GENERAL ELECTRIC

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JNF 055-83

July 26, 1983

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, DC 20555

Attention: Mr. D.G. Eisenhut, Director
Division of Licensing

SUBJECT: IN THE MATTER OF 238 NUCLEAR ISLAND
GENERAL ELECTRIC STANDARD SAFETY ANALYSIS REPORT (GESSAR II)
DOCKET NO. STN 50-447

CONTAINMENT DESIGN MARGINS

REFERENCES:

1. Letter from D.G. Eisenhut to G.G. Sherwood, "Adequacy of the Design Margins for the Mark III Containment System of GESSAR II Nuclear Island", August 10, 1982.
2. Letter from G.G. Sherwood to D.G. Eisenhut, "Containment Design Margins", April 8, 1983.

The purpose of this letter is to transmit for your review the GESSAR II responses to the action plan for resolving the containment design issues identified by John Humphrey. This action has been developed in response to Reference 1. This letter and attachment address all of the issues, either completing the GE action plan defined by Reference 2, or on two issues committing to a schedule for completion.

If you have any questions please contact C.A. Cameron on (408) 925-2441.

Very truly yours,

Glenn G. Sherwood

Glenn G. Sherwood, Manager
Nuclear Safety & Licensing Operation

Change: PDR, NTIS, NSIC } Non Prop Only

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Attachments

cc: F.J. Miraglia (w/o attachments)
D.C. Scaletti
C.O. Thomas (w/o attachments)
L.S. Gifford (w/o attachments)

GGS:td

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AFFIDAVIT

I, Glenn G. Sherwood, being duly sworn, depose and state as follows:

1. I am Manager, Nuclear Safety and Licensing Operation, General Electric Company, and have been delegated the function of reviewing the information described in paragraph 2 which is sought to be withheld and have been authorized to apply for its withholding.

2. The information sought to be withheld is contained in the response to NRC questions related to Humphrey concerns.

3. In designating material as proprietary, General Electric utilizes the definition of proprietary information and trade secrets set forth in the American Law Institute's Restatement Of Torts, Section 757. This definition provides:

   "A trade secret may consist of any formula, pattern, device or compilation of information which is used in one's business and which gives him an opportunity to obtain an advantage over competitors who do not know or use it.... A substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring information.... Some factors to be considered in determining whether given information is one's trade secret are: (1) the extent to which the information is known outside of his business; (2) the extent to which it is known by employees and others involved in his business; (3) the extent of measures taken by him to guard the secrecy of the information; (4) the value of the information to him and to his competitors; (5) the amount of effort or money expended by him in developing the information; (6) the ease or difficulty with which the information could be properly acquired or duplicated by others."

4. Some examples of categories of information which fit into the definition of proprietary information are:

   a. Information that discloses a process, method or apparatus where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

   b. Information consisting of supporting data and analyses, including test data, relative to a process, method or apparatus, the application of which provide a competitive economic advantage, e.g., by optimization or improved marketability;

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c. Information which if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality or licensing of a similar product;

d. Information which reveals cost or price information, production capacities, budget levels or commercial strategies of General Electric, its customers or suppliers;

e. Information which reveals aspects of past, present or future General Electric customer-funded development plans and programs of potential commercial value to General Electric;

f. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection;

g. Information which General Electric must treat as proprietary according to agreements with other parties.

5. In addition to proprietary treatment given to material meeting the standards enumerated above, General Electric customarily maintains in confidence preliminary and draft material which has not been subject to complete proprietary, technical and editorial review. This practice is based on the fact that draft documents often do not appropriately reflect all aspects of a problem, may contain tentative conclusions and may contain errors that can be corrected during normal review and approval procedures. Also, until the final document is completed it may not be possible to make any definitive determination as to its proprietary nature. General Electric is not generally willing to release such a document to the general public in such a preliminary form. Such documents are, however, on occasion furnished to the NRC staff on a confidential basis because it is General Electric's belief that it is in the public interest for the staff to be promptly furnished with significant or potentially significant information. Furnishing the document on a confidential basis pending completion of General Electric's internal review permits early acquaintance of the staff with the information while protecting General Electric's potential proprietary position and permitting General Electric to insure the public documents are technically accurate and correct.

6. Initial approval of proprietary treatment of a document is made by the Subsection Manager of the originating component, the man most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within the Company is limited on a "need to know" basis and such documents at all times are clearly identified as proprietary.

7. The procedure for approval of external release of such a document is reviewed by the Section Manager, Project Manager, Principal Scientist or other equivalent authority, by the Section Manager of the cognizant Marketing function (or his delegate) and by the Legal

Operation for technical content, competitive effect and determination of the accuracy of the proprietary designation in accordance with the standards enumerated above. Disclosures outside General Electric are generally limited to regulatory bodies, customers and potential customers and their agents, suppliers and licensees only in accordance with appropriate regulatory provisions or proprietary agreements.

8. The information mentioned in paragraph 2 above has been evaluated in accordance with the above criteria and procedures and has been found to contain information which is proprietary and which is customarily held in confidence by General Electric.

9. The information, to the best of my knowledge and belief, has consistently been held in confidence by the General Electric Company, no public disclosure has been made, and it is not available in public sources. The material consists of information which is part of the General Electric technology base which has a value that is clearly substantial and would be lost if the information were disclosed to the public.

STATE OF CALIFORNIA)
COUNTY OF SANTA CLARA) ss:

Glenn G. Sherwood, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 26 day of July, 1983.

Glenn Sherwood
Glenn G. Sherwood
General Electric Company

Subscribed and sworn before me this 26 day of July 1983.

OFFICIAL SEAL
KAREN S. VOGELHUBER
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My Commission Expires Dec. 21, 1984

Karen S. Vogelhuber
NOTARY PUBLIC, STATE OF CALIFORNIA

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GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 1

I. Issues Addressed

1.1 Presence of local encroachments such as the TIP platform, the drywell personnel airlock and the equipment and floor drain sumps may increase the pool swell velocity by as much as 20 percent.

1.2 Local encroachments in the pool may cause the bubble breakthrough height to be higher than expected.

1.4 Piping impact loads may be revised as a result of the higher pool swell velocity.

II. Program for Resolution

1.+ Provide details of the one-dimensional analysis which was completed and showed a 20% increase in pool velocity.

2.+ The two-dimensional model will be refined by addition of a bubble pressure model and used to show the pool swell velocity decreases near local encroachments. The code is a version of SOLA.

3.+ The inherent conservatisms in the code and modeling assumptions will be listed.

4.+ The modified code will be benchmarked against existing clean pool PSTF data.

5.+ A recognized authority on hydrodynamic phenomena will be retained to provide guidance on conduct of the analyses.

6. A discussion of the local encroachment effects on pool swell will be provided.

III. Schedule

Item 6 will be completed for submittal on September 30, 1983.

\+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

Action Plan 2

I. Issues Addressed

1.3 Additional submerged structure loads may be applied to submerged structures near local encroachments.

II. Program For Resolution

1. The results obtained from the two-dimensional analyses completed as part of the activities for Action Plan 1 have been used to define changes in fluid velocities in the suppression pool which are created by local encroachments. Supporting arguments to verify that the results from two-dimensional analyses are bounding with respect to velocity changes in the suppression pool are given in the attached response.

2. The velocity fields generated in Action Plan Element 2.1 have been reviewed. See the attached summary.

3. See the attached summary of design basis hydrodynamic loads.

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Action Plan 2 -- GENERAL ELECTRIC RESPONSE

1. Fluid Velocities

Additional loads may be applied to both submerged structures and the pool boundary due to the effect of local encroachments. These two areas will be addressed separately:

A) Submerged Structure Loads

The results of the SOLA code analysis completed for Action Plan Element 1.6 are used in this study. The velocity and pressure fields throughout the pool are direct outputs of the modified SOLAV01. These changes in these fields may then be used to calculate the changes in loading determined in Action Plan Element 2.2

B) Pool Swell Boundary Loads

The present load definition specifies the pool swell boundary load on the drywell wall to be the peak drywell presure. There is a concern that the encroachment will increase the bubble pressure and cause the bubble to be translated closer to the containment wall, which will increase the pool boundary loading on the containment wall. Pressure on the containment wall is a direct output of the SOLAV code. The pool boundary load definition on the containment wall is based on PSTF full scale test data that has been correlated with SOLAV output. The PSTF design value is 10 psid. The maximum containment wall pressure is 97% of the PSTF design value. Thus, the encroachments do not cause the boundary design loads for GESSAR II to be exceeded. Consequently, General Electric considers this issue closed.

2. Velocity Fields

The SOLA fluid velocity fields in the vicinity of known submerged structures in the GESSAR II suppression pool have been analyzed for the unencroached and encroached cases. The maximum standard acceleration drag forces were calculated from the SOLAV velocity fields near the SRV quencher and ECCS piping. The sum of these two maximum drag loads was found to be less than the standard drag load calculated using a velocity of 32 ft/sec*. If the plant design included submerged structures at or above the top vent and within 12 feet of the drywell wall, additional analysis would be required, since the loads would be expected to exceed this envelope. GESSAR II does not have submerged structures in this area.

*Based on current information, the minimum design criterion for submerged structures is a 32 ft/sec standard drag load.

3. Hydrodynamic Loads

The hydrodynamic loading on the submerged equipment in the suppression pool due to structural encroachments has been found to be less than the load corresponding to the 32 ft/sec standard drag velocity per Action Plan Element 2.2. This value (32 ft/sec) has been used as the basis for comparison with the design loads on the existing submerged equipment.

The submerged equipment has been designed to the following standard drag velocities:

Wetwell Equipment

	SRV Quencher	ECCS Suction	RCIC Suction
a) Water jet loads	50 ft/sec	50 ft/sec	50 ft/sec
b) Air bubble loads	32 ft/sec	50 ft/sec	50 ft/sec
c) Pool swell loads	45 ft/sec	50 ft/sec	50 ft/sec
d) Pool fallback loads	35 ft/sec	50 ft/sec	50 ft/sec

As it can be seen from the table above, SRV quenchers, ECCS and RCIC suctions have been designed to a standard drag velocity no less than 32 ft/sec. It can be concluded that they are adequately designed to withstand the hydrodynamic loading due to structural encroachments.

As for SRV, ECCS and RCIC discharge pipes and instrumentation, the Applicant shall design this submerged equipment to withstand the hydrodynamic loading resulting from structure encroachment.

Action Plan 3

I. Issues Addressed

1.5 Impact loads on the HCU floor may be imparted and the HCU modules may fail which could prevent successful scram if the bubble breakthrough height is raised appreciably by local encroachments.

II. Program For Resolution

1. The commitment of Action Plan 1 is expected to demonstrate by a conservative analysis that the maximum impact on the HCU floor due to encroachments is less than the existing design basis. This issue will be resolved prior to the first applicant reference to GESSAR II.

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Action Plan 4

I. Issues Addressed

1.6 Local encroachments or the steam tunnel may cause the pool swell froth to move horizontally and apply lateral loads to the gratings around the HCU floor.

II. Program For Resolution

1. A bounding analysis for determining the horizontal liquid and air flows created by the presence of the steam tunnel and HCU floor has been performed. The forces imposed on the HCU floor supports and grating were also calculated from this information. See the attached summary.

2. For a statement on the HCU floor lateral load capability, see the attached response.

1. HCU Floor Loads

A bounding, steady, potential flow analysis was performed to determine the free jet flow field passing through the HCU floor. This analysis assumed all the rising fluid passed through the HCU floor open area (i.e., no separation of liquid droplets following impact on the solid portion of the HCU floor) and the velocities of the liquid and gas phases are equal.

This potential flow model was driven with the same conditions as used for calculation of the 238 standard plant HCU floor differential pressure model. This model is documented in Reference 1 and assumes the pool swell froth mixture impacts on the HCU floor, stagnates, and then is reaccelerated due to wetwell pressurization.

The analysis concluded that horizontal loads on the HCU floor are small and vary with location. For beams, the horizontal force is a maximum of 1.7 psid. For grating, the horizontal force is a maximum of 0.42 psid.

Details of the load definition are given in Attachment 4.1

The analysis which yields these results is felt to be very conservative, due to the assumptions of steady flow, equal phase velocities, and stagnation of liquid droplets upon impact with solid portions of the HCU floor. In reality the flow is highly transient. Most of the rising two-phase mixture is expected to impact the solid floor, stagnate, and fall back to the pool surface. Hence, the flow which actually passes through the HCU floor will have total momentum substantially less than determined with this analysis. The calculated loads are thus expected to be bounding and very conservative.

2. HCU Floor Lateral Load Capability

The HCU floor design presented in GESSAR II has been reviewed for capability to handle the lateral loads which result from pool swell. The loads used in this assessment are those reported in the response to Action Plan Element 4.1.

The structural assessment which has been performed leads to the conclusion that the lateral loads due to pool swell result in relatively minor stresses in the support beams. The grating is adequately installed, therefore, this issue is considered closed.

Reference

1. Bilanin, W. J. "Mark III Containment Analytical Model", NEDO-20533, Supplement 1, June 1974.

ATTACHMENT 4.1

I. The GESSAR II unique HCU floor horizontal beam load is defined as:

$$\Delta P_{beam,\ max} = 1.7\ \text{lbf/in}^2 \qquad (1)$$

This load is to be applied to the first radial beam under each grating section.

(1) The loading on major beams may be reduced, linearly, from $\Delta P_{beam,\ max}$ to zero between the 1st major beam and the zero shear planes. Zero shear planes are located at

$$\theta_1 = 199°$$

$$\theta_2 = 311°$$

(2) For beams not directed radially outward from the reactor centerline, the pressure may be reduced by:

$$\Delta P_{beam} = \Delta P_{beam,\ max.} \cos \alpha$$

where α is the angle between that of the subject beam and a radially outward line through the reactor centerline.

In all cases, the direction of loading is from concrete areas toward the zero shear planes.

Since the flow is assumed to stagnate between beams which extend below the HCU floor, there is no horizontal loading under concrete areas.

II. The GESSAR II unique floor grating load is defined as:

$$\Delta P_{grating} = 0.42\ \text{lbf/in}^2$$

This loading is to be applied uniformly to all vertical surfaces of all grating components. Direction of the load is the same as on beams.

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 5

I. Issues Addressed

2.1 The annular regions between the safety/relief valve discharge lines and the drywell wall penetration sleeves may produce condensation oscillation (CO) frequencies near the drywell and containment wall structural resonance frequencies.

2.2 The potential condensation oscillation and chugging loads produced through the annular area between the SRVDL and sleeve may apply unaccounted for loads to the SRVDL. Since the SRVDL is unsupported from the quencher to the inside of the drywell wall, this may result in failure of the line.

2.3 The potential condensation oscillation and chugging loads produced through the annular area between the SRVDL and sleeve may apply unaccounted for loads to the penetration sleeve. The loads may also be at or near the natural frequency of the sleeve.

II. Program for Resolution

1.+ The existing condensation data will be reviewed to verify that no significant frequency shifts occurred. The data will also be reviewed to confirm that the amplitudes were not closely related to acoustic effects.

2.+ GE intends to produce a generic SRVDL sleeve CO load definition. The driving conditions for condensation oscillation at the SRVDL exit will be calculated. Based on these calculations, existing test data will be used to estimate the frequency and bounding pressure amplitude of condensation oscillation at the SRVDL annulus exit. The new load case, taken in combination with existing main vent CO loads (CLR-basis), will then be compared, on an amplified response spectrum (ARS) basis, to other existing loads to show that existing load cases are bounding.

\+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

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3. Deleted

4. A detailed description of all hydrodynamic and thermal loads that are imposed on the SRVDL and the SRVDL sleeve during LOCA blowdowns is attached.

5&6. GESSAR II Appendix 3B will be modified by adding the following paragraphs to Section 3BA.10.2:

   (7) Applicant to provide SRVDL sleeve design which accommodates loads created by steam flow through the annulus region.

   (8) Applicant to provide definition of the external pressure loads which the SRVDL enclosed by the sleeve can withstand.

7. The maximum lateral loads which could be applied to the sleeve by phenomena analogous to the Mark I and Mark II downcomer lateral loads will be defined.

III. Schedule

Item 7 will be completed for submittal on September 30, 1983.

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4. SRVDL Loads

The hydrodynamic and thermal loads that are imposed on the SRVDL and the SRVDL sleeve during LOCA blowdowns are listed below:

SRVDL Piping

a. Hydrodynamic Loads

1) Dynamic response due to SRV (one, all, ADS) actuation
2) Horizontal Vent Chugging/Condensation Oscillation
3) Drag Loads due to Quencher Air Clearing
4) Vent Air Clearing Drag Loads

b. Thermal Loads

Thermal loads on piping are based on 470°F maximum steam temperature in the entire line.

SRVDL Sleeve

a. Hydrodynamic Loads

1) Horizontal Vent Chugging/Condensation Oscillation
2) Drag Loads due to Quencher Air Clearing
3) Vent Air Clearing Drag Loads

b. Thermal Loads

Thermal loads are based on 350°F steam temperature inside the sleeve.

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 6

I. Issues Addressed

3.1 The design of the STRIDE plant did not consider vent clearing, condensation oscillation and chugging loads which might be produced by the actuation of the RHR heat exchanger relief valves.

