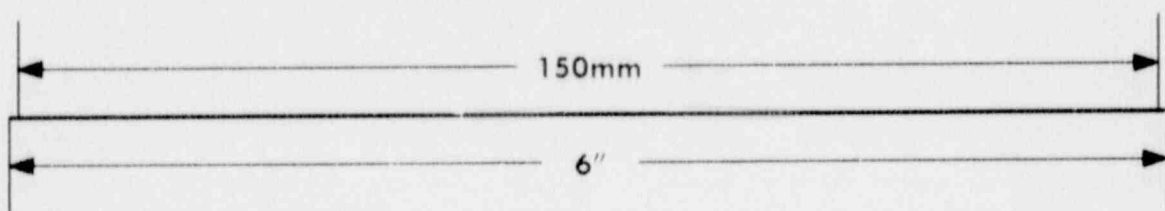
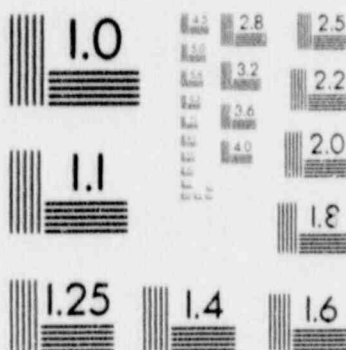
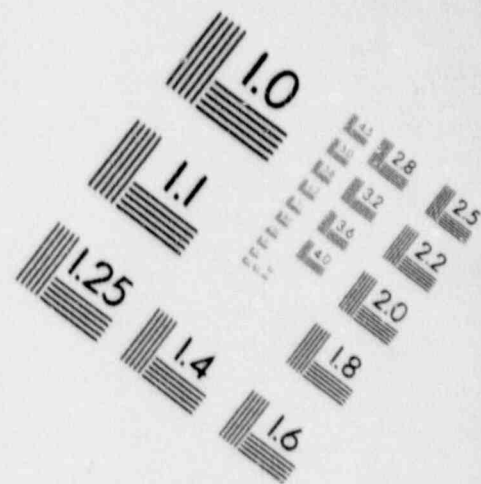
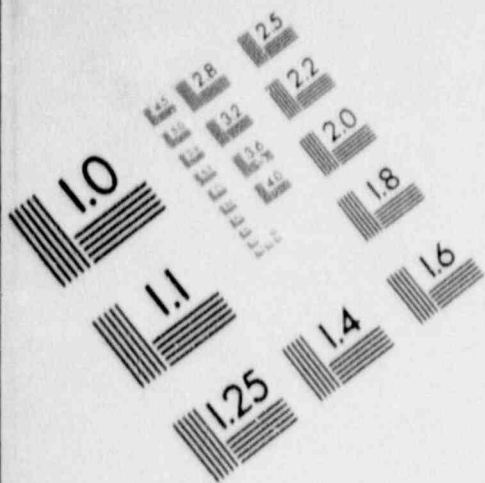
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IMAGE EVALUATION
TEST TARGET (MT-3)



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IMAGE EVALUATION TEST TARGET (MT-3)



...when interlocks are present, loss of RHR suction is the largest contributor to core melt frequency for all assumed values of P(CM-LRHRs). However, when the interlocks are not present, the core melt frequency due to loss of RHR suction is comparable to or less than the V-LOCA core melt frequency for the "best estimate" cases."

The AEOD report concluded that even though it was most likely a good idea to remove ACI, the effects of ACI removal upon plant safety must be evaluated on a plant-by-plant basis because of numerous plant-specific differences. The WOG submittal (Reference 1) contains such a plant-specific analyses for four different groups of plants.

An additional benefit associated with removal of ACI is that the isolation valves will remain open during low-temperature overpressurization (LTOP) events which allows the RHR relief valves to relieve pressure and aid in the LTOP protection of the RCS.

2.5 Safety Function of the Autoclosure Interlock

The WOG has shown in Reference 1 that the RHR relief valves have adequate capacity to mitigate pressure transients that occur during RHR operation. Therefore, the purpose of ACI is to ensure that there is a double barrier between the RCS and the RHRS when the plant is at normal operating conditions (hot and pressurized) and not in the RHRS cooling mode. The ACI function is to preclude conditions that could lead to a LOCA outside of containment, Event V, due to operator error. The sequence that concerns the staff in particular is that case in which the operator closes one of the isolation valves and not the other, since if both valves were left open, the operator would not be able to pressurize the plant.



