GENERAL ELECTRIC

NUCLEAR ENERGY DIVISION

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BWR PROJECTS DEPARTMENT
Letter No. 781-206-75

September 26, 1975

Mr. Benard C. Rusche, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUBJECT: CONTAINMENT AND BYPASS LEAKAGE, DOCKET NO. STN 50-447

Dear Mr. Rusche:

On September 15, 1975, GE met with members of the NRC Staff for the purpose of discussing the issue of containment and bypass leakage control currently pending on the 238 GESSAR. GE informed the Staff that if the conservative positions of Regulatory Guide 1.3 are combined with the positions taken by the Staff in Branch Technical Position CSB 6-3 and applied to the GESSAR Mark III containment, two plant changes are evidently clear: (1) the containment leak rate must be reduced from its current value of 1% per day, and (2) the so-called "bypass leakage" - that leakage from the containment which goes directly to the site environs without processing - must be reduced to zero or near zero.

To meet the Regulatory Guide and Branch Technical Position (BTP), GE will develop a design for positive leakage control systems, upgrade some piping systems to seismic Category I for the purpose of achieving credit for closed loops or water seals, and identify those containment water legs and loop seals which perform a sealing function and are presently contained in the Mark III design. These changes will permit the containment leak rate to be reduced to 0.3% per day, will eliminate any leakage directly to the environs through the containment penetrations, and will limit the leakage rate through containment penetrations which communicate directly with the auxiliary building or fuel building to 8% of the containment leak rate. Thus the leakage to the unprocessed areas is zero, leakage to the processed areas is 8% of the containment leak rate, and leakage to the mixed and processed areas is 92% of the containment leak rate. Using these values for leakage rates results in off-site doses not exceeding the guidelines of Regulatory Guide 1.3.

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Where positive leakage control systems are employed, such systems will be designed to meet Branch Technical Position CSB 6-3 and Regulatory Guide 1.96. Addition of positive leakage control systems may cause the containment pressure to increase. The increase in containment pressure as a result of positive leakage control systems will not exceed the containment design pressure. The preliminary estimate of the maximum expected pressure increase to the containment is shown in the attached figure. Where static water legs or loop seals are employed, such water legs and loop seals will be seismic Category I and will be designed with sufficient capacity and capability to control leakage for as long as postulated accident conditions require containment integrity to be maintained.

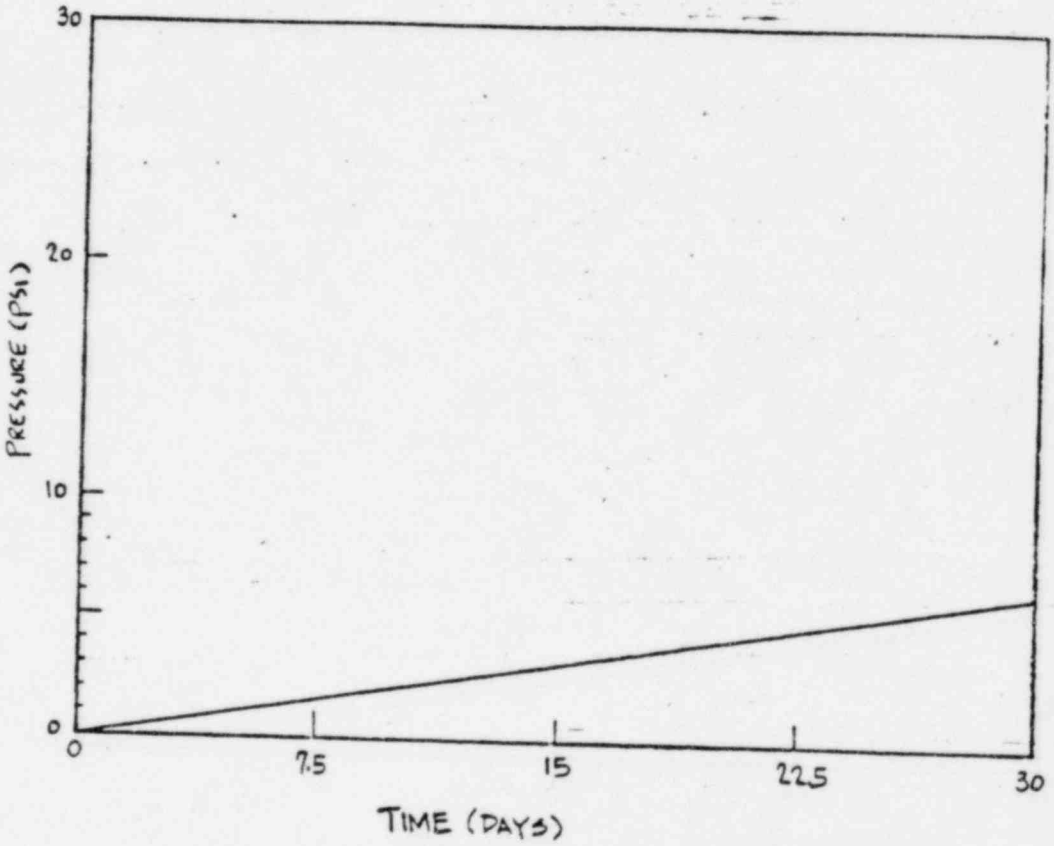
The design changes being employed and the systems analysis will be submitted to the NRC for review by April 15, 1976. Such documentation will include piping and instrumentation drawings (P&ID) for positive leakage control systems and an identification of the positive seal being employed for each containment penetration. Elementary diagrams for the control and instrumentation portions of the systems will be submitted to the NRC by October 15, 1976.