3.7 The concerns related to the RHR heat exchanger relief valve discharge lines should also be addressed for all other relief lines that exhaust into the pool.

II. Program for Resolution

1. The appropriate section(s) of GESSAR II will be revised to specify the applicant to define all applicable dynamic loads and to demonstrate that all relief valve lines will be designed not to produce unacceptable loads on the containment boundary, the relief valve line containment penetration, submerged structures or safety related equipment. See attachment.

2. The appropriate section(s) of GESSAR II will be revised to specify the applicant to provide design/configuration of relief valve lines which exhaust into the suppression pool. See attachment.

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Action Plan 6 -- GENERAL ELECTRIC RESPONSE

General Electric will revise GESSAR II by adding the following paragraphs to the appropriate section identified:

Section 5.4.7.2.3

The design and configuration of all safety related valve lines which exhaust into the suppression pool shall be provided by the applicant. The RHR System safety relief valves are to be designed to assure that physical damage to the RHR System and containment/structure will not result from dynamic loading associated with relief valve actuation. Specifically, all RHR System relief valves, except RHR relief valves E12-F055, that discharge to the suppression pool, discharge water. Normal actuation of these relief valves is caused by small quantities of water that either leak back from the reactor and/or result from thermal expansion of water in the systems' lines. Since these actuation conditions are characterized by pressure slowly approaching the relief valve setpoint on discharge of small quantities of water, significant water hammer and dynamic loads do not occur. The dynamic loading associated with abnormal actuation of these relief valves caused by spurious failure of the valves in the open position shall be provided by the applicant.

RHR relief valve E12-F055 is provided to prevent overpressurization of the RHR heat exchanger during the steam condensing mode (SCM). Actuation of this relief valve would occur if it spuriously failed open or if the steam pressure reducing valve E12-F051 failed open during the SCM and steam would be discharged to the suppression pool. The dynamic loading associated with actuation of valve E12-F055 during the SCM shall be provided by the applicant.

Section 6.3.1.1.3

The design and configuration of all ECCS safety relief valve lines which exhaust into the suppression pool shall be provided by the applicant. All ECCS safety relief valves are to be designed to assure that physical damage to these systems and containment/structure will not result from dynamic loading associated with relief valve actuation. Specifically, all ECCS relief valves, except RHR relief valve E12-F055 discussed in Section 5.4.7.2.3, that discharge to the suppression pool, discharge water. Normal actuation of these relief valves is caused by small quantities of water that either leak back from the reactor and/or result from thermal expansion of water in the systems' lines. Since these actuation conditions are characterized by pressure slowly approaching the relief valve setpoint and discharge of small quantities of water, significant water hammer and dynamic loads do not occur. The dynamic loading associated with abnormal actuation of these relief valves caused by spurious failure of the valves in the open position shall be provided by the applicant.

Action Plan 7

I. Issues Addressed

3.2 The STRIDE design provided only nine inches of submergence above the RHR heat exchanger relief valve discharge lines at low suppression pool levels.

II. Program for Resolution

The Program for Resolution of Action Plan Element 6.1 and 6.2 apply to this item; accordingly, this issue is closed.

Action Plan 8

I. Issues Addressed

3.4 The RHR heat exchanger relief valve discharge lines are provided with vacuum breakers to prevent negative pressure in the lines when discharging steam is condensed in the pool. If the valves experience repeated actuation, the vacuum breaker sizing may not be adequate to prevent drawing slugs of water back through the discharge piping. These slugs of water may apply impact loads to the relief valve or be discharged back into the pool at the next relief valve actuation and apply impact loads to submerged structures.

3.5 The RHR relief valves must be capable of correctly functioning following an upper pool dump which may increase the suppression pool level as much as five feet creating higher back pressures on the relief valves.

II. Program for Resolution

The Program for Resolution of Action Plan Element 6.1 and 6.2 apply to this item; accordingly, this issue is closed.

Action Plan 9

I. Issues Addressed

3.6 If the RHR heat exchanger relief valves discharge steam to the upper levels of the suppression pool following a design basis accident, they will significantly aggravate suppression pool temperature stratification.

II. Program for Resolution

The Program for Resolution of Action Plan Element 6.1 and 6.2 apply to this item; accordingly, this issue is closed.

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 10

I. Issues Addressed

4.1 The present containment response analyses for drywell break accidents assume that the ECCS systems transfer a significant quantity of water from the suppression pool to the lower regions of the drywell through the break. This results in a pool in the drywell which is essentially isolated from the suppression pool at a temperature of approximately 135°F. The containment response analysis assumes that the drywell pool is thoroughly mixed with the suppression pool. If the inventory in the drywell is assumed to be isolated and the remainder of the heat is discharged to the suppression pool, an increase in bulk pool temperature of 10° may occur.

II. Program for Resolution

1.+ Complete analysis to quantify maximum bulk suppression pool temperature increase produced as a result of an isolated drywell pool.

\+ These results are generic in that they deal with analytical methods, data or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

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Action Plan 11

I. Issues Addressed

4.2 The existence of the drywell pool is predicated upon continuous operation of the ECCS. The current Emergency Procedure Guidelines require the operators to throttle ECCS operation to maintain vessel level below level 8. Consequently, the drywell pool may never be formed.

9.1 The current FSAR analysis is based upon continuous injection of relatively cool ECCS water into the drywell through a broken pipe following a design basis accident. The EPG's direct the operator to throttle ECCS operation to maintain reactor vessel level at about level 8. Thus, instead of releasing relatively cool ECCS water, the break will be releasing saturated steam which might produce higher containment pressurizations than currently anticipated. Therefore, the drywell air which would have been drawn back into the drywell will remain in the containment and higher pressures will result in both the containment and drywell.

II. Program for Resolution

1.+ Calculations will be submitted to demonstrate that failure to form the drywell pool will not cause adverse consequences. The calculations will quantify the variation of suppression pool level without formation of the drywell pool and with upper pool dump.

2.+ Interactions between ESF system operation and suppression pool level will be reviewed to assure that higher suppression pool level will not degrade performance.

3.+ A realistic analysis of the effects of failure to recover the drywell air mass will be performed. This analysis will include the effects of containment heat sinks and the mitigating effects of containment spray.

+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

Action Plan 12

I. Issues Addressed

4.3 All Mark III analyses presently assume a perfectly mixed uniform suppression pool. These analyses assume that the temperature of the suction to the RHR heat exchangers is the same as the bulk pool temperature. In actuality, the temperature in the lower part of the pool where the suction is located will be as much as 7½° cooler than the bulk pool temperature. Thus, the heat transfer through the RHR heat exchanger will be less than expected.

II. Program for Resolution

1.+ A study will be completed to identify and quantify the major conservatisms which have been used in the analyses of RHR suppression pool cooling performance.

2.+ An assessment will be provided of the maximum difference which could exist between the bulk suppression pool temperature and the RHR heat exchanger inlet temperature. Based on existing test data this assessment should show that the difference will be below 7½°F. An analysis will be performed to assess the effect of this temperature difference on peak pool temperature.

3.+ Applicable heat exchanger test data and other test data will be reviewed to provide assurance that the correct heat exchanger capacity has been used.

\+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

Action Plan 13

I. Issues Addressed

4.4 The long term analysis of containment pressure/temperature response assumes that the wetwell airspace is in thermal equilibrium with the suppression pool water at all times. The calculated bulk pool temperature is used to determine the airspace temperature. If pool thermal stratification were considered, the surface temperature, which is in direct contact with the airspace, would be higher. Therefore, the airspace temperature (and pressure) would be higher.

7.1 The containment is assumed to be in thermal equilibrium with a perfectly mixed, uniform temperature suppression pool. As noted under issue 4, the surface temperature of the pool will be higher than the bulk pool temperature. This may produce higher than expected containment temperature and pressures.

II. Program for Resolution

1.+ The maximum increase in bulk suppression pool temperature which could occur as a result of temperature stratification will be determined from Action Plan 12. The maximum suppression pool surface temperature will be estimated based on the current understanding of thermal stratification as contained in GESSAR II. The effects of this higher surface temperature on containment airspace pressure and thermal will be calculated.

2.+ The conservatism inherent in assuming thermal equilibrium between the containment atmosphere and suppression pool surface will be quantified. This conservatism results from neglecting the effects of drywell and containment heat sinks and conduction of heat through the containment structure into the secondary containment.

\+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

Action Plan 14

I. Issues Addressed

4.5 A number of factors may aggravate suppression pool thermal stratification. The chugging produced through the first row of horizontal vents will not produce any mixing from the suppression pool layers below the vent row. An upper pool dump may contribute to additional suppression pool temperature stratification. The large volume of water from the upper pool further submerges RHR heat exchanger effluent discharge which will decrease mixing of the hotter, upper regions of the pool. Finally, operation of the containment spray eliminates the heat exchanger effluent discharge jet which contributes to mixing.

II. Program for Resolution

1.+ Testing information will be submitted to demonstrate the effectiveness of chugging as a mixing mechanism in the suppression pool.

Chugging will be present under all accident conditions when the containment temperature or pressure requires activation of the containment sprays. Therefore, effective mixing will still be maintained during spray operation.

\+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

Action Plan 15

I. Issues Addressed

4.6 The initial suppression pool temperature is assumed to be 95°F while the maximum expected service water temperature is 90°F for all GGNS accident analyses as noted in FSAR Table 6.2-50. If the service water temperature is consistently higher than expected, as occurred at Kuo Sheng, the RHR system may be required to operate nearly continuously in order to maintain suppression pool temperature at or below the maximum permissible value.

II. Program for Resolution

Under normal plant operating conditions, the required operational frequency (duty cycles) of the RHR system pool cooling mode will depend to a large extent on the actual temperature of the essential service water provided. GESSAR II contains conservative assumptions used in performing containment accident response analysis, and for sizing associated systems. It is assumed that the actual plant service water temperature will always be below the design basis. Consequently, General Electric believes this item is not applicable to GESSAR II and is considered closed.

ACTION PLAN 16

I. Issues Addressed

4.7 All analyses completed for the Mark III are generic in nature and do not consider plant specific interactions of the RHR suppression pool suction and discharge.

4.10 Justify that the current arrangement of the discharge and suction points of the pool cooling system maximizes pool mixing. (pp. 150-155 of 5/27/82 transcript).

II. Program For Resolution

1. A discussion of analyses and test results is provided to demonstrate that the RHR system design achieves satisfactory pool mixing. See attachment.

Action Plan 16 -- GENERAL ELECTRIC RESPONSE

The GESSAR II RHR system suppression pool suction and discharge design configuration is based on the Perry subscale pool mixing tests reported in Reference 1. These 1/10 scale tests demonstrated the effective pool mixing performance of the piping configuration employed at Perry and adopted in GESSAR II (see Figure 16.1). The effectiveness of this RHR suction/discharge design to reduce vertical thermal stratification in the suppression pool has been determined analytically, and also empirically from in-plant SRV discharge tests during RHR operation. The in-plant SRV discharge tests were conducted at the Kuo Sheng (which has a suppression pool RHR suction/discharge arrangement like that in GESSAR II, see Table 16.1) and Caorso plants.

The in-plant SRV discharge tests experienced approximately the same vertical stratification (10 to 17°F) between RHR suction and return locations during no-RHR operation as Mark III PSTF LOCA tests (Reference 2). Therefore, SRV in-plant discharge tests are applicable for determining the RHR effectiveness in reducing vertical thermal stratification in the suppression pool.

In-Plant Tests:

Approximate RHR suction and return locations were instrumented with thermocouples and termpatures were measured during Kuo Sheng (Reference 3) and Caorso (Reference 4) discharge tests with RHR operation.

Figure 16.2 shows that the Kuo Sheng RHR (with only one of two loops operation) reduced the vertical thermal stratification from 17°F to 2°F in 10 minutes or 1.5°F per minute during the SRV test. Figure 16.3 shows the location of the thermocouples during the Kuo Sheng SRV/RHR tests.

Figure 4 shows that the Caorso RHR reduced the vertical suppression pool thermal stratification from 12°F to approximately 5°F in 4 minutes, or 1.8°F per minute during in-plant SRV tests.

Analytical Evaluations:

GESSAR II Figure 3BI-3 (see Figure 16.5) specifies a worst case suppression pool vertical thermal stratification gradient. As discussed in GESSAR II Section 3B.1E, the thermal stratification gradient is based on 1/3-area scale PSTF test data. One of the NRC LOCA load questions was to justify the use of 1/3-area scale data to model prototypical thermal stratification. The scaling question was successfully resolved by a RELAP MOD5 code simulation of a Mark III Standard Plant and 1/3-area PSTF test facility. The simulation demonstrated that the GESSAR II thermal stratification load definition was conservative. GESSAR II Figure 3B.28-6 (See Figure 16.6) reveals a peak thermal stratification at approximately 350 seconds. The thermal stratification will be reduced when RHR pool cooling operation is initiated at 600 seconds.

The simulation assumes that an intermediate break accident (IBA) which uncovers only the top row of the vents produces the most severe thermal stratification. The simulation was performed using standard FSAR licensing assumptions and includes vent, SRV, RCIC exhaust, and RHR flows. Details of this analysis and verification of the RELAP modeling with PSTF test data model comparison are documented in Section 3B.28 of GESSAR II, (Reference 4). Figure 16.7 shows the vertical stratification predicted by the RELAP simulation at 300, 600, 900 and 1200 seconds after an IBA. As shown in Figure 16.7, the Mark III RELAP analysis reveals a 24°F temperature difference between the RHR suction and return locations at the start of RHR operation (10 minutes after LOCA). This analysis reveals that RHR operation reduces vertical thermal stratification between RHR suction and return location by 1.6°F per minute which agrees with the Kuo Sheng and Caorso in-plant test data.

Fifteen minutes of RHR operation are all that is required to reduce the calculated RELAP 24°F suction - return temperature difference to an arbitrary 2°F difference if minimum data are used (the Kuo Sheng 1.5°F per minute). From an energy balance, the 15 minutes RHR operation to reduce thermal stratification to 2°F results in a 3°F increase in peak bulk pool temperature. This is small compared to the 20°F of conservatisms contained in the FSAR licensing assumptions. It should be noted that Figure 16.5 which is based on PSTF test data and Figure 16.7, an analytical simulation, both show negligible thermal stratification above the top vent and RHR return elevations.

Based on the above in-plant test data and analytical evaluations, GE concludes that the GESSAR II RHR system suction/discharge configuration in the suppression pool will provide more than adequate pool thermal mixing performance and, therefore, this issue is considered closed.

To appropriately document this design in GESSAR II, Section 6.2.2.2 Containment Cooling System Design, will be revised to add the following information:

> 'The configuration of the RHR System suction and return lines in the suppression pool is designed to assure effective mixing of the cooled return water, and thereby minimizes thermal stratification and/or hot regions in the pool.'

References:

1. Residual Heat Removal/Suppression Pool Tests, Gilbert Associates Incorporated Report No. 1989, September 8, 1978.

2. General Electric, GESSAR II, 22A7007, Rev. 0, Appendix 3B Sections 3B.1E and 3.B.28.

3. Nutech International, Quick Look Test Report, Safety Relief Valve Discharge Test, Kuo Sheng Nuclear Power Station Unit 1, Rev. 1, December 1981.

4. J. Holan and S. Mintz, General Electric, Mark II Containment Program, Caorso Extended Discharge Test Report, NEDE-24798-P, Class III, July 1980.