2.6 Probabilistic Risk Assessment of the Event V Sequence and Safety Analyses of Transients

WCAP-11736 provides a plant-specific probabilistic risk assessment (PRA) for the four lead plants (Salem, Callaway, North Anna, Shearon Harris); these analyses follow the PRA format previously reviewed by the staff for Diablo Canyon (Reference 3). The results of these analyses agree with the Diablo Canyon finding that the proposed configuration with the ACI removal and an alarm added will result in a lower probability for the Event V sequence than the present plant configuration. The staff has no requirements based on the absolute values in the PRA analyses and will not require a plant-specific PRA from each licensee proposing to remove the ACI. However, the licensee should do sufficient PRA and safety analyses to ensure that its plant will not show results that will invalidate the conclusions of WCAP-11736.

3.0 STAFF POSITION

The staff finds that the removal of the ACI for Westinghouse plants covered by WCAP-11736 can produce a net safety benefit provided that the following five key improvements are in place. Furthermore, the staff finds that WCAP-11736 may be referenced in the licensee's plant-specific submittals to show compliance with those items that are not plant specific. However, this SER does not grant permission to remove the ACI for any plant.

- Plant Improvements (1) *Does this mean a separate alarm window on the main control board for each valve or can this alarm be a common window for all four valves?*
- (1) An alarm will be added to each RHR suction valve which will actuate if the valve is open and the pressure is greater than the open permissive setpoint and less than the RHR system design pressure minus the RHR pump head pressure [justified by WCAP-11736].
 - (2) Valve position indication to the alarm must be provided from the stem-mounted limit switches (SMLSs) and power to the SMLSs must not be affected by power lockout of the valve [justified by WCAP-11736].
- (2) *V.C. Summer design uses limit switches on valve operator. Why the requirement to use stem mounted limit switches? Power removed from our valves will not affect alarm or limit switch operation.*

- (3) The procedural improvements described in WCAP-11736 should be implemented. Procedures themselves are plant specific.
- (4) Where feasible, power should be removed from the RHR suction valves prior to their being leak-checked [plant specific].
- (5) The RHR suction valve operators should be sized so that the valves cannot be opened against full system pressure [plant specific].

4.0 REFERENCES

- (1) N. L. Burns (et al.), "Residual Heat Removal System Autoclosure Interlock Removal Report for the Westinghouse Owners Group," February 1988, WCAP-11736, Revision 0.0.
- (2) Letter, Roger A. Newton (WOG) to M. W. Hodges (NRC), January 3, 1989.
- (3) Letter, Harry Rood (NRC) to J. D. Shiffer (PGE), "Safety Evaluation of Removal of RHR Autoclosure Interlock Function and Installation of an Alarm at Diablo Canyon Units 1 & 2," February 17, 1988.
- (4) H. O. Ornstein, "Decay Heat Removal Problems at U.S. Pressurized Water Reactors," December 1985, AEOD/C503.
- (5) D. R. Gallup, D. M. Kunsman, M. P. Bohr; Sandia National Laboratories, "Potential Benefits Obtained by Requiring Safety-Grade Cold Shutdown Systems," NUREG/CR-4335, July 1985.

3.0 PROPOSED BASIC LOGIC CHANGE

The proposed interlock change for V. C. Summer removes the autoclosure interlock feature from the RHRS suction/isolation valves (8701A/B, 8702A/B). All other valve interlock features described in Section 2.3 of this report remain in place. With removal of the autoclosure interlock feature, valves 8701A&B and 8702A&B will not close automatically on increasing RCS pressure greater than the valve closing setpoint. Alarms will be added (for each RHRS suction/isolation valve) that actuate in the main control room given a "VALVE NOT FULL CLOSED" signal in conjunction with a "RCS PRESSURE-HIGH" signal. The intent of the alarms is to alert the operator that a RCS-RHRS, series, suction/isolation valve(s) is not fully closed, and that double valve isolation from the RCS to the RHRS is not being maintained. Valve position indication to the alarm must be provided from the valve limit switches and power to the limit switches must not be affected by power lockout to the valve.

#1.

#2.

The proposed interlocks for valves 8701A&B and 8702A&B are shown functionally on Figure 3-1. In addition, the proposed valve interlock changes are shown on the elementary wiring diagrams in Figures 3-2, 3-3, 3-4 and 3-5. The only change to the valves interlock and circuitry is to remove the autoclosure portion of the interlock and add a control room alarm; the valves open permissive circuit will not be altered.

In summary, the proposed V. C. Summer interlock changes provide deletion of the autoclosure interlock feature from the RHRS suction/isolation valves, while still meeting the regulatory requirements to retain the open permissive portion of the interlock. In addition, the change provides a control room alarm to alert the operator if a RHRS suction/isolation valve is not fully closed, and provides justification for elimination of power lockout of the suction/isolation valves during shutdown.