We will proceed with the design of the Mark III containment and the above noted changes such that the requirements of Regulatory Guide 1.3 and Branch Technical Position CSB 6-3 can be met. Concurrently, we will work with the NRC Staff to establish a program to re-evaluate Regulatory Guide 1.3, which we understand is being contemplated by the Staff.* It is proposed that the final decision to install these systems be made after the Staff re-evaluation and appropriate revision to Regulatory Guide 1.3 applicable to the BWR/6 Mark III design indicates an actual need for the systems.

Ivan F. Stuart, Manager
Safety and Licensing

IFS:jrm

*Summary of meeting with GE to discuss GE appeal of NRC's dose calculations, dated August 4, 1975, Docket No's STN 50-447 and STN 50-531



LONG TERM CONTAINMENT PRESSURE INCREASE FOLLOWING A DBA DUE TO ADDITION OF POSITIVE LEAKAGE CONTROL SYSTEM.

Aerojet Nuclear Company

Interoffice Correspondence

October 8, 1975

JHRamsthaler
Rogers 220

TRANSMITTAL OF TRIP REPORTS-LLW-59-75

This letter documents informal transmittal to NRC-TR (R. L. Tedesco, J. A. Kudrick) and ERDA-ID (P. E. Litteneker, T. D. Knight) of two trip reports relating to BWR dynamics. The transmitted reports are: BAB-4-75 discussing the September 18, 1975 San Jose NRC/GE/ANC meeting, and BAB-3-75 which describes the August 21, 1975 Mark I containment loads meeting held in Washington, D. C.

L. L. Wheat, Manager
Containment Systems Project
Reactor Behavior Program

ala

cc: BABush
RRStiger
File C2.0

D-33

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Aerojet Nuclear Company

Interoffice Correspondence

September 2, 1975

RRStiger
CSC D16

TRIP REPORT-BWR MARK I CONTAINMENT LOADS MEETING - BAB-3-75

L. L. Wheat and I attended a Mark I Containment Hydrodynamic Loads meeting held in Bethesda, Maryland, on August 21, 1975. EPRI and Teledyne representatives were also present.

General Electric (GE) presented to the NRC staff, a summary of primary and secondary hydrodynamic loads considered in the Mark I short term program. Previously considered loads (from large scale demonstration tests), new loads, and loads the NRC has been concerned about were reviewed and GE explained the basis for determining which loads they felt were "significant". These loads have been given to Bechtel for analytical work. The NRC expressed continued concern over the reaction loads on the downcomer ring header due to pool swell and axisymmetric main downcomer clearing loads.