TABLE 16.1

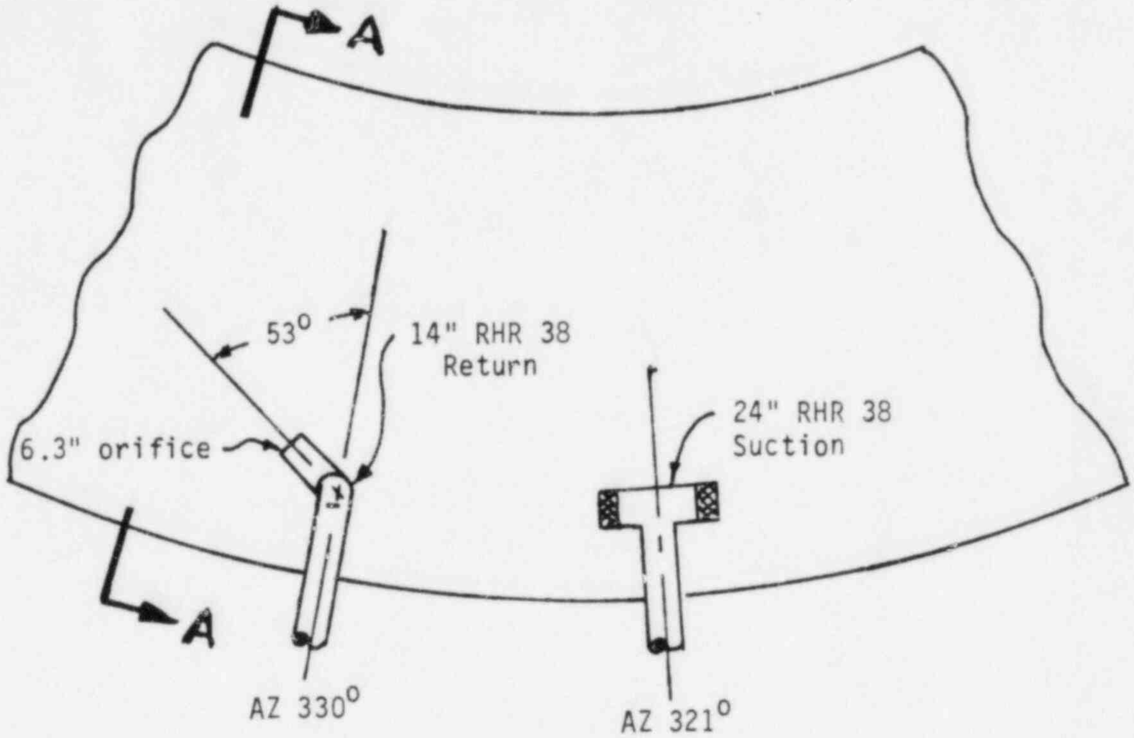
COMPARISON OF KUO SHENG AND GESSAR II

QUENCHER AND RHR SUCTION AND DISCHARGE LOCATIONS

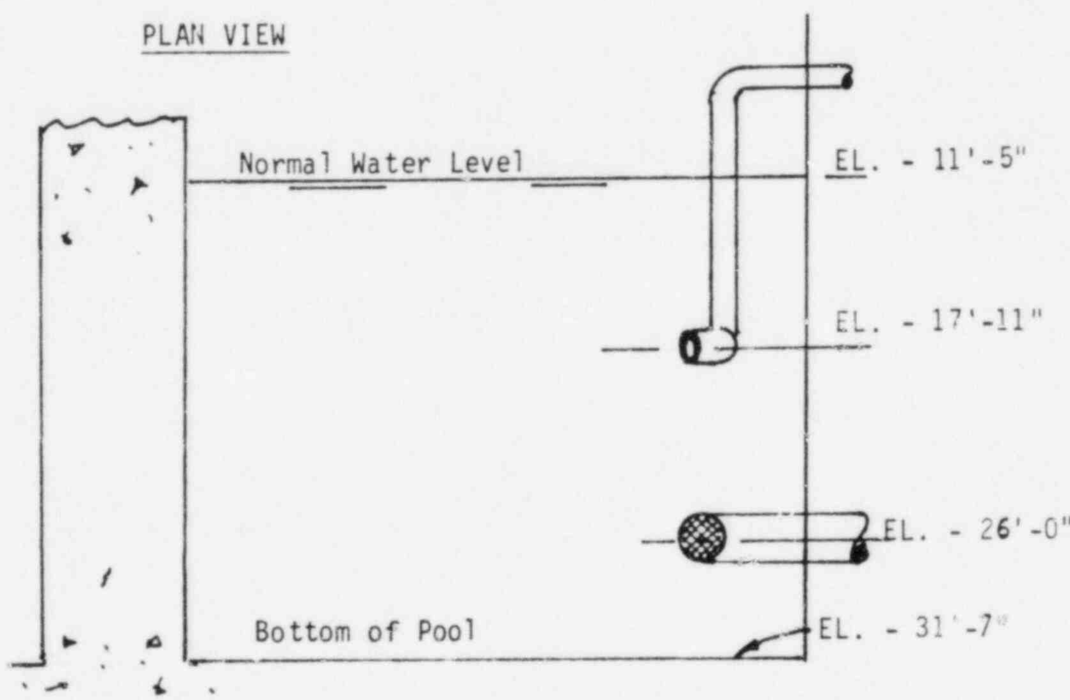
Parameter		Kuo Sheng	GESSAR II
Suppression pool depth, ft. (NWL)		19.2	20.2
Height of Quencher arm centerline above basemat, ft.		5.3	6.5
Height of RHR suction above basemat, ft.		4.0	5.6
Height of RHR discharge above basemat, ft.	RHR A RHR B	12.0 12.0	13.7 13.7
Elevation difference between suction and discharge, ft.		8.0	8.1

FIGURE 16.1

STRIDE RHR SUCTION AND RETURN LINE CONFIGURATION



PLAN VIEW

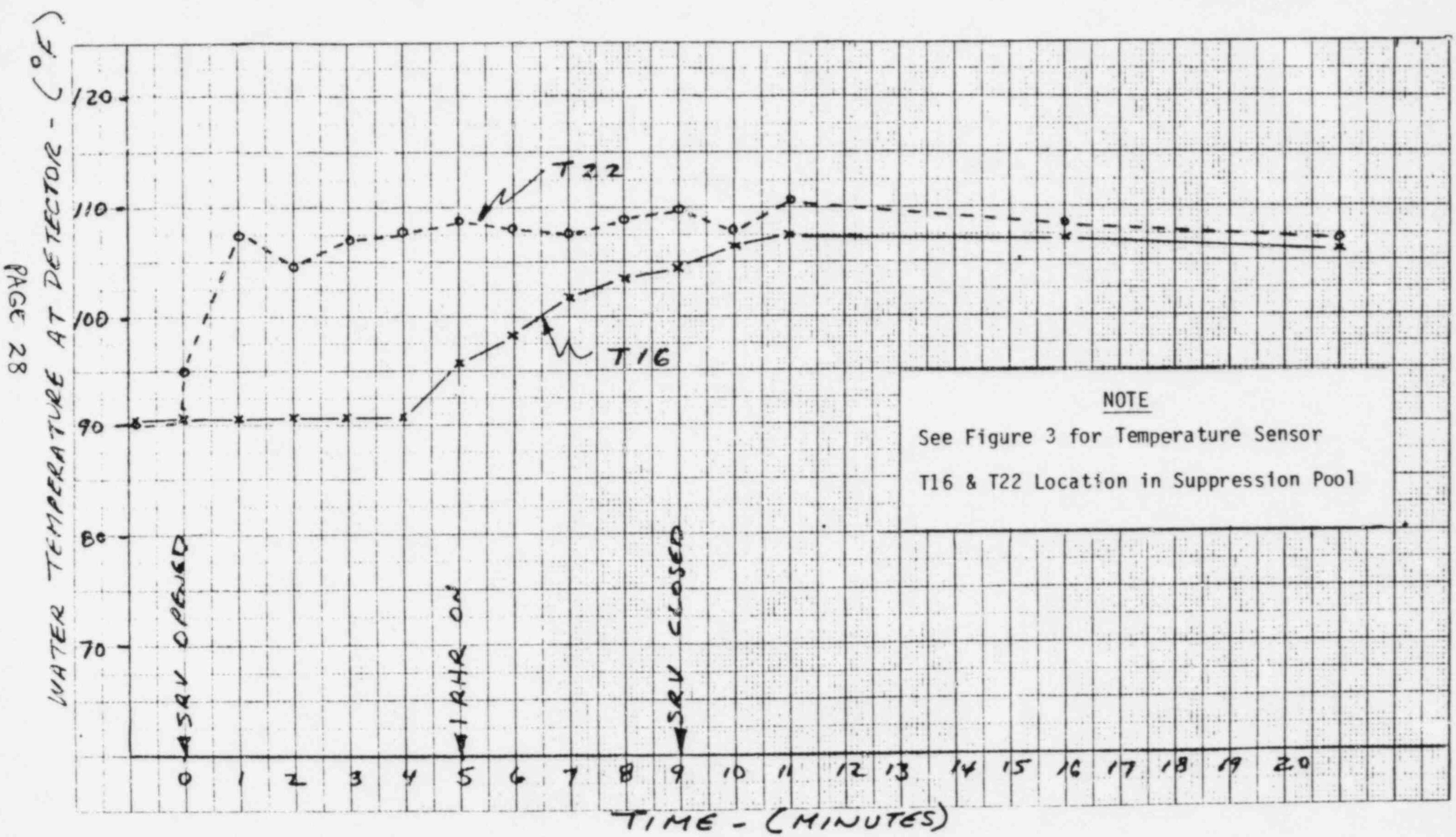


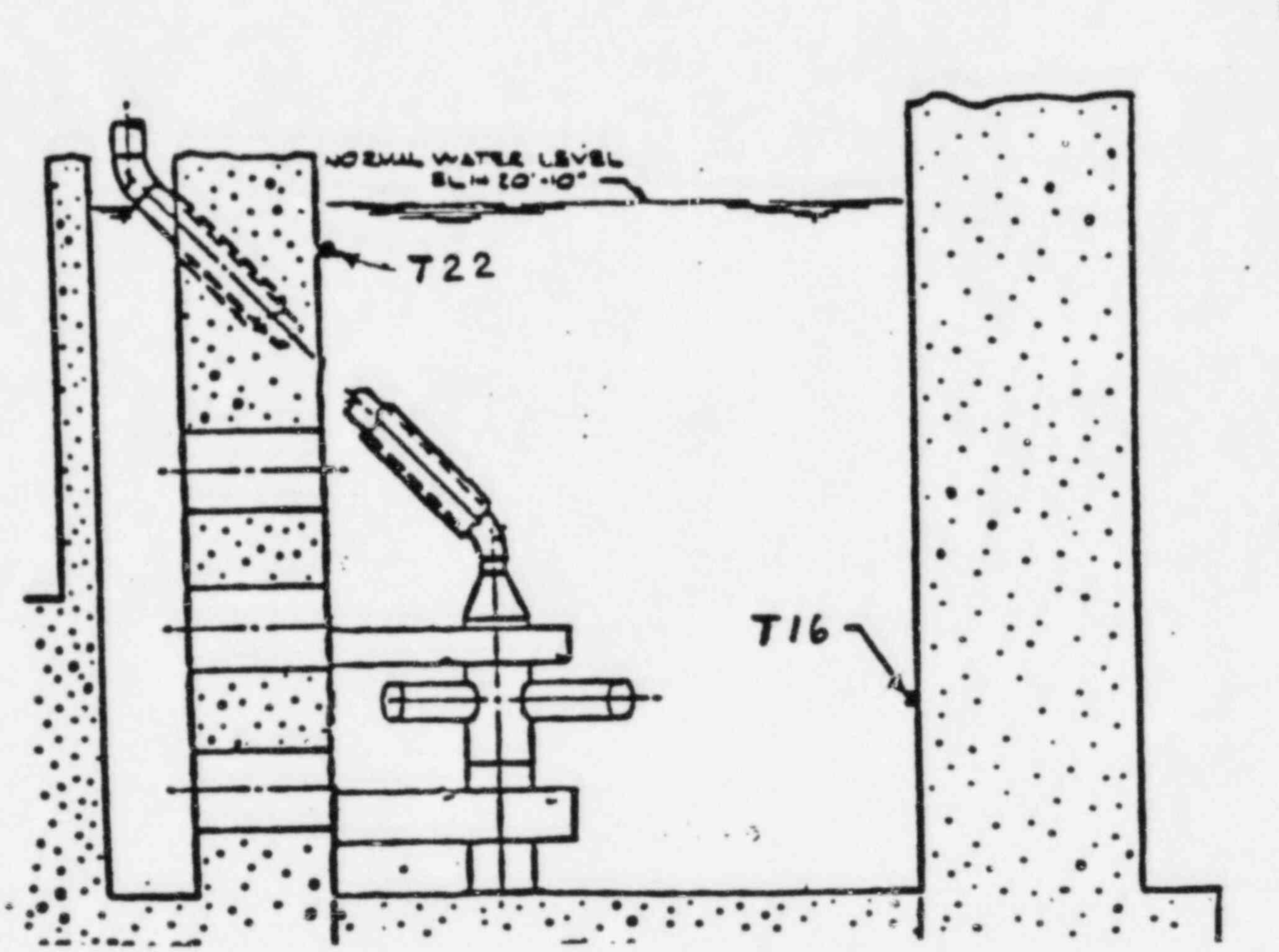
SECTION A-A

FIGURE 16.2

SUPPRESSION POOL TEMPERATURE - TIME HISTORIES AT

SENSORS T16 & T22 DURING KUO SHENG IN-PLANT SRV TESTS





NOTE: Temperature sensors T16 & T22 located 52° Azimuth from SRV Discharged in Test.

FIGURE 16.3

Kuo Sheng Suppression Pool Temperature Sensor Locations

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This Page is Located Behind Page 85 Because of Contents of Proprietary Info.

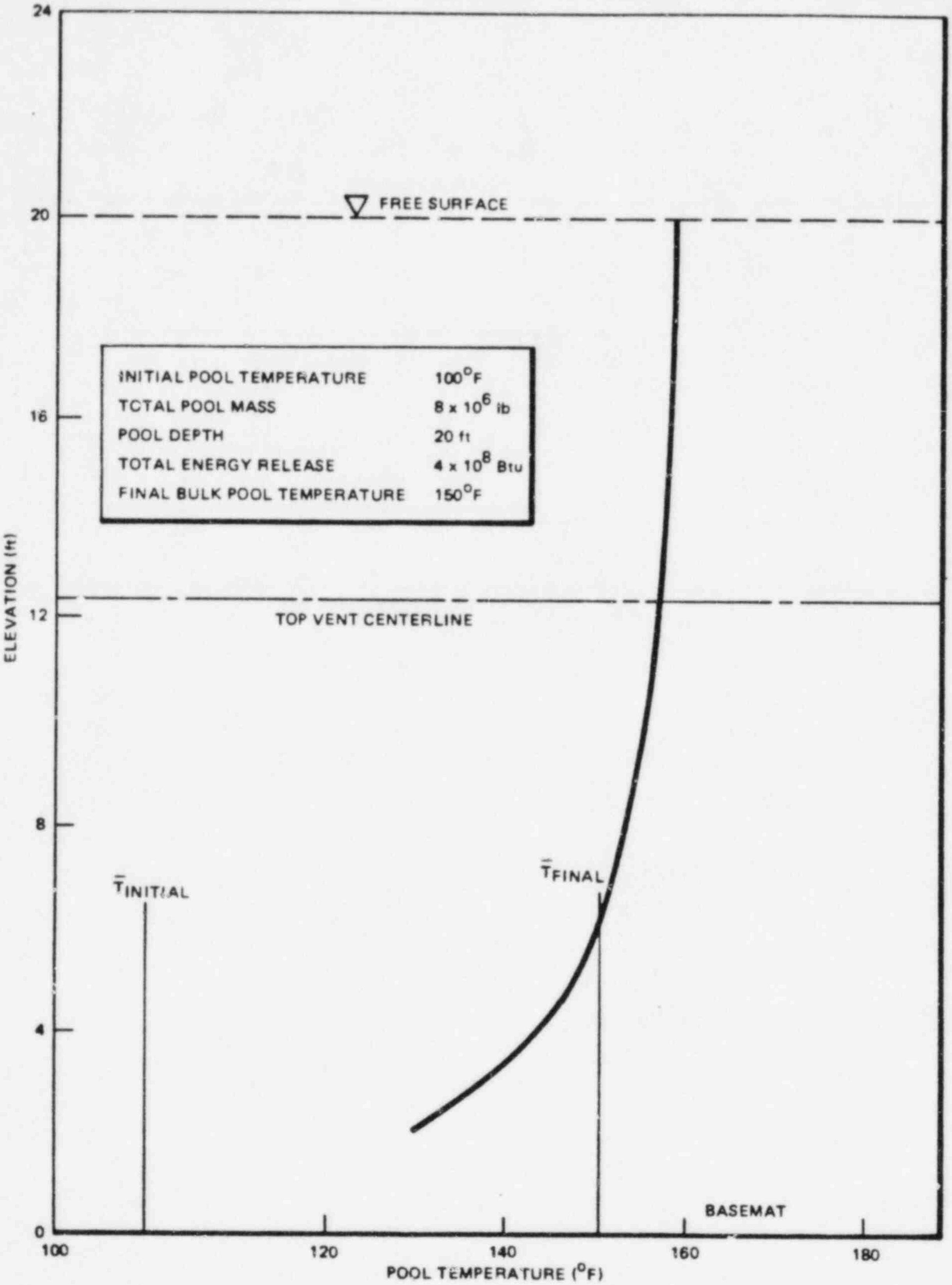

Figure 3BI-3. Suppression Pool Temperature Profile for Large Breaks
(16.5)

