R. Cullen

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

MAY 4 1973

Docket Nos. 50-416/417

Voss A. Moore, Assistant Director for Boiling Water Reactors, L

CONTAINMENT SYSTEMS BRANCH - REQUEST FOR ADDITIONAL INFORMATION FOR GRAND GULF NUCLEAR STATION, UNITS 1 & 2.

Plant Name: Grand Gulf, Units 1 & 2
Licensing Stage: Construction Permit Review
Docket Numbers: 50-416/417
Responsible Branch & Project Manager: BWR #1:G. Owsley
Requested Completion Date: May 4, 1973
Applicant's Response Date: June 22, 1973
Review Status: Awaiting Information

The attached first round question list requesting additional information for the construction permit review for Grand Gulf 1 & 2 has been prepared by the Containment Systems Branch after having reviewed the applicable portions of the PSAR for which we have responsibility. We have also reviewed the responses to certain questions previously submitted to the applicant by the mini-review.

In the course of our review, we have identified the following as significant review items:

1. The analytical model used to calculate the containment response to loss-of-coolant accidents must be presented in sufficient detail with suitable justification to allow an independent review of the model to be made and to assure the adequacy of containment design margins.

2. The blowdown mass and energy rates must be justified as conservative for containment design purposes. The short-term blowdown is especially significant for the Grand Gulf containment as the peak drywell differential pressure occurs at approximately one second post-LOCA.

3. The objectives and design of the General Electric large scale test program must be described in detail and justified as sufficient to establish and/or confirm the Grand Gulf containment design parameters.

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4. The operation of the hydrogen recirculation system must be more clearly defined to assure proper coordination with the containment spray system.

For several review areas, such as containment isolation valve arrangements and subcompartment differential pressures, we have included only minimal questions as we feel that these areas can be pursued most effectively through a meeting with the applicant. We are also continuing our review of the bypass matter and the modeling to include a time dependent metal-water reaction rate suitable to model the provisions of