GE recently conducted new tests; on a crash basis, using a plexiglass 1/12 scale Mark I model which was not vented to the atmosphere. (EPRI had tested a 1/10 vented model which did not account for wetwell compression effects.) The test assembly was spring loaded, for measuring reaction forces, and the torus interior was initially set at a subatmospheric pressure. The tests showed that compression in the wetwell, due to a non-vented system, reduces the frothing and dampens the pool level sloshing.

A GE short term report will be coming out at the end of September discussing all of the loads along with the justification of their use or non-use in analytical work. The report also will look at combinations of these loads. Accompanying the report will be the long term program test plan which will include vertical vent testing in a closed tank, in plant relief valve testing, and small scale relief valve device testing.

Currently, the GE facility is being set up for a Swedish test layout for the impact of structures in the wetwell. NRC requested that GE look at the results of these tests for applicability to the Mark I design and report any data used.

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Early in the afternoon, ANC and NRC met with GE to discuss GE's response to a set of questions, prepared by NRC, regarding scaling and conservatism in GE 1/3 scale PSTF test results. The main GE points were: that the scaling analysis was used to show that breakthrough occurs before the pool swell reaches the wetwell steam tunnel; and that the small structure impact and drag loads are conservative. The NRC would like to see dimensional analyses on all phenomena such as impulse and breakthrough.

Finally, L. L. Wheat and I met with Jack Kudrick (NRC) to clarify some BWR dynamics tasks. NRC's greatest concern at this time is the applicability of GE's dimensional analysis. ANC was asked to perform a more rigorous study using dimensional analysis on the 1/3 scale facility test results, especially in relation to breakthrough. NRC also wants a review of the adequacy of the test data for velocity and slug thickness, as a function of time and elevation, and for wetwell roof impact pressure. An evaluation of 1/3 scale air test data also is desired.

B. A. Bush

B. A. Bush
Containment Model Development
Analytical Model Development

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cc: BSAnderson
EPEales
WJMings
CLNalezny
JHRamsthaler
DCSlaughterbeck
LLWheat (4)

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Aerojet Nuclear Company

Interoffice Correspondence

July 28, 1975

J. H. Ramsthaler
Rogers 220

BWR MARK I OWNERS MEETING TRIP REPORT AND COMMENTS - LLW-39-75

Attached is a summary of the BWR Mark I owners meeting held in Bethesda, Maryland on July 17, 1975. The purpose of the meeting was to discuss the status and progress achieved on understanding and assessing BWR containment pressure loads in Mark I containments. The meeting agenda is attached. A brief summary of discussions between NRC-TR (Kudrick, Lainas) and ANC (Wheat) is also presented.

A considerable amount of BWR dynamics evaluation has been and is being done by the involved utilities, General Electric, EPRI, Bechtel, and other consultants. The problems encountered require not only containment pressure considerations, but numerous structural static and fatigue analyses. ANC should fully support NRC-TR in this task. ANC participation in several future meetings is anticipated and encouraged.

LL Wheat

L. L. Wheat, Supervisor
Containment Model Development
Analytical Model Development

gj

Attachment as stated

cc: BSAnderson
NRAnderson
BABush
ACCrail
JADearien
IAEngen
EGGood
GEGruen
JEHartman
SWJames
KRKatsma
JDKerrigan
PMLang
WHLee
ECLemmon
JIMills
WJMings
CFObenchain
VHRansom
RCSchmitt
DCSlaughterbeck
CWSolbrig
RRStiger

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I. TRIP REPORT ON MARK I OWNERS MEETING

1. GENERAL

A two-page agenda of the meeting is attached with this letter. NRC (Kudrick) agreed to send ANC (Wheat) a copy of the handouts provided at the meeting by General Electric (GE) and the owners group. Figure 1 illustrates a Mark I containment plant.