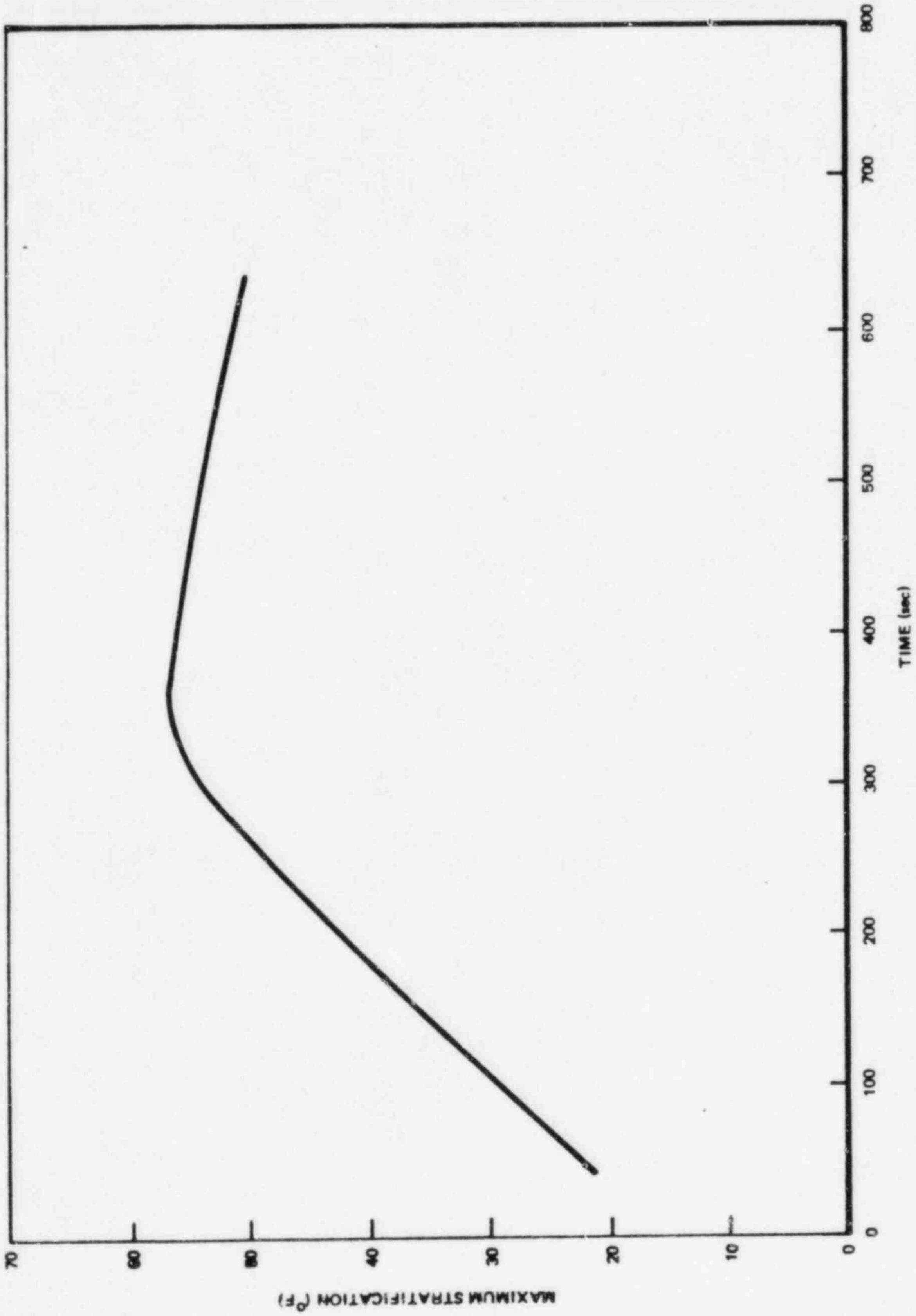

Figure 3B.28-6. Post Pool Swell Stratification Time History Seen in RELAP Simulation of Mark III IBA (16.6)

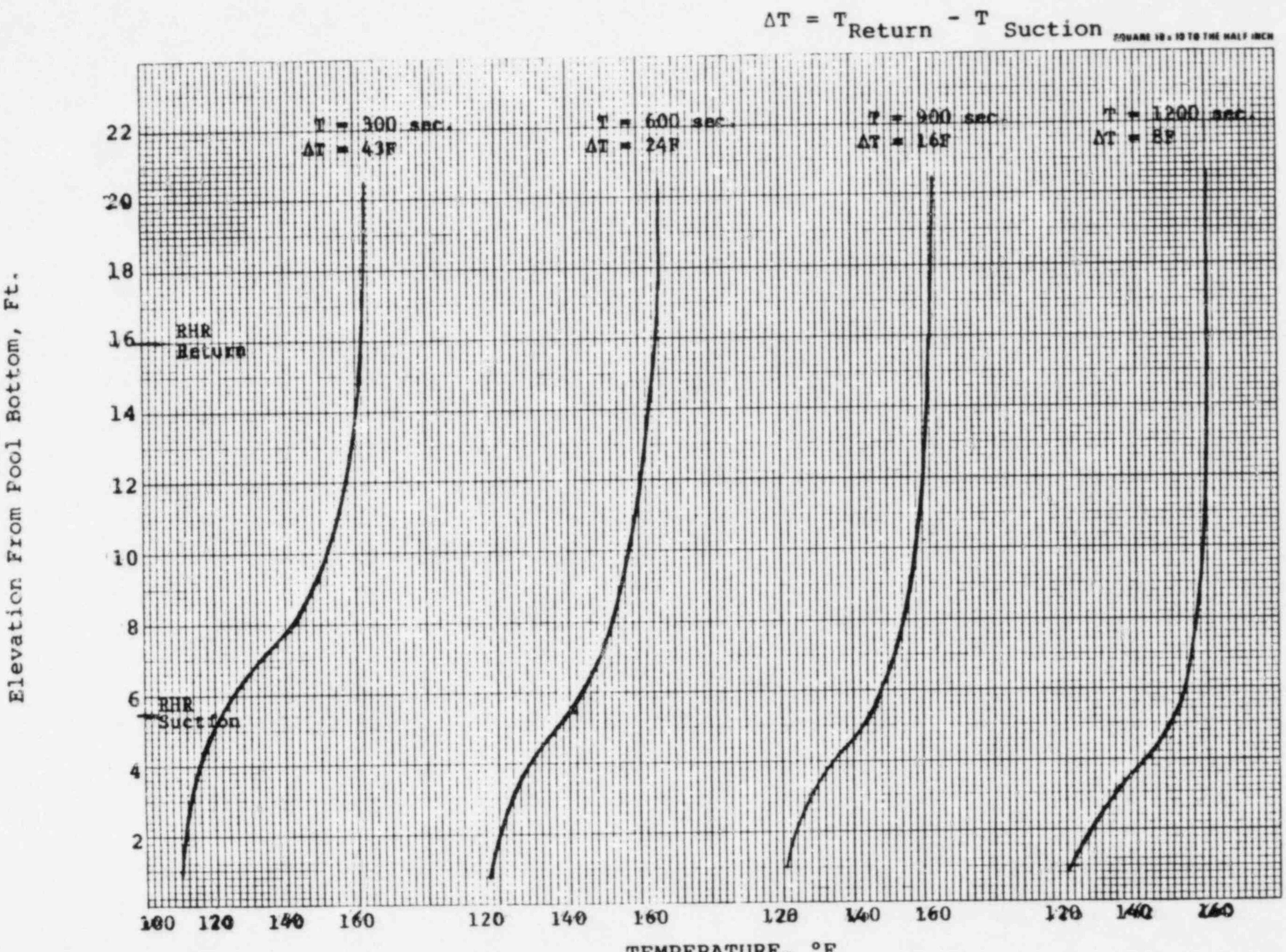

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Figure 16.7 RELAP Simulation of Standard Plant IBA

ACTION PLAN 17

I. Issues Addressed

4.8 Operation of the RHR system in the containment spray mode will decrease the heat transfer coefficient through the RHR heat exchangers due to decreased system flow. The FSAR analysis assumes a constant heat transfer rate from the suppression pool even with operation of the containment spray.

II. Program For Resolution

1.+ Additional analyses will be completed which incorporate lower RHR heat exchanger heat transfer coefficients during the period when the RHR system is in the containment spray mode. The analyses will be performed both with and without the presence of the bypass leakage capability.

2.+ The analyses performed in Item 1 will be repeated so that the effects of containment heat sinks can be included and quantified. The containment spray will be assumed to be operational only when it is necessary to assure pressure control.

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* These results are generic in that they deal with analytical methods, data or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

ACTION PLAN 18

I. Issues Addressed

4.9 The effect on the long term containment response and the operability of the spray system due to cycling the containment sprays on and off to maximize pool cooling needs to be addressed. Also provide and justify the criteria used by the operator for switching from the containment spray mode to pool cooling mode, and back again.

5.3 Leakage from the drywell to containment will increase the temperature and pressure in the containment. The operators will have to use the containment spray in order to maintain containment temperature and pressure control. Given the decreased effectiveness of the RHR system in accomplishing this objective in the containment spray mode, the bypass leakage may increase the cyclical duty of the containment sprays.

II. Program for Response

1. Analyses completed for Grand Gulf Action Plan 18 demonstrated that containment spray cycling is not an issue. These results are also applicable to GESSAR II. This item is considered closed.

ACTION PLAN 19

I. Issues Addressed

5.1 The worst case of drywell to containment bypass leakage has been established as a small break accident. An intermediate break accident will actually produce the most significant drywell to containment leakage prior to initiation of containment sprays.

5.6 The test pressure of 3 psig specified for the periodic operational drywell leakage rate tests does not reflect additional pressurization in the drywell which will result from upper pool dump. This pressure also does not reflect additional drywell pressurization resulting from throttling of the ECCS to maintain vessel level which is required by the current EPG.

9.2 The continuous steaming produced by throttling the ECCS flow will cause increased direct leakage from the drywell to the containment. This could result in increased containment pressures.

II. Program For Resolution

1.* A complete spectrum of analyses for varying break sizes will be completed neglecting depressurization of the drywell prior to initiation of containment sprays, but including the effects of containment heat sinks.

2. Not applicable.

3.* An evaluation of the need for reducing the GE internal draft Technical Specification recommendations, intended for publication in GGNS Chapter 16, covering a proposed allowable technical specification for drywell leakage, will be provided. Any revised limit would be based upon a pressure of 6 psig in the drywell which would reflect the additional pressure produced by upper pool dump. In the evaluation, credit will be taken for drywell and containment heat sinks.

NOTE: Refer to the GESSAR II SER Section 6.2.1.7

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* These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

ACTION PLAN 20

I. Issues Addressed

5.4 Direct leakage from the drywell to the containment may dissipate hydrogen outside the region where the hydrogen recombiners take suction. The anticipated leakage exceeds the capacity of the drywell purge compressors. This could lead to pocketing of hydrogen which exceeds the concentration limit of 4% by volume.

II. Program For Resolution

1. A discussion of hydrogen mixing and potential pocketing follows.

GENERAL ELECTRIC RESPONSE

Pocketing can be defined as a volume which does not participate fully in the post-LOCA global circulation patterns in the containment and drywell. Pocketing can lead to flammability only if a source of hydrogen exists within a pocketed volume. No large source of hydrogen, sufficient to cause flammability, exists in any enclosed volume (mostly RWCU rooms) in the containment. Since the bulk hydrogen concentration in the surrounding atmosphere will always be maintained at less than 4 volume percent, the concentration in any potential pocket also will not exceed 4 percent. More specifically, because the drywell hydrogen concentration will always be less than 4 percent, any leakage from the drywell will not form a flammable pocket in the containment. This is because hydrogen, like all gases, will not settle, rise, or selectively diffuse to form a mixture more enriched than its source.

If the mixing path in the containment is completely short-circuited, it may be possible for a buildup in drywell hydrogen concentration to occur. This buildup could occur only if both the recombiners and the bulk containment were bypassed. Conceivably, the complete short-circuiting could only occur if drywell leakage equivalent to the technical specification limit or more was located at a point very close to the operating mixer inlet (conservatively assume the other mixer, located away from this concentrated leakage point, is inoperative). In this manner, the mixer would be recycling all the leakage directly back into the drywell.

Three factors prevent this direct recycling from occurring. The first is that, although the mixers are located in the containment on the drywell ceiling slab, they take suction from an elevation near the operating floor, approximately 20 feet above the drywell. This arrangement minimizes the development of any short, direct path from the drywell or the suppression unrecombined hydrogen through the mixers is further reduced. Secondly, the design of the hydrogen mixing system provides for the mixers to take suction from the containment and discharge into the drywell, depressing the water in the weir annulus, and allowing the drywell atmosphere to flow through the horizontal vents into the suppression pool. A portion of the mixer flow will always be diverted through drywell leakage. Only when the drywell leakage approaches or exceeds the technical specification will most or all of the mixer flow go through leakage paths, and perhaps be recycled directly back to the drywell.

Thirdly, there is no valid technical argument to support the contention that drywell leakage will be concentrated in one area. The lower portion of the drywell and the removable drywell head are steel structures, precluding leakage through either of these regions. The portions of the drywell covered by the fuel storage, fuel transfer, and refueling pools are also not viable leakage paths. Available evidence leads to the conclusion that the leakage from the drywell into the containment under nominal, vent-clearing pressures (~2 to 3 psi) will be primarily at the structural-mechanical interfaces such as electrical and pipe penetrations and seals. All these concrete-penetration interfaces constitute potential leakage paths, and are distributed randomly around the drywell, well below the mixer and recombiner elevations. Strong, free convective currents exist in the lower containment which circulate mixer flow from the suppression pool to the bulk containment atmosphere. This has been established in analyses presented in Section 6.2.5 of GESSAR II. At the random leakage around the drywell, similar passive mixing mechanisms exist. Therefore, hydrogen leakage from the drywell will mix with the bulk containment atmosphere along with hydrogen and air from the pool.

In light of the multiple Combustible Gas Control System design features which prevent the accumulation of flammable amounts of hydrogen in either the drywell or the containment, regardless of drywell leakage, General Electric considers this issue closed.

ACTION PLAN 21

I. Issues Addressed

5.5 Equipment may be exposed to local conditions which exceed the environmental qualification envelope as a result of direct drywell to containment bypass leakage.

II. Program For Resolution

1. A discussion of essential equipment located near the drywell wall is provided.

GENERAL ELECTRIC RESPONSE

Section 3.11.1, Equipment Identification and Environmental Conditions, in GESSAR II addresses safety-related mechanical and electrical equipment located within various environmental zones of the Nuclear Island Buildings and the Turbine Building. The environmental conditions such equipment is exposed to within a given building (including potential local hot spots resulting from direct drywell to containment bypass leakage and/or hydrogen recombiner operation) depend on where in the building the equipment is located and other factors (i.e., enclosures, cooling systems, heat sinks, etc.). Since the equipment location and environmental control measures provided are the responsibility of the BWR/6 - Mark III purchasing utility and its design representative, the GESSAR II Table 3.11-2, Environmental Conditions for Reactor Building Equipment, and Table 3.11-9, Safety Related Equipment Identification and Environmental Qualification Summary, specify "Applicant to Supply." Consequently, General Electric considers this issue closed.

ACTION PLAN 22

I. Issues Addressed

5.8 The possibility of high temperatures in the drywell without reaching the 2 psig high pressure scram level because of bypass leakage through the drywell wall should be addressed.

II. Program For Resolution

1.+ A new analysis will be performed using the capability bypass leakage. This analysis will show that a temperature of 330°F is not reached in the drywell until after ten minutes. In this interval, the operator will have received sufficient information to manually scram the reactor.

2. A detailed list of alarms and parameter displays which inform the operator of conditions in the drywell is attached.

+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

2. Drywell Instrumentation

Considerable instrumentation is provided to inform the operator of high drywell temperature and cooling system conditions. This instrumentation enables the operator to make a timely determination of whether drywell high temperature is caused by a HVAC failure or a small reactor cooling leak and also allows the operator to avoid operation outside of specified bands of drywell pressure and temperature. There are a total of 44 temperature sensors in various locations and elevations in the drywell (including 21 spares). These sensors provide signals to control room monitoring by indicators, recorders and computer printouts as shown in Table 22.1. Ten of the temperature monitors also actuate high temperature alarms in the control room. Included among the various temperature monitoring channels are two which are Class 1E and are located at an intermediate height for monitoring average drywell temperature. Because of these redundant and diverse temperature indications, it is unlikely that a high temperature condition would go unnoticed by the operator.

In addition to high temperature, there are other indications available which would alert the operator to a small reactor coolant leak in the drywell. Drywell floor drain sump level and level fill-up rate are recorded in the control room. An alarm is actuated when the sump fill rate exceeds setpoints (5 gpm for floor drain and 25 gpm for equipment drain). Drywell floor and equipment drain sump pumps are equipped with timers which actuate alarms when the time required to fill the sump between pumping cycles is short enough to be indicative of a leak or the time required to pump out the sump is long enough to be indicative of a leak. Condensate flow from the drywell coolers, which is indicative of steam condensing from a leak, is indicated in the control room and actuates an alarm when flow exceeds 5 gal/min. The drywell atmosphere is continuously monitored for particulate, and noble gas activity. These variables are recorded in the control room and initiate alarms when they increase significantly above background levels. An increase in drywell cooler differential temperature, as monitored by the drywell cooler inlet and outlet temperature indicator may indicate an increase heat load due to condensing steam from a leak. In addition, a narrow range drywell pressure channel is recorded in control room, and small pressure increases, in conjunction with temperature change may indicate reactor coolant leakage.

In addition to drywell high temperature, other means are provided to alert the operator to a failure in the drywell cooling system. The run-stop status of drywell cooling fans and open-closed status of drywell cooling dampers are displayed in the control room by indicating lights. Chiller water flow rates to drywell coolers, as well as both air and differential temperatures are available through the plant computer.