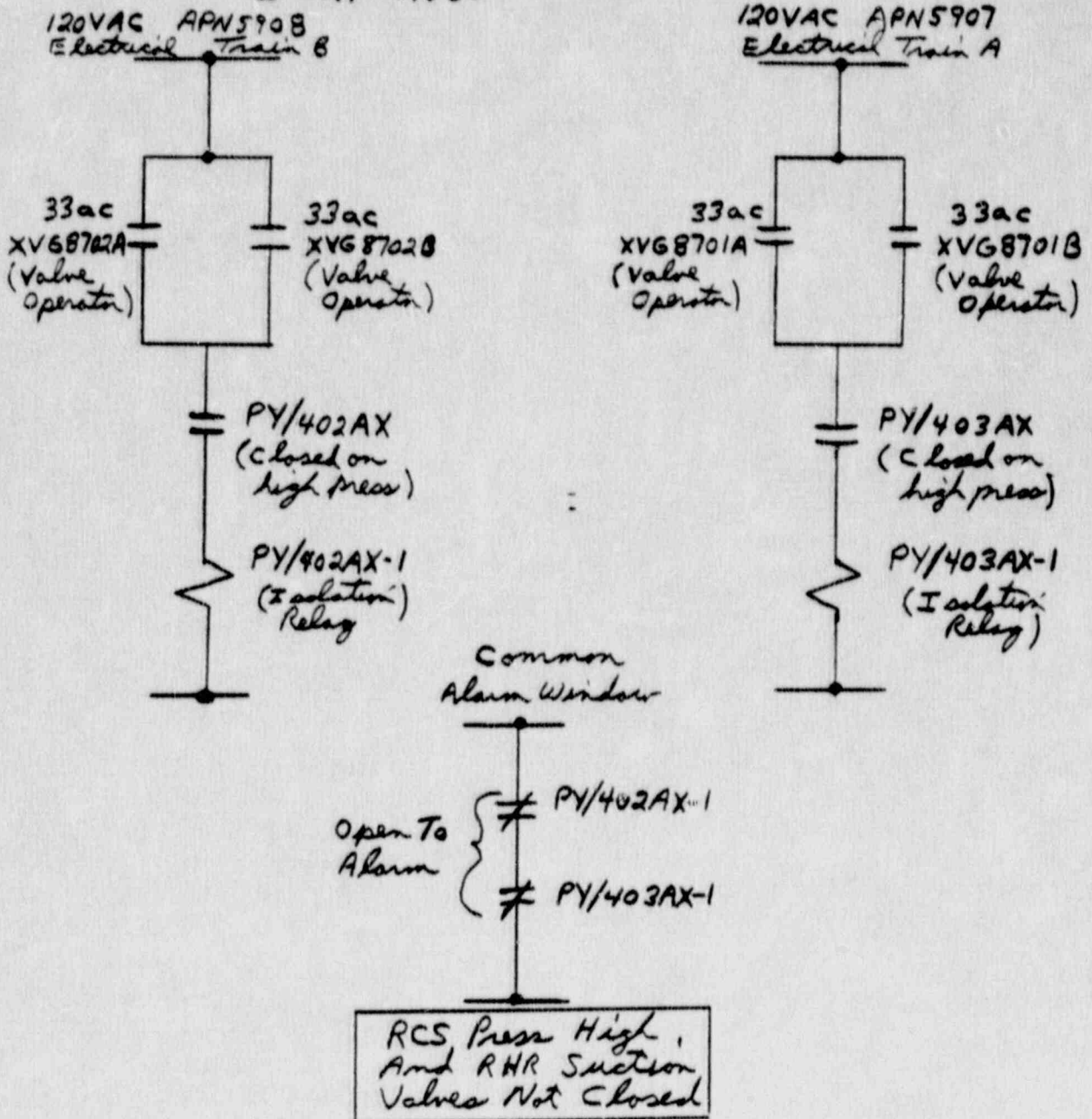
- # 1.) All four valves are alarmed on a common alarm window on the main control board. (see attached sketch).
- # 2.) Limit switches for V. C. Summer design are in valve operator not on stem. Removal of power will not affect alarm function. Alarm fed by separate power supplies.

ENGINEERS
TECHNICAL WORK RECORD

Serial 9939
Engineer T.L. Williams
Date 9/20/89

Project Title RHR ASI Deletion
V.C. Summer Submittal
WCAP-11835

Tab Page 1 of 1



Verification

Type of Verification	Verifier Signature/Date

Approval

Signature/Date

DISTRIBUTION FOR MEETING SUMMARY DATED: September 25, 1989

Facility: Summer

Packet File

NRC PDR

Local PDR

T. Murley 12-G-18

J. Sniezek 12-G-18

E. Adensam 14-B-20

P. Anderson 14-B-20

J. Hayes 14-B-20

OGC 15-B-18

E. Jordan MNBB-3302

B. Grimes 9-A-2

H. Conrad 9-H-15

ACRS (10) P-315

B. Borchardt 17-G-21