Many details of the meeting are not reported here, but general comments are presented. The basic problem facing the reactor owners is that recent experimental data have shown the existence of various suppression pool pressure oscillations during tests simulating an LOCA or relief value operation. These pressure fluctuations and resultant stress loads were not considered specifically in the Mark I containment designs which in general were completed several years ago. While the designs were based on conservative estimates at that time, the recent data requires NRC and the owners to prove the design adequacy, using the latest information. Much experimental and analytical results are still needed to completely resolve this issue. It was apparent from the meeting that the owners and their contractors are working hard to prove the adequacy of the Mark I containment design. NRC also needs immediate support from their consultants to review the owner's work, and other information, and help form an NRC operating decision on this issue.

The Mark I owners are committed to the following: (1) by July 31, 1975, each owner will docket a letter referencing GE dat and results and state why their plant should be allowed to continue operation, (2) in

early September, 1975, complete a short-term assessment of each Mark I plant using best-estimate dynamic loads, and (3) initiate a long-term program to obtain added data and confidence in the vertical vent BWR containment systems. The plan for the long-term program is to be delivered to NRC by September, 1975, and the program completion is targeted for late 1976. The long-term program would use the worst case conservative approach, and treat the dynamics problem as a generic issue.

The Mark I owners group has contracted EPRI to act as their technical manager and review team. EPRI also hires several consultants, such as Energy Incorporated and Stanford Research Institute (SRI). General Electric is providing the bulk of the experimental data and other information needed by the owners. Bechtel is acting as the AE consultant, reviewing specific plants in cooperation with GE guidance. Teledyne is serving as an independent consultant to the owners group.

2. SELECTED TOPICS

GE stated that the short term program will be based on best estimate or "most probable course of action" loads rather than conservative worst case estimates. Knowledge based on the Mark III PSTF data, Marviken data, other European data, and analytical models will be used in the short and long term programs. SRI has completed some 1/10 scale Mark I pool swell tests and had movies of the pool swell action. The scale model was made of plexiglass so very good movies were obtained.

One item of interest, which at first appears to contradict a recent ANC calculation, is that the air ejected from the vertical vent traveled

downward in the suppression pool halfway to the bottom of the torus. ANC calculations indicated the air would only travel a relatively short distance. The observed behavior may not be a contradiction, but rather it may indicate a deficiency in the scaling and SRI model. The air penetration into the water will be limited primarily by momentum transfer. If the SRI test had an air exit velocity similar to that expected in a full scale plant, then the air injection depth in the scaled model would be excessive (scaled). This in turn would produce a non-conservative pool swell force and slower pool swell time in the scaled model. It is not obvious how one could do the experiment better, although ANC (and NRC) does not yet have details of the experiment. To obtain the same vent exit velocity, physics dictates that the air injection depth will not be scaled correctly. To force a conservative pool swell, one might install a flat horizontal plate below the vents at a properly scaled distance. This would force the air out and upward. However, this would be overconservative in getting air out of the pool and would include momentum exchange which was not realistic.

It is also probable that the ANC calculation of air injection depth was incomplete by not including explicit effects of the liquid slug ejection from the downcomer. Penetration of the slug into the suppression pool will allow air from the downcomer to follow along and therefore the effective air penetration depth would exceed that determined from normal air momentum exchange considerations. Depending on the magnitude of these effects, the ANC pool swell model may be extra conservative when applied to vertical downcomers. The questions of air injection and liquid slug penetration, and model conservatism, are currently being investigated by ANC.

GE stated that the short-term evaluations would be based on FSAR blowdowns, and would specifically consider three dynamic loads: pool swell, vent reaction, and downcomer lateral thrust. The pool swell information is based on GE and Marviken work, and German data are associated with the lateral thrust and reaction loads. The lateral thrust loads result from steam collapse and resultant water impact on the surfaces of the downcomers. The prime concern with lateral thrust is the possibility of failing the downcomers where they connect to the ring header, and thus bypassing steam condensation in the suppression pool. Either immediate or fatigue failure is considered possible and must be investigated. The primary concerns over the pool swell process are the effect of pool rise on the ring header structure and its supports and the thrusts on the torus support columns. GE stated there was a significant ring header load resulting from both the air bubble and frothy mixture.