Action Plan 22 -- GENERAL ELECTRIC RESPONSE

The indications available to the operator provide a straightforward means for determining whether a drywell temperature increase is caused by a reactor coolant leak or drywell cooler failure. A reactor coolant leak will cause an increase in drywell particulate radioactivity, an increase in cooler condensate drain flow, and an increase in sump level fill-up rate and sump pump use, whereas a drywell cooler failure will not. A leak will cause an increase in drywell cooler load as indicated by greater differential temperatures, whereas a drywell cooler fan failure will produce smaller differential temperature. It is possible that a tube leak in a drywell cooler would produce an increase in cooler drain flow along with increased flows to the floor drain sump. A defective cooler would also affect the drywell chiller performance as indicated by its temperature and/or flow indication recording and alarms.

It can therefore be concluded that adequate instrumentation has been provided to alert the operator of a high drywell temperature condition and to allow him to determine the cause of the high drywell temperature. Therefore, General Electric considers this issue closed.

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TABLE 22.1

DRYWELL TEMPERATURE MONITORING PROVISIONS

No. of Points	Sensor Locations	Indicator	Control Room Readouts Recorder	Computer	Alarm
1	~90° Azimuth, D.W. Upper Elevation	-	MP*	Print Out	Annun
1	~90° Azimuth, D.W. Mid Elevation	-	MP	Print Out	Annun
1	~90° Azimuth, D.W. Lower Elevation	-	MP	Print Out	Annun
1	~180° Azimuth, D.W. Upper Elevation	-	MP	Print Out	Annun
1	~180° Azimuth, D.W. Mid Elevation	-	MP		
1	~180° Azimuth, D.W. Lower Elevation	-	MP		
6	D. W. Cooler Outlet (each)	Selected Indication	-	-	-
6	D. W. Cooler Inlets (each)	Selected Indication	-	-	-
1	~190°/~50' Azimuth/ Elevation	Class 1E Meter	-	-	-
1	~0°/~50' Azimuth/ Elevation	Class 1E Meter	-	-	-
1	Under vessel		MP	-	-
1	Air Duct "A" to Skirt Region			Print out	Annun
1	Air Duct "B" to Skirt Region			Print out	Annun

*MP = Multipoint

ACTION PLAN 23

I. Issues Addressed

6.3 The recombiners may produce "hot spots" near the recombiner exhausts which might exceed the environmental qualification envelope or the containment design temperature.

6.5 Discuss the possibility of local temperatures due to recombiner operation being higher than the temperature qualification profiles for equipment in the region around and above the recombiners. State what instructions, if any, are available to the operator to actuate containment sprays to keep this temperature below design values.

II. Program For Resolution

1. Arrangement of equipment in the region above the recombiner exhausts is discussed.

2. A discussion of the criteria used for actuating the containment sprays on high temperature is attached.

Action Plant 23 -- GENERAL ELECTRIC RESPONSE

Locating essential equipment, and providing and meeting environmental qualification envelopes is the responsibility of the purchasing utility and its design representative. Tables 3.11-12 and 3.11-9 of GESSAR II address environmental qualification of safety-related equipment and specify that the applicant is to supply information to complete the tables. Accordingly, it is the responsibility of the purchasing utility and its architect-engineer to assure that the qualification envelope for each containment zone includes any contribution to pressure, temperature and relative humidity from the recombiners.

More generally, it should be noted that General Electric's design requirements and the test results for the recombiner used in the GESSAR II design indicate a recombiner exhaust temperature no higher than 50°F above the recombiner inlet. This is achieved by mixing the cooler ambient containment atmosphere with the hot recombiner process stream in an exhaust plenum within the recombiner. Since the recombiners are actuated late in the design basis event, the containment temperature has decayed sufficiently so that locally high temperatures around the recombiners should not be a concern. Because the recombiners are located to participate in global circulation patterns in the containment, it is reasonable to expect the heat from the recombiners to be distributed throughout a major portion of the containment volume. Comparing the magnitude of the extensive, low temperature, heat sinks available (assuming free convection heat transfer) and the maximum heat input from the recombiners, General Electric also expects heating of the bulk containment atmosphere not to be a concern.

Should containment spray be required to control temperature, the generic BWR EPGs (Rev. 3) instruct the plant operator to initiate containment sprays before the general containment temperature reaches 185°F, based on multiple temperature sensors located throughout the primary containment. Given the high rate of heat transfer available late in the event and the availability of spray per the EPG's, General Electric considers this issue closed.

ACTION PLAN 24

I. Issues Addressed

7.2 The computer code used by General Electric to calculate environmental qualification parameters considers heat transfer from the suppression pool surface to the containment atmosphere. This is not in accordance with the existing licensing basis for Mark III environmental qualification. Additionally, the bulk suppression pool temperature was used in the analysis instead of the suppression pool surface temperature.

II. Program For Resolution

1. A description of the calculation methods for environmental qualification parameters follows.

GENERAL ELECTRIC RESPONSE

General Electric uses the methodology of NEDO-20533, "The General Electric Mark III Pressure Suppression Containment System Analytical Model," for calculating Mark III environmental qualification parameters. This methodology is the licensing basis, and has been approved by the NRC. Therefore, General Electric considers this issue closed.

ACTION PLAN 25

I. Issues Addressed

8.1 This issue is based on consideration that some technical specifications allow operation at parameter values that differ from the values used in assumptions for FSAR transient analyses. Normally analyses are done assuming a nominal containment pressure equal to ambient (0 psig) a temperature near maximum operating (90°F) and do not limit the drywell pressure equal to the containment pressure. The technical specifications permit operation under conditions such as a positive containment pressure (1.5 psig), temperatures less than maximum (60 or 70°F) and drywell pressure can be negative with respect to the containment (-0.5 psid). All of these differences would result in transient response different than the FSAR descriptions.

II. Program For Resolution

GESSAR II does not contain technical specifications which define these parameters. The applicant will provide technical specifications which are compatible with the assumptions used in the transient analyses.

ACTION PLAN 26

I. Issues Addressed

8.2 The draft GGNS technical specifications permit operation of the plant with containment pressure ranging between 0 and -2 psig. Initiation of containment spray at a pressure of -2 psig may reduce the containment pressure by an additional 2 psig which could lead to buckling and failures in the containment liner plate.

8.3 If the containment is maintained at -2 psig, the top row of vents could admit blowdown to the suppression pool during an SBA without a LOCA signal being developed.

II. Program For Resolution

GESSAR II does not contain technical specifications which define these parameters. The applicant will provide technical specifications which are compatible with the containment design bases.

ACTION PLAN 27

I. Issues Addressed

8.4 Describe all of the possible methods both before and after an accident of creating a condition of low air mass inside the containment. Discuss the effects on the containment design external pressure of actuating the containment sprays.

II. Program For Resolution

1. A complete list of scenarios which might result in reduced containment air mass follows.

2. The list of scenarios developed in Item 1 was reviewed and a worst case, bounding scenario was selected.

3. An analysis was completed to establish the containment response under the bounding scenario.

NOTE: Refer to the GESSAR II SER Section 6.2.1.5

GENERAL ELECTRIC RESPONSE

1. Scenarios leading to reduction of containment air mass

a. Initiation Event: Small line break in the containment airspace (RWCU or steam) while the containment is not isolated.

Sequence of Events:

- containment air space temperature rises due to energy input from the break.
- containment air is purged through the open ventilation system due to thermal expansion and steam addition (direct or flashing of hot water) to the airspace.
- containment isolated on high radiation level or operator action.

b. Initiating Event: loss of containment HVAC

Sequence of events:

- containment airspace temperature rises
- containment air is being lost through the open ventilation system due to thermal expansion.
- Containment isolated by operator action.

c. Initiating event: LOCA in drywell

Sequence of Events:

- o containment isolated on LOCA signal (2 psig in drywell).
- o upper pool dump (UPD) occurs at 30 minutes post-LOCA.
- o hydrogen mixing compressors are put in operation by the operator.
- o air is being transferred from containment to drywell until the top row of vents is uncovered. That requires assuming previous UPD approximately 6 psid between drywell and wetwell.

2. Selection of Bounding Scenario

The first scenario (SBA in containment airspace) results in the minimum containment air mass and hence the minimum containment pressure after spray activation. The second scenario (loss of containment HVAC) caused the steepest pressure drop during the short time when the containment spray is cooling by evaporation, but the containment has a higher final pressure. The third scenario (LOCA in drywell) has little impact on the containment negative pressure since any drop in containment pressure resulting from the spray actuation results in the flow of air from the drywell to the wetwell through the drywell horizontal vents.

3. Analysis of Bounding Scenario

The containment heat-up rate resulting from a SBA in the containment is sufficiently slow enough for the operator to react to prevent significant air loss. It is estimated that a 201°F rise in the containment air temperature would take 2 hours following a small steam line break.

Following containment isolation, the operator must follow the Emergency Procedure Guidelines (EPG's). Step PC/P-2 was designed to insure that the negative pressure design limit will not be exceeded even if the operator erred in not preventing excessive containment air loss. Step PC/P-2 instructs the operator not to initiate the containment spray unless the containment pressure is above 1.7 psig. This pressure limit was obtained from an analysis varying the initial containment conditions of temperature and relative humidity. Automatic spray actuation is at a containment pressure of 9 psig, well above the 1.7 psig limit; therefore, no adverse effect will be caused by automatic spray actuation. Consequently, General Electric considers this issue closed.

ACTION PLAN 28

I. Issues Addressed

9.3 It appears that some confusion exists as to whether SBA's and stuck open SRV accidents are treated as transients or design basis accidents. Clarify how they are treated and indicate whether the initial conditions were set at nominal or licensing values.

II. Program for Resolution

1. A response is provided confirming that the small break accident and stuck open relief valve transient were treated as design basis accidents. The analyses for these transients are completed using licensing basis values for the initial conditions.

GENERAL ELECTRIC RESPONSE

The list of assumptions, used by GE in evaluating SBA and SORV is attached (Table 28.1). Both events are conservatively treated as accidents with one exception: in case of SORV, credit is taken for non-safety grade systems, RHR shutdown cooling mode and main condenser. This is consistent with the requirements of NUREG-0783 (see the response to GESSAR II question 480.05 for the NUREG-0783 evaluation). All other assumptions and initial conditions are those applied to FSAR design basis accident analysis. General Electric considers this issue closed.

TABLE 28.1

SUMMARY OF INITIAL CONDITIONS, EVENT SEQUENCES, AND ASSUMPTIONS
(FOR EXCLUSIVE USE IN THE SUPPRESSION POOL TEMPERATURE TRANSIENTS GIVEN IN THIS TABLE)

PARAMETERS	STUCK-OPEN SRV		DEPRESSURIZATION FROM ISOLATION		SMALL BREAK ACCIDENT	
	EVENT 1(a) During Power	EVENT 1(b) During Hot Standby	EVENT 2(a) 1 RHR (>100°F/hr)	EVENT 2(b) 2 RHR (≤100°F/hr)	EVENT 3(a) Accident Mode	EVENT 3(b) Normal Mode
1. INITIAL CONDITIONS						
1.01 Reactor Power (% Rated)	←		102%			→
1.02 Service Water Temp. (°F)	←		Max. Plant Data			→
1.03 Initial Pool Temp. T_i (°F)	←		Max. Tech. Spec.			→
1.04 Initial Pool Volume (cu. ft)	←		Min. Tech. Spec.			→
1.05 Drywell Pressure and Temp. (psig, °F)	←	135°F and normal operating pressure				→
1.06 Wetwell Air Pressure (psig)	←	Normal operating pressure				→
2. EVENT SEQUENCE						
2.01 Reactor Scram, Manual @ Pool	T_p = 110°F	N/A	N/A	N/A	N/A	N/A
2.02 Reactor Scram, Automatic	N/A	t=o	t=o	t=o	High Drywell Pressure	
2.03 Isolation Time, t_i (sec.)	Note (1)	3.5	3.5	3.5	3.5	3.5
2.04 Feedwater Stops, Motor Driven Pumps	←		Note (2)			→
2.05 Feedwater Stops, Turbine Driven Pumps	←		Note (2)			→
2.06 Add'l SRV's Opened	← Note (3)	→	← Note (3)	→	Note (4)	Note (3)
2.07 Time to Turn RHR on in Pool Cooling Mode (See Note 12)	10 Min	10 Min	10 Min	10 Min	10 Min	10 Min
2.08 Bypass Valves to Main Condenser Opened (See Note 5)	20 Min	No	No	No	No	No
2.09 Shutdown Cooling Initiated	Note (7,8)	No	Note (7,8)	No	No	Yes
2.10 Maximum Pool Temperature						
2.11 Time Max. Pool Temp. Reached						

TABLE 28.1 (Continued)

PARAMETERS	STUCK-OPEN SRV		DEPRESSURIZATION FROM ISOLATION		SMALL BREAK ACCIDENT	
	EVENT 1(a)	EVENT 1(b)	EVENT 2(a)	EVENT 2(b)	EVENT 3(a)	EVENT 3(b)
3.0 ASSUMPTIONS						
3.01 Auxiliary Power Available	Yes	Yes	Yes	Yes	No	Yes
3.02 Condensate Storage Tank Water Temp. (°F)			Max. Plant Data (Note 9)			
3.03 HPCI (HPCS) Available	Yes	Yes	Yes	Yes	Note (10)	Yes
3.04 RCIC Available	Yes	Yes	Yes	Yes	Note (11)	Yes
3.05 Condensate Storage Tank Avail	Yes	Yes	Yes	Yes	No	Yes
3.06 Drywell Fan Coolers Available		See Note (13)			No	No
3.07 RHR Heat Exchanger Duty		Based on Maximum Observed Equilibrium Crud Buildup				
3.08 Number of RHR Loops Avail.	1	2	1	2	1	2
3.09 SRV Capacities (% of ASME Rated)	←		122.5%			→
3.10 Decay Heat Curve	←	Decay Heat Curves for Containment Analysis				→

NOTES;

N/A = Not Applicable

1. In Event 1(a), the turbine control valves (TCV) will close on low turbine throttle pressure approx. 20 sec (plant specific) after the SORV occurs, effectively isolating the reactor from the main condenser. The MSIVs will not close because the low steamline pressure trip is bypassed when the operator scrams the plant by changing the mode switch from the RUN to the SHUTDOWN position. In the other events, 3.5 seconds is the isolation time (one-half second closure signal delay time plus MSIV closure time).
2. It is assumed that the containment accepts the "hot" portion of the feedwater in the feedwater system. The available mass energy data will be prorated according to flow rates on the NSSS heat balance sheets to provide estimates for plants without feedwater mass-energy data.
3. When the pool temperature reaches 120°F as required by the Technical Specifications.
4. All ADS SRV's are manually opened at 10 minutes after scram and isolation for Mark III plants.

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NOTES: (Continued)

5. In Event 1(a), the main condenser is assumed to be made available as a heat sink for reactor steam 20 minutes after the TCVs initially closed (see Note 1). The main condenser is assumed to be available until the reactor pressure is less than approx. 150 psia (plant specific).
6. In Event 3(b), it is not necessary that the main condenser be made available as a heat sink to avoid exceeding the pool temperature limit, but the main condenser could be made available after 20 minutes.
7. When reactor pressure $\leq$ interlock pressure (plant specific). If possible, it should be assumed that shutdown cooling is not used if the main condenser is made available as a heat sink (see 2.08). However, if the main condenser is not assumed to be available, then the use of shutdown cooling should be assumed.
8. The 16 minute switchover time assumes no flushing of the RHR loops to maintain water chemistry standards. With flushing, the total switchover time is 66 minutes. For plants which can avoid the pool temperature limit with flushing of the loops, flushing should be assumed.
9. If no Condensate Storage Tank data are available, the CST water temperature is assumed to be 10°F less than the initial pool temperature (T).
10. HPCS available except if the small line break is the HPCS line.
11. RCIC is only available (safety grade) on Mark III plants.
12. The RHR is assumed to be in operation in the pool cooling mode 10 minutes after the maximum pool temperature allowed by Tech Specs during normal operation is exceeded.
13. It is assumed that the drywell fan coolers keep the drywell pressure below the high drywell pressure trip setpoint (approx. 2 psig, but plant specific) in all events except 3(a) and 3(b). If this trip setpoint is reached, the RHR will automatically switch out of the pool cooling mode and line up in the LPCI mode. The operator would have to manually switch the RHR back into the pool cooling mode. This would require 10 minutes. No pool cooling would occur during this time. The time at which the high drywell pressure trip occurs, and the 10 minute loss of pool cooling will be considered for Mark III plants.

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ACTION PLAN 29

I. Issues Addressed

10.1 The suppression pool may overflow from the weir wall when the upper pool is dumped into the suppression pool. Alternately, negative pressure between the drywell and the containment which occurs as a result of normal operation or sudden containment pressurization could produce similar overflow. Any cold water spilling into the drywell and striking hot equipment may produce thermal failures.

II. Program for Resolution

1. An evaluation has been performed to identify possible weir wall overflow scenarios based on the GESSAR II containment and auxiliary system design.