The vent reaction load was not discussed in detail, but if this load is determined to be excessive, it would be the most damaging of all loads. One might think of the downcomer exits as rocket exhausts, to understand this process. During downcomer clearing a reaction force acts upward on the downcomers and ring header assembly. Such forces would tend to move the ringheader and large vent pipes upward, thereby torquing the large vent pipes. The stress concentration probably would occur where the vents attached to the drywell. Structural failure at that point would open the entire containment. This possibility should be examined very carefully.

Various specific models and estimated results were discussed, usually in general terms. The long range program presented very briefly by GE

consisted of structural assessment, LOCA behavior test program, and a relief valve behavior test program.

Neither vent chugging nor relief value operation in a Mark I were discussed. Evaluation of both effects seems warranted. In summary, the meeting was informative and cognizant ANC personnel should attend similar future meetings.

II. DISCUSSION OF BWR DYNAMICS TASKS

Approximately one-half hour was spent with Jack Kudrick discussing part of the BWR dynamics tasks. A brief discussion was also held with G. Lainas and J. Kudrick. Most of the time was spent discussing the PSTF 1/3 scale test program. Kudrick stated that NRC was not interested in ANC evaluating vent clearing times. Instead, emphasis should be placed on pool swell, scaling effects, pressure loads, etc. In general, pool surface velocity and ligament thickness will be determined as functions of space and time. Impact loads will be measured at the top of the PSTF building. The 1/3 scale pool baffles have been extended all the way from the pool floor up to the PSTF building roof.

Presently, NRC assigns top priority to evaluation of the GE 1/3 scale test facility, procedures, conclusions, and applicability. The first priority is not an evaluation or comparison of actual data, but rather, formation of a defensible judgment on the value and applicability of the overall 1/3 scale test program. Specifically, pool swell and load profiles are the main items of concern in this test series, and the ANC evaluation must be directed at these items. The analysis must include

scaling considerations, and determine if GE can reach proper conclusions based on observed data. The applicability of the facility and results to a Mark III system must be assessed. ANC does not yet know if vent flow and fluid composition will be measured, or if only pressure and temperature data will be available. A tour of the 1/3 scale PSTF should be arranged for ANC.

NRC assigns second priority to actual evaluation and correlation of the pool swell behavior data. This task relates only to the PSTF and does not include specific extrapolation to full size Mark III plants. It was stated that data would be available within about one week.

Third priority was assigned to determine quantitatively the applicability of the 1/3 scale pressure load data to a general Mark III plant. Various scaling and pool depth differences must be evaluated to resolve this task.

Fourth priority was assigned to an ANC review of a GE report to be issued to NRC in August (hopefully). The report will present load data on small structures located above the suppression pool surface. Loads will be determined on 5. in. and 10. in. diameter pipes, on 5. in. and 10. in. I-beams, and on grating. The first test series will determine pool behavior for various test conditions, and the second series will determine load profiles on the various structures as a function of ligament thickness or other pool parameter, based on results of the first test series.

Kudrick stated that GE recently completed about a dozen 1/3 scale air tests. NRC is trying to obtain the air test information by September.

No further discussion was conducted on the 1/3 scale PSTF tests. Some additional clarification is needed by ANC and will be obtained in the near future.

There was a brief discussion of the applicability of horizontal vent data to vertical vent systems. This has been addressed previously by ANC. Additional evaluation is desired by NRC, including consideration of the flowing mixture composition. Also, the 1/3 scale PSTF data should be evaluated for vertical vent systems. Additional GE PSTF tests should be recommended if necessary. Additional NRC/ANC clarification of this task is needed.

No other specific tasks were discussed. Mr. Lainas expressed his position that adequate ANC support was needed immediately for BWR dynamic behavior evaluation. Lainas considers the BWR tasks considerably more important than other ANC work funded by his branch.

7/17/75 Meeting / LLW

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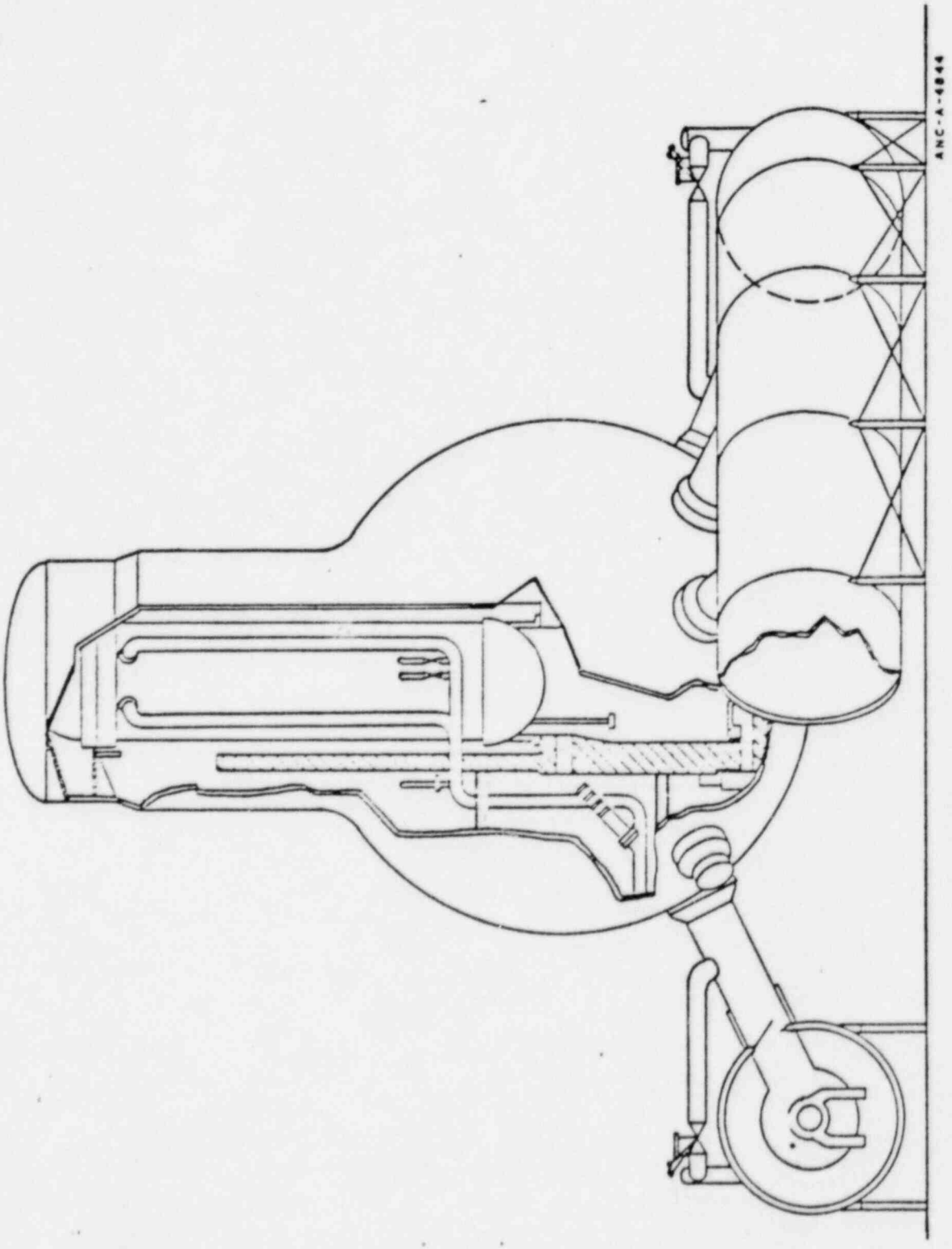
DETAILED AGENDA