GENERAL ELECTRIC RESPONSE

An assessment of the GESSAR II containment design indicates that a potential weir wall overflow during normal or upset plant conditions could only occur if an inadvertent or intentional upper pool dump is assumed coincident with other abnormal plant conditions (i.e., a negative drywell-to-containment differential pressure). Per GESSAR II Tables 6.2-1 and 6.2-30, the top of the weir wall is located 5 ft.-8 in. (freeboard) above the suppression pool normal high water level (HWL). Under normal plant operating conditions, the GESSAR II drywell vacuum breakers are designed to remain closed until a 2 psid (equivalent to approximately 4 ft.-7 in. of water) containment-to-drywell differential pressure exists. However, even this drywell negative differential pressure would not raise the water level in the weir annulus above the normal minimum freeboard of 5 ft - 8 in. required to flood the drywell.

The remaining text addresses the probability and potential consequences of an inadvertent or intentional upper pool dump flooding the drywell during normal or upset operating conditions.

The design of the control logic for opening the suppression pool makeup system (SPMS) dump valves assures with high probability that no inadvertent dump will occur. The suppression pool level signal (LLWL) to open the valves is in series with a permissive which only allows the open signal to pass through when a LOCA signal exists on that division. A manual system start of either Division 1 or 2 ECCS also supplies the LOCA permissive signal to the appropriate division of the SPMS.

The suppression pool makeup system dump valves can be tested manually one at a time during plant power operations. An interlock prevents manual testing of one valve unless the other valve in series on the same line is closed. A single failure in this interlock during testing would have to occur to result in an inadvertent upper pool dump through this line. To intentionally perform a manual dump through one line without a LOCA permissive signal present, the following conditions and operator actions would be required:

(1) The SPMS mode selector switch would have to be in the 'AUTO' position, and

(2) The operator would have to turn the keylock test switch to the 'TEST' mode position, and

(3) The operator would have to actuate the remote manual switches of both valves on that line.

The valve initiation logic is designed with interlocks such that neither automatic nor manual action can open the suppression pool makeup valves while the plant is in the refueling mode.

Although an inadvertent dump is very remote, the GESSAR II weir wall elevation was designed (per Reference 1 G.E. SPMS Requirements Specification) to provide sufficient freeboard volume to accept a dump of the upper pool without resulting in overflow flooding into the drywell. This design is based on the assumptions that prior to the dump, the water in the suppression pool and weir annulus are at the same level, and the containment upper pool water was at its nominal level (elevation 83 ft. - 7 in. maintained by continuous overflow of level control weirs). If the drywell pressure were negative ($\geq$0.2 psid) relative to that in the containment and the suppression pool were at HWL when the inadvertent upper pool dump occurred, overflow of the weir wall becomes possible.

If either an inadvertent or intentional manual upper pool dump occurred, the control room operators would be quickly alerted to the event by alarms from both the suppression pool high water and the upper pool low water level alarms. In addition, an alarm is sounded in the control room whenever the SPMS has been manually bypassed when required to be functional (i.e., system mode switches in 'OFF' and reactor mode switch not in 'REFUEL') or the system is enabled during refueling operation when it is required to be deactivated (i.e., system mode switches in 'AUTO' and reactor mode switch in 'REFUEL'). Once alerted, the generic BWR EPGs (Rev. 3) direct the control room operator to 'maintain suppression pool water level between 23 ft - 9 in. (or 2 ft. - 4 in. below the top of the GESSAR II weir wall) and 19 ft. - 11 in. (minimum suppression pool water level)'. Based on the calculated flow rate through one of the dump lines, it would take over 8 minutes for the entire upper pool water volume to be delivered to the suppression pool. This should be adequate time for an operator to terminate the pool dump by manually actuating the appropriate valve closure switch (either one of the two in series on each line) in the control room. The operator could extend the time to dump the entire upper pool water volume by actuating the RHR system loop which returns suppression pool water back to the upper pool.

In the event that suppression pool water did spill into the drywell during reactor operation, assessment of the consequences indicate that it would represent a plant availability concern, but not a safety issue. The thermal stresses on equipment most likely impacted (recirculation piping and pumps) by such an event are in a category (secondary and peak) that does not require evaluation except for normal and upset plant conditions. The peak stresses produced by the thermal shock are important only for fatigue, and fatigue usage for such a rare event is not required by the ASME codes or by NRC rules. If it were necessary to consider the fatigue usage due to such a thermal shock, calculations show based on worst case conditions (insulation removed and a 450°F temperature difference between the outside and inside of the recirculation piping) that excessive fatigue usage would not result unless there were several hundred such cycles. Under a worst case condition, the potential damage to the piping could be slight distortion at the weld joints.

In summary, based on (1) the remote probability of an inadvertent or otherwise unwarranted manual initiated upper pool dump occurring when two or more abnormal or out-of-tech. spec. plant conditions exist, (2) the alarm annunications provided to the operator, (3) operator EPG instructions and means to quickly terminate or mitigate the event, and (4) the non-safety consequences of suppression pool water spilling into the drywell; General Electric believes the applicable containment and SPMS designs in GESSAR II are acceptable and this issue is considered closed. However, the appropriate part of Section 6.2.7 of GESSAR II will be revised to include the assumptions used in establishing the minimum weir wall freeboard before and after an upper pool dump.

References:

1. GE Requirements Specification, A62-4300 (22A7411), 'Suppression Pool Makeup System'.

ACTION PLAN 30

I. Issues Addressed

10.2 Describe the interface requirement that specifies that no flooding of the drywell shall occur. Describe your intended methods to follow this interface or justify ignoring this requirement.

II. Program for Resolution

1. The wording of the requirement, and the interpretation of this requirement which were used to assure that the requirement was met are as follows.

GENERAL ELECTRIC RESPONSE

This response is given with the understanding that the issue addressed in this Action Plan refers to the requirements imposed upon the Suppression Pool Makeup System (SPMS) design through the GE requirements specification for this system. The SPMS requirements specification (see Reference 1) does not specify, per se, that drywell flooding shall not occur. The design intent is that, with consideration that other containment design parameters are within plant operations specifications, sufficient suppression pool volume will be available to contain the SPMS dump. The applicable specific requirement of the Reference 1 document is as follows:

"4.2.5 The suppression pool weir wall height shall provide sufficient freeboard volume to accept a dump of the upper pool without resulting in overflow flooding into the drywell. The freeboard height shall be measured between the top of the weir wall and HWL which is 7'-6" above the top vent center line."

To assure that this requirement is met, it is GE's intent to monitor that the system design as developed by the BOP A/E is in accordance with these requirements and that proper consideration is given to other containment design variables (e.g., the maximum upper pool water level for plant operation, the worst case design basis drywell/containment pressure differential, etc.).

Reference

1. BWR Requirements Specification, 22A7411, "Suppression Pool Makeup System".

ACTION PLAN 31

I. Issues Addressed

11.0 Mark III load definitions are based upon the levels in the suppression pool and the drywell weir annulus being the same. The GGNS technical specifications permit elevation of differences between these pools. This may effect load defintion for vent clearing.

II. Program for Resolution

The Mark III containment load definitions in GESSAR II are reported on a generic basis assuming equal water levels in the suppression pool and drywell weir annulus. During normal plant operation, elevation differences between these pool waters will be controlled by the applicable Technical Specifications which define such influential parameters as drywell/containment temperature, humidity and pressure. It is the responsibility of the Mark III Owner/AE who follows the GESSAR II containment design to develop Technical Specifications which are consistent with their FSAR defined loads.

GESSAR II does not include these Technical Specifications; consequently, General Electric believes this issue is not applicable and is considered closed.

ACTION PLAN 32

I. Issues Addressed

14.0 A failure on the check valve in the LPCI line to the reactor vessel could result in direct leakage from the pressure vessel to the containment atmosphere. This leakage might occur as the LPCI motor operated isolation valve is closing and the motor operated isolation valve in the containment spray line is opening. This could produce unanticipated increases in the containment spray.

II. Program for Resolution

1.+ The potential effect of maximum backflow which can occur will be estimated. This will include calculating the maximum backflow which can occur, evaluating thermal interaction with the relatively cool RHR spray flow and estimates of the limitations on flashing created by flow through the spray nozzles.

2.+ An evaluation of the possibility of adding interlocks to prevent simultaneous actuation of these valves will also be performed.

+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

ACTION PLAN 33

I. Issues Addressed:

16.0 Some of the suppression pool temperature sensors are located (by GE recommendation) 3" to 12" below the pool surface to provide early warning of high pool temperature. However, if the suppression pool is drawn down below the level of the temperature sensors, the operator could be misled by erroneous readings and required safety action could be delayed.

II. Program for Resolution

1. The GESSAR suppression pool temperature monitoring system and the Emergency Procedure Guidelines were reviewed to ensure that proper sensor installation locations have been defined, and that the appropriate operator instructions exist for determining bulk suppression pool temperature.

GENERAL ELECTRIC RESPONSE

The GESSAR II suppression pool temperature monitoring system (SPTMS), described in Figure 7.6-16, specifies 32 temperature sensors to be located 3" to 12" below normal low water level, and 8 (post-LOCA) temperature sensors to be located between minimum post-LOCA and 12" below minimum post-LOCA water level. Section 6.2.7.5 in GESSAR II specifies safety grade suppression pool level monitors to provide control room operator alarm/indication whenever the water level is outside the normal (Technical Specification) high and low water level range.

A general operator caution (Caution #5) in the BWR generic Emergency Procedures Guidelines (EPG, Revision 3) reads; "Suppression pool temperature is determined by procedure for determining bulk suppression pool water temperature". Each BWR owner completes this operator caution by specifying in their Emergency Operating Procedures a specific procedures for determining bulk pool temperature which is based on their plant unique SPTMS design.

With pool temperature sensors at multiple elevations, control room alarm provided whenever the water level falls below the normal operating range, and a basis for establishing procedures for determining bulk suppression pool water temperature; the GESSAR II design should present no delay in safety action by the plant operator in the event some of the pool temperature monitors have uncovered. Consequently, General Electric believes this issue is closed.

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 34

I. Issues Addressed

19.1 The chugging loads were originally defined on the basis of 7.5 feet of submergence over the drywell to suppression pool vents. Following an upper pool dump, the submergence will actually be 12 feet which may effect chugging loads.

II. Program for Resolution

1. The maximum, bounding effect of vent submergence on chugging boundary loads has been quantified. The GGNS results bound the GESSAR II results for loads on the drywell wall and basemat floor. The GESSAR II containment wall chug load is three percent higher than the GGNS containment wall chug load. The exceedance is judged to be negligible due to the degree of conservatism employed in developing the increased chug loading response. The GGNS response to this Action Plan Element is the applicable GESSAR II response. The existing local and global load definitions adequately bound increased submergence effects on chugging pressure loads, therefore, this item is considered to be closed.

Action Plan 35

I. Issues Addressed

19.2 The effect of local encroachments on chugging loads needs to be addressed.

II. Program for Resolution

1.+ An evaluation of the adequacy of available models to investigate the impact of longer acoustic paths on chugging load definition will be performed.

2.+ The inertial impedance effect of the GESSAR II local encroachments on the chugging source is negligible. The GESSAR II encroachments, like the GGNS encroachments, are greater than two bubble diameters away from the chugging bubble. The GESSAR II encroachments have a negligible contribution to the hydrodynamic mass of the source. The GGNS response to this Action Plan Element is the applicable GESSAR II response.

\+ These results are generic in that they deal with analytical methods, data, or a combination of the two. The GGNS Action Plan response is applicable, and this element is considered to be closed.

Action Plan 36

I. Issues Addressed

20.0 During the latter stages of a LOCA, ECCS overflow from the primary system, can cause drywell depressurization and vent backflow. GESSAR II defines vent backflow vertical impingement and drag loads to be applied to drywell structures, piping and equipment, but no horizontal loading is specified.

II. Program for Resolution

1. No action is required on this item based on MP&L/GE discussions with the NRC staff. This item is closed.

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 37

I. Issues Addressed

22.0 The EPGs currently in existence have been prepared with the intent of coping with degraded core accidents. They may contain requirements conflicting with design basis accident conditions. Someone needs to carefully review the EPGs to assure that they do not conflict with the expected course of the design basis accident.

II. Program for Resolution

1. GE believes that the development program through which the Eemergency Procedure Guidelines have passed has adequately addressed this concern. GE has participated in bringing this concern to the attention of the Emergency Procedures Committee of the BWR Owners Group. GE will pursue generic resolution of this issue with the BWR Owners Group. Accordingly, GE believes that for GESSAR II, this issue is closed.

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7/21/83

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 38

I. Issues Addressed

1.8 Bechtel drawing C-1043A which supposedly represents the as-built condition of the TIP platform does not show the platfrom extending into the suppression pool. This is not in agreement with MP&L's contention that the TIP platform extends into the pool.

II. Program for Resolution

1. Although the specific issue relates only to GGNS, GE has reviewed the GESSAR II drawings to ensure that the TIP platform base extends into the suppression pool.

2. A sketch is provided to show the general configuration and elevations in relation to the pool normal operating level range.

3. The drawings were also reviewed to ensure all other significant structures, e.g., the personnel hatch, at this near-pool elevation also extend beneath the pool surface.

GENERAL ELECTRIC RESPONSE

General Electric has reviewed the GESSAR II drawings which show the TIP platform design. Section A-A in Figure 38.1, attached, confirms that the base of the TIP platform extends into the suppression pool.

Figures 38.2, 38.3 and 38.4, attached, showing the general containment configuration above the suppression pool, also confirm that all the other significant structures (e.g., sumps, personnel lock, etc.) extend beneath the pool surface. Consequently, General Electric considers this issue closed.

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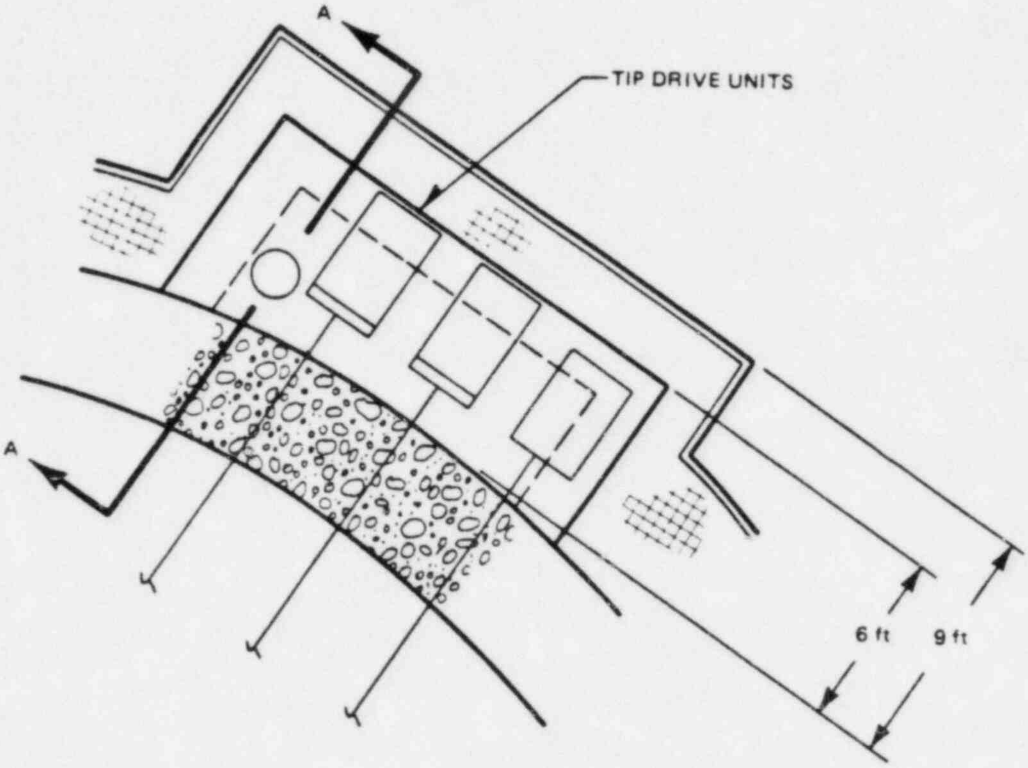

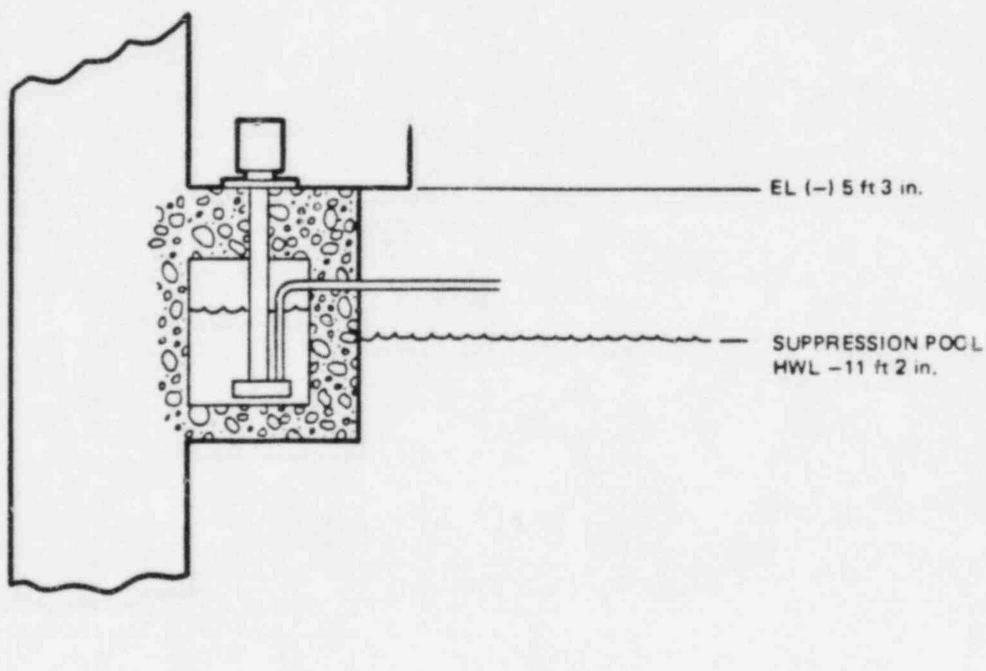

SECTION A–A

Figure 3B-2. Containment Floor Drain Sump - 238 Plant
(38.1)