	SUBJECT	PRESENTED BY	ESTIMATED TIME
1.	INTRODUCTION A. STRUCTURE OF BWR OWNERS GROUP, ITS PHILOSOPHY AND PURPOSE B. ORGANIZATIONAL RELATIONSHIPS C. OVERALL APPROACH AND TIME FRAME D. OBJECTIVES OF SHORT AND LONG-TERM PROGRAMS E. PRESENTATION OF OWNERS GROUP POSITION IN REGARD TO PRESENT OPERATIONS	BWR GROUP CHAIRMAN- MR. T. D. KEENAN	30 MIN.
2.	GENERAL TECHNICAL REVIEW OF SHORT-TERM PROGRAM	GENERAL ELECTRIC MR. P. IANNI	15 MIN.
3.	DETAILED PRESENTATION OF LOADING CRITERIA UTILIZED IN SHORT-TERM PROGRAM	GENERAL ELECTRIC MR. A. JAMES	45 MIN.
4.	INDEPENDENT ASSESSMENT OF SHORT-TERM PROGRAM LOADING CRITERIA	TELEDYNE DR. W. COOPER	15 MIN.
5.	DETAILED PRESENTATION OF ADDITIONAL LOADING CRITERIA UTILIZED IN SHORT-TERM PROGRAM	GENERAL ELECTRIC MR. A. JAMES	90 MIN.

DETAILED AGENDA (CONT'D)

	SUBJECT	PRESENTED BY	ESTIMATED TIME
6.	SUMMARY OF SIGNIFICANT LOADINGS UTILIZED IN SHORT-TERM PROGRAM	GENERAL ELECTRIC MR. P. IANNI	10 MIN.
7.	STATUS OF SHORT-TERM PROGRAM PLANT SPECIFIC ANALYSIS	BECHTEL MR. C WIEDNER	40 MIN.
8.	INDEPENDENT ASSESSMENT OF SHORT-TERM PROGRAM STRUCTURAL CRITERIA	TELEDYNE DR. W. COOPER	10 MIN.
9.	GENERAL TECHNICAL REVIEW OF LONG-TERM PROGRAM	GENERAL ELECTRIC MR. P. IANNI	30 MIN.
10.	INDEPENDENT EVALUATION OF LONG-TERM PROGRAM CONCERNING APPLICABILITY OF ASME CODE CRITERIA	TELEDYNE DR. W. COOPER	10 MIN.
11.	SUMMARY A. CONCLUSIONS B. GENERAL QUESTIONS & ANSWER PERIOD	BWR GROUP CHAIRMAN MR. T. D. KEENAN	OPEN



Mark I pressure suppression containment system "light globe" drywell with "torus" wetwell design.

Figure 1

2937

TECHNICAL ASSISTANCE - MK I & II
POOL DYNAMIC LOADS

I. EVALUATION OF THE SHORT-TERM MARK I & II EXPERIMENTAL & ANALYTICAL PROGRAMS USED TO SUPPORT THE ADEQUACY OF THE PROPOSED PRESSURE LOADS DUE TO LOCA POOL DYNAMICS

II. EVALUATION OF THE LONG-TERM MARK I & II EXPERIMENTAL & ANALYTICAL PROGRAMS PROPOSED BY THE OWNERS GROUPS

The purpose of this investigation is to determine the adequacy of the proposed program plan to establish the design pressure loads for the following:

A. Local pool swell loads prior to breakthrough for pipes, I-beams, downcomers, vent header, and vent lines;

B. LOCA loads on components described in (A) for post-breakthrough froth impingement;

C. Long-term LOCA steam condensation oscillatory loads on containment structures; and,

D. Pool dynamic loads due to relief valve actuation.

III. EVALUATION OF THE SCALING CONSIDERATIONS FOR MARK I & II LOCA POOL SWELL DYNAMICS

A. Review dimensionless analysis proposed by Mark I Owners Group to support the validity of the 1/10 scale test results; and,

B. Perform a dimensionless analysis to determine the appropriate scaling parameters if different than those proposed in (A).