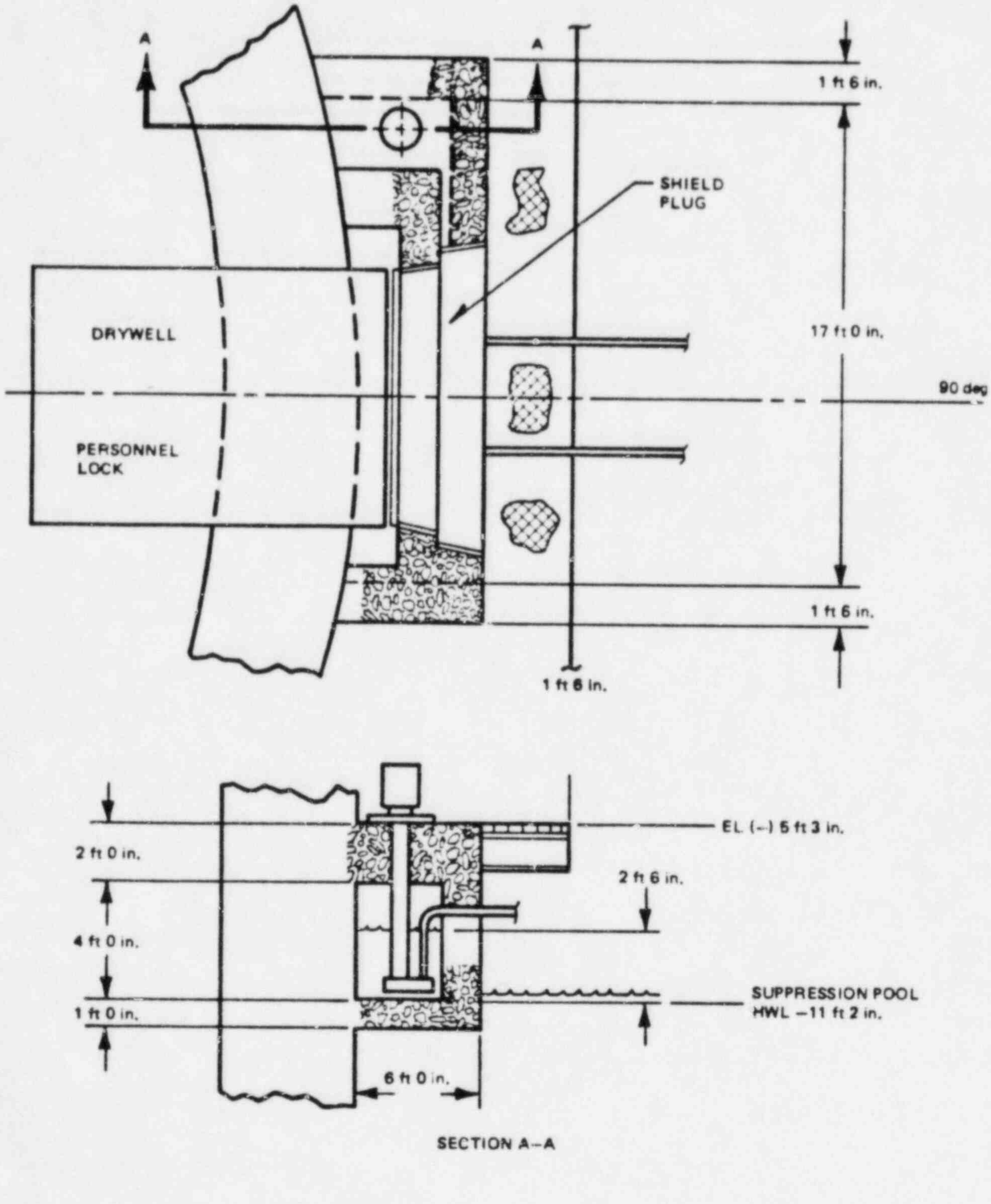

Figure 3B-3. Containment Equipment Drain Sump - 238 Plant
(38.2)

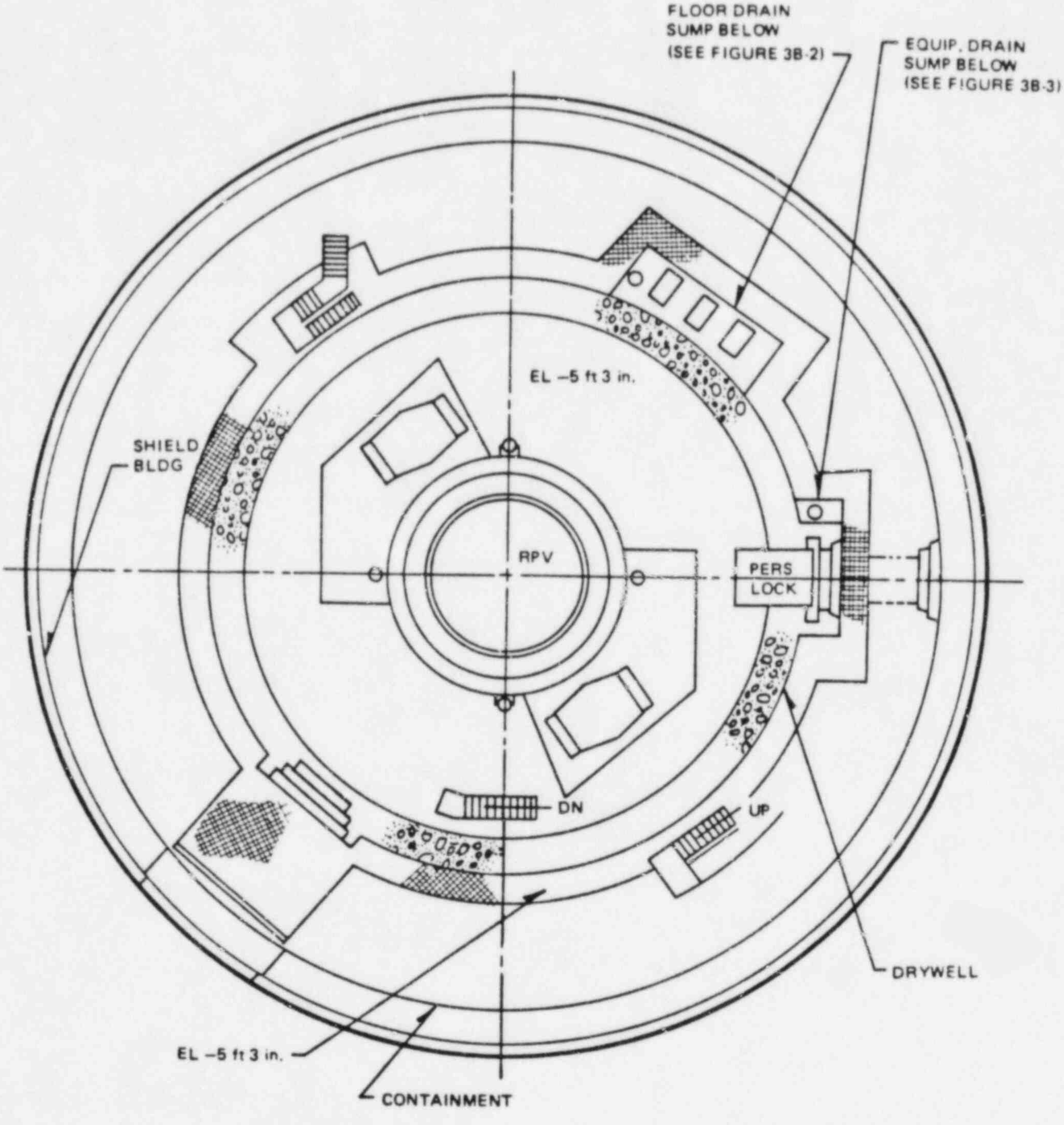

Figure 3B-4. Plan At Elevation (-)5 Feet, 3 Inches
(3B-3)

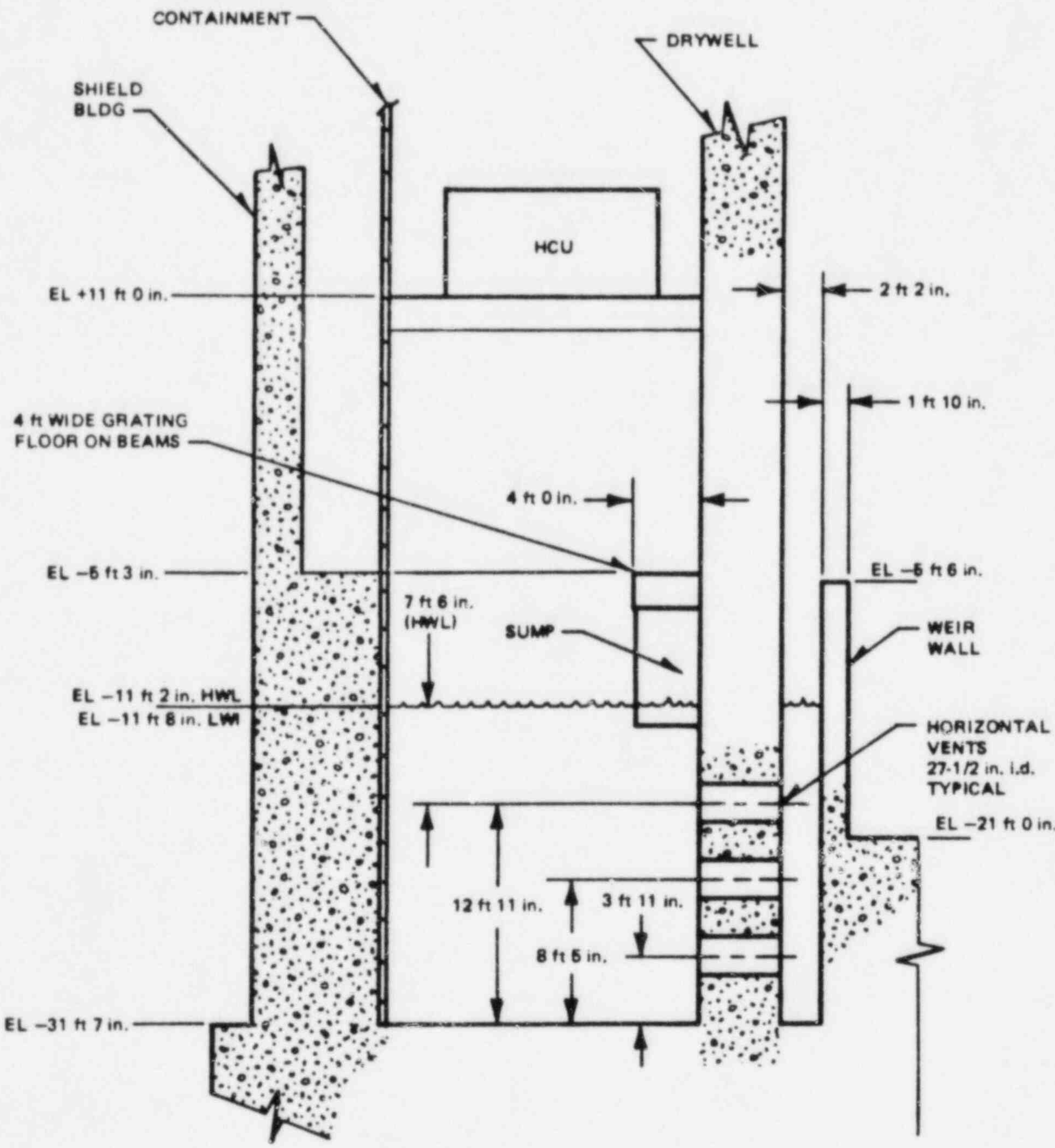

Figure 3B-5. Typical Suppression Pool Cross Section - 238 Plant
(38.4)

Action Plan 39

I. Issues Addressed

6.4 For the containment air monitoring system furnished by General Electric, the analyzers are not capable of measuring hydrogen concentration at volumetric steam concentrations above 60%. Effective measurement is precluded by condensation of steam in the equipment.

II. Program for Resolution

1. The containment air monitoring system (CAMS) which was described in GESSAR II has been removed from the GE scope of supply, because it does not meet all post-TMI regulatory requirements. To reflect this change, the CAMS descriptions in GESSAR II have been deleted by GESSAR II Amendment 14 (March 31, 1983), and replaced with the words "Applicant to Provide". Consequently, General Electric considers this issue closed.

CC: rf/G07212*-6
7/21/83

Action Plan 40

I. Issues Addressed

1.7 GE suggests that at least 1500 square feet of open area should be maintained in the HCU floor. In order to avoid excessive pressure differentials, at least 1500 square feet of opening should be maintained at each containment elevation.

II. Program for Resolution

1. References to the applicable portions of GESSAR II which address this issue are provided.

2. The amounts of open area contained in the GESSAR design at the HCU floor, and at key containment elevations about the HCU floor, are also provided.

GENERAL ELECTRIC RESPONSE

The applicable portions of GESSAR II which address the issue of maintaining 1500 square feet of open area at the HCU floor elevation are found in Appendix 3B; Sections 3B.6.1.6 and 3B.11, and Attachment K.

The calculated free-flow open area above the suppression pool at the HCU floor 11'-0" elevation is 1,500 square feet.

The open area at the only other key floor (elevation 37'-1") was calculated to be over 2,000 square feet. Consequently, General Electric considers this issue closed.

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 41

I. Issues Addressed

6.2 General Electric has recommended that an interlock be provided to require containment spray prior to starting the recombiners because of the large quantities of heat input to the containment. Incorrect implementation of this interlock could result in inability to actuate the recombiners without containment spray.

II. Program for Resolution

Review of the technical issues involved has indicated the interlock should be removed. This activity is not seen as part of the GE Action Plan to resolve the issues identified by Mr. Humphrey as they relate to the GESSAR docket.

GENERAL ELECTRIC RESPONSE

General Electric has never recommended adding an interlock to require containment spray prior to starting the hydrogen recombiners. The source of this issue is an erroneous permissive on the GE RHR FCD document (Figure 7.3-5f in GESSAR II) which enabled the hydrogen mixing system to be operated only after containment spray has been actuated. This logic permissive signal was carried over from a previous design concept.

GE identified this disconnect in 1982 and has initiated the required design change process to correct it. A poll of the Mark III utilities by GE found that no plant had the subject interlock installed, so no hardware change was required. Consequently, General Electric considers this issue closed.

CC:rf/G07212*-8
7/21/83

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 42

I. Issues Addressed

12. The upper pool dumps into the suppression pool automatically following a LOCA signal with a thirty-minute delay timer. If the signal which starts the timer disappears on the solid state logic plants, the timer resets to zero preventing upper pool dump.

II. Program for Resolution

1. Review of the technical issues involved has identified the need for documentation changes to insure that a seal-in of the LOCA signal is provided.

   This activity is not seen as part of the GE Action Plan to address Mr. Humphrey's concerns as they relate to the GESSAR II docket.

GENERAL ELECTRIC RESPONSE

GESSAR II requires, in paragraph 7.3.1.1.6.C.2, that the signal to the thirty-minute timer, once initiated, is to be sealed-in unless terminated by operator action.

To provide assurance that this feature will be incorporated into the actual system design, the General Electric document which imposes requirements for design of the SPMS (see Reference 1) has been clarified as follows:

(1) A new paragraph has been added which reads:

"4.5.20 The SPMS initiation logic shall include seal-in circuitry as is necessary to assure compliance with IEEE-279 requirement that protective system actions, once initiated, shall go to completion unless terminated by deliberate operator action."

(2) The Functional Control Diagram (Drawing #794E797) which forms a part of this requirements document as a recommended design has been clarified to display a seal-in for the thirty-minute timer.

Reference

1. BWR Requirements Specification, 22A7411, "Suppression Pool Makeup System".

Action Plan 43

I. Issues Addressed

13. Ninety Second Spray Delay

The "B" loop of the containment sprays includes a 90 second timer to prevent simultaneous initiation of the redundant containment sprays. Because of instrument drift in the sensing instrumentation and the timers, GE estimates that there is a 1 to 8 chance that the sprays will actuate simultaneously. Simultaneous actuation could produce negative pressure transients in the containment and aggravate temperature stratification in the suppression pool.

II. Program for Resolution

1. Initially, both the containment and drywell are at elevated pressures (at least 9 psig). Transient analyses were performed to show that, under these conditions, containment design external pressure will not be exceeded, even if both containment sprays are activated simultaneously.

GENERAL ELECTRIC RESPONSE

Two cases were analyzed. In each case, bounding conditions were assumed at the time of spray actuation to provide the maximum containment/shield building annulus negative pressure difference. Assumptions included maximum containment air mass (resulting in maximum water vapor mass), maximum design containment airspace temperature (185°F), minimum spray temperature (42°F), and for Case A, minimum total air mass (containment + drywell). These assumptions result in a maximum heat transfer to the containment spray. Case B assumed no air in the drywell with the total air mass (containment + drywell; minimized by appropriate initial conditions) in the containment.

Case A produced the largest containment shield building annulus negative pressure difference because this case had the minimum containment air mass at the time of spray actuation. As shown in Figure 43.1, the maximum negative pressure difference was -0.33 psi at 227 seconds after spray actuation, which is less than the design negative pressure difference of -0.8 psi.

In Case B, the containment pressure never dropped below the shield building annulus pressure (see Figure 43.2). The minimum containment positive pressure difference was 1.3 psi.

General Electric considers this issue closed.

Figure 43.1-

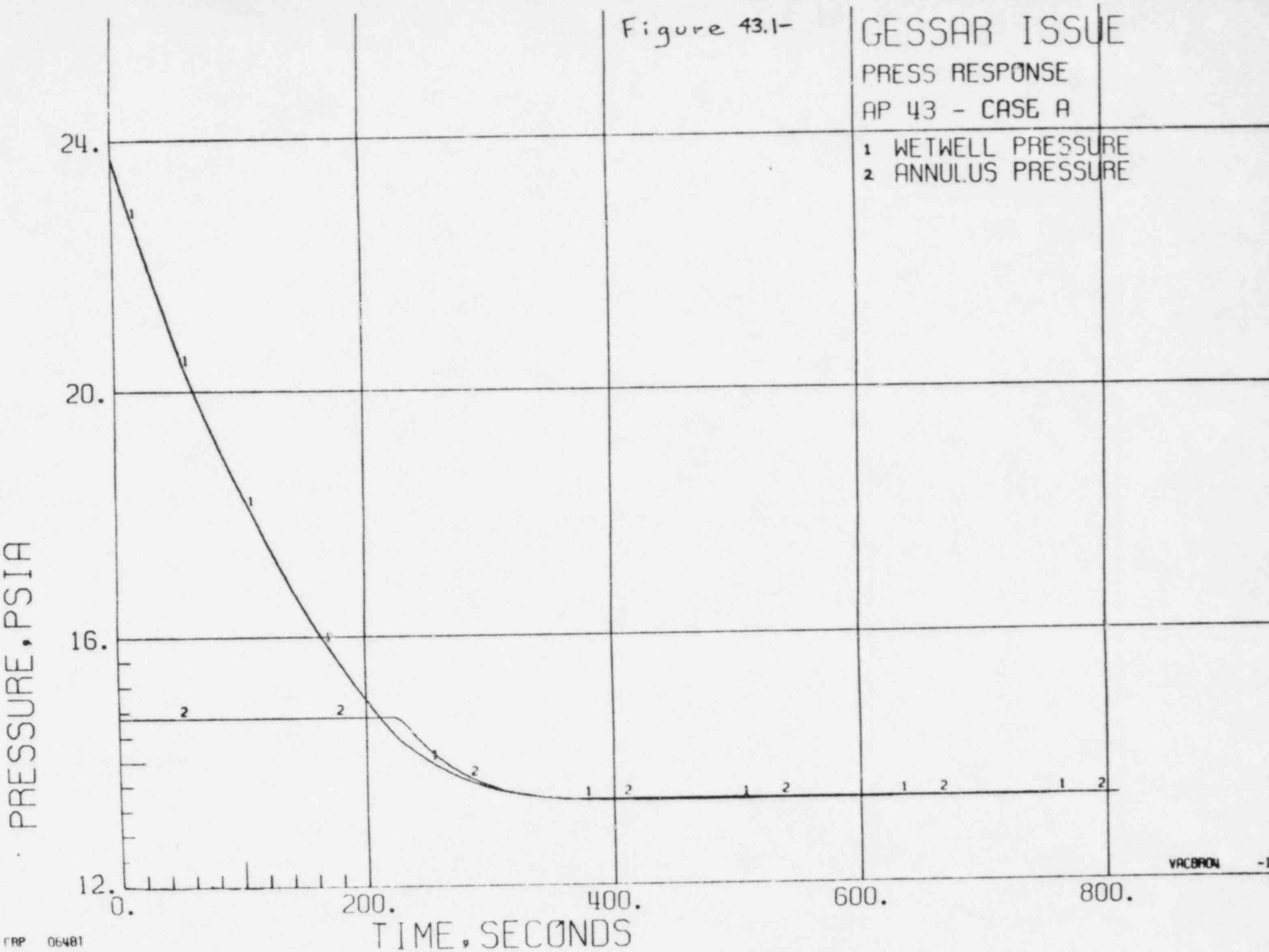

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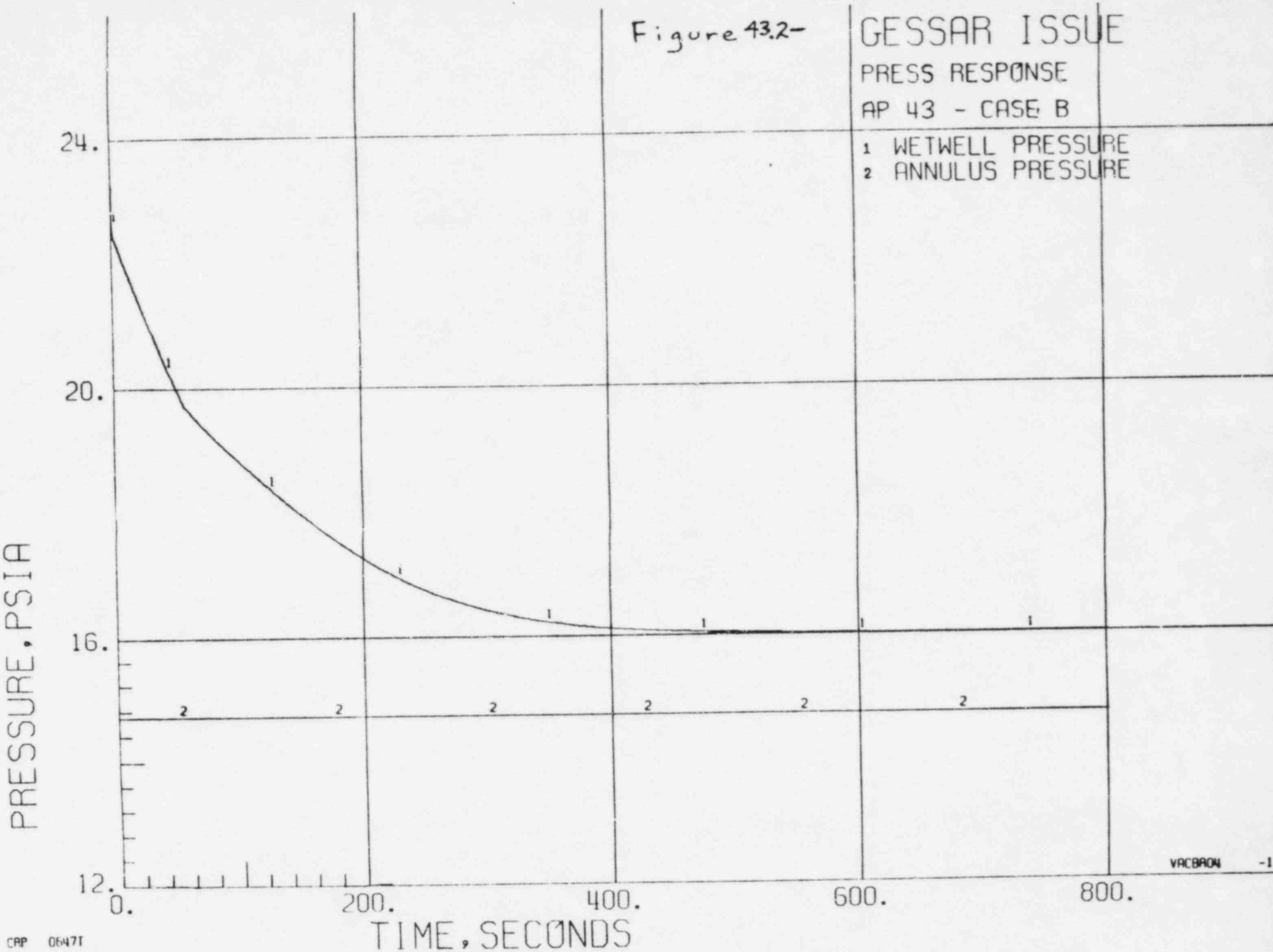
Figure 43.2-



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Action Plan 44

I. Issues Addressed

15. Secondary Containment Vacuum Breaker Plenum Response

The STRIDE plants had vacuum breakers between the containment and the secondary containment. With sufficiently high flows through the vacuum breakers to containment, vacuum could be created in the secondary containment.

II. Program for Resolution

1. The response of the STRIDE secondary containment has been evaluated for the most severe depressurization transient in the primary containment.

GENERAL ELECTRIC RESPONSE

The most severe depressurization transient in the primary containment is caused by the actuation of one containment spray loop with the wetwell airspace at high temperature, low pressure, and high relative humidity. Thus, at the time of spray actuation, the wetwell pressure is assumed to be 1.7 psig (minimum wetwell pressure for spray actuation according to EPG) with 100% relative humidity. Operator action to isolate the containment is assumed to occur within 20 minutes of the initiating event and prior to containment spray actuation. Once the containment is isolated and the wetwell airspace reaches the minimum airspace pressure for spray actuation, analysis has shown that for a spray temperature of 80°F, the maximum environment/shield building annulus negative pressure difference does not exceed -1.0 psi, which is below the design negative pressure difference for the shield building and the standby gas treatment system. Thus, for those conditions, the secondary containment integrity is preserved, and General Electric considers this issue closed.

Action Plan 45

I. Issues Addressed

18.2 Insulation debris may be transported through the vents in the drywell wall into the suppression pool. This debris could then cause blockage of the suction strainers.

II. Program for Resolution

1. The insulation used on TVA STRIDE (GESSAR II) is the stainless steel, "Mirror", heat reflective type of material, consisting of inner and outer layers of heavy gage stainless with 6 layers of thinner metal (SS) sheets in between. An analysis, using conservative assumptions, on the potential of this insulation material plugging ECCS suction strainers following a LOCA was completed by GE and found to be of minor significance. See attachment.

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7/21/83

Action Plan 45 -- GENERAL ELECTRIC RESPONSE

As stated in the Program for Resolution, TVA STRIDE (GESSAR II) uses the stainless steel, "Mirror", heat reflective type of insulation on all primary piping within the drywell, and an analysis was completed by GE to determine the potential of this material plugging ECCS suction strainers following a LOCA. The analysis was broken down into three sub-tasks:

1) Determination of the amount of reflective insulation likely to be torn loose in the drywell following a DBA.

2) Determination of the fraction of insulation that would be held up in the drywell.

3) Determination of the amount of insulation entering the suppression pool that would be captured by the suction strainers.

The quantity of piping insulation torn loose following a LOCA was estimated as 3 panels (each 2 ft long) on each side of the break. The amount of insulation depends on the size of the pipe and the location of the break relative to bends. Consequently a main steam line break probably offers the greatest potential for insulation damage. Considering the jet loads from a 26 inch steam line with a 1000 psi stagnation pressure, this evaluation assumed conservatively that the six insulation panels were completely ripped apart. Neglecting the relatively heavy inner and outer sheets, this would generate roughly 620 ft^2 of 30 mil stainless steel mirror insulation.

Both the analyses of drywell holdup and suction strainer capture fraction were based on insulation trajectories defined by the vectorial addition of their terminal velocity and the fluid flow field. Terminal velocities for the mirror type insulation fragments were 29 ft/sec in the drywell and 1.0 ft/sec in the suppression pool, assuming a drag coefficient of 1.0.

Drywell holdup fractions were calculated assuming the insulation fragments were uniformly distributed across the top of the drywell in the second before vent cleraing, followed by the trajectory calculations described above with a drywell volumetric flow rate of 122,000 ft^3/sec. The resulting velocity flow field in the drywell was calculated to exhaust 80% of the steel insulation into the suppression pool. Because of the high flow velocities in the weir annulus and the subsequent clearing of the 2nd and 3rd row of vents, no credit was taken for insulation holdup in the annulus.

Suction strainer capture areas were calculated based on the suction strainer flow field and the insulation terminal velocities. For a uniform insulation distribution across the surface of the pool, this resulted in a capture fraction of 1.6% for the mirror insulation.

Action Plan 45 -- GENERAL ELECTRIC RESPONSE (Continued)

The five ECCS suction strainers for the GESSAR II design have a total surface area of about 95 ft^2, and are designed to accommodate a 50% flow blockage. The results of this conservative analysis indicated a suction strainer blockage fraction of less than 10% for the mirror type insulation. Consequently, it is concluded that the stainless steel mirror type insulation used in the GESSAR II drywell piping design is of minor significance in potential ECCS suction strainer plugging following a LOCA, and this issue is considered to be closed.

CC:rf:csc/G07212*-14
7/25/83

Action Plan 46

I. Issues Addressed

5.7 After upper pool dump, the level of the pool will be 6 feet higher, and drywell-to-containment differential pressure will be greater than 3 psi. The drywell H_2 purge compressor head is nominally 6 psid. The concern is that after an upper pool dump, the purge compressor head may not be sufficient to depress the weir annulus enough to clear the upper vents. In such a case, H_2 mixing would not be achieved.

II. Program for Resolution

1. GE has reviewed the possible suppression pool water levels and containment/drywell differential pressures over the period the compressors will be operated, in order to confirm that compressor purge discharge head will accomplish positive air flow through the drywell horizonal vents.

GENERAL ELECTRIC RESPONSE

The maximum suppression pool water level, as determined in Action Plan 29, could be very close to the top of the weir wall. Assuming the water level is at the top of the weir wall, approximately 5.6 psi is required to clear the vents. The drywell purge compressor is nominally rated at 500 SCFM at 6 psi. At the time of purge compressor initiation, only 40 SCFM is required to control the hydrogen concentration. Therefore, adequate margin exists in the drywell purge compressor sizing. General Electric considers this issue closed.

Action Plan 47

I. Issues Addressed

Containment Pressure Response

7.3 The analysis assumes that the containment airspace is in thermal equilibrium with the suppression pool. In the short term this is non-conservative for Mark III due to adiabatic compression effects and finite time required for heat and mass to be transferred between the pool and containment volumes.

II. Program for Resolution

1. The written response provided in MP&L's submitted AECM-82/237 letter concerning this issue is also applicable to GESSAR II, and therefore GE believes this issue is closed.

Action Plan 48

I. Issues Addressed

Effects of Insulation Debris

18.1 Failures of reflective insulation in the drywell may lead to blockage of the gratings above the weir annulus. This may increase the pressure required in the drywell to clear the first row of drywell vents and perturb the existing load definitions.

II. Program for Resolution

1. There are no gratings over the weir annulus in the GESSAR II drywell design; therefore, GE believes this issue is not applicable.

GENERAL ELECTRIC -- GESSAR II -- ACTION PLAN

Action Plan 49

I. Issues Addressed

21. Containment Makeup Air for Backup Purge

Regulatory Guide 1.7 requires a backup purge H_2 removal capability. This backup purge for Mark III is via the drywell purge line which discharges for the shield annulus, which in turn is exhausted through the standby gas treatment system (SGTS). The containment air is blown into the drywell via the drywell purge compressor to provide a positive purge. The compressors draw from the containment, however, without hydrogen-lean air makeup to the containment, no reduction in containment hydrogen concentration occurs. It is necessary to assure that the shield annulus volume contains a hydrogen lean mixture of air to be admitted to the containment via containment vacuum breakers.

II. Program for Resolution

1. The GESSAR II drywell purge hydrogen recombiner backup design has been reviewed to determine if any change is required to assure adequate reduction in containment hydrogen concentration occurs during its operation.

GENERAL ELECTRIC RESPONSE

An assured supply of air or hydrogen-lean air to balance the potentially hydrogen-rich Standby Gas Treatment System flow is required. The expected leakage of outside air to the Shield Building annulus may not be sufficient to provide a reduction in the containment and drywell hydrogen concentrations. A line with normally-closed valves will be ducted into the suction of the shield annulus exhaust and recirculation fans to permit controlled air leakage into the shield building. The valves on this line will be opened in the event the backup purge line is required for hydrogen control. The appropriate portions of sections 6.2.5 and 9.4 of GESSAR II will be revised to include this change, in accordance with General Electric's normal change control process. With this change, General Electric considers this issue closed.

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7/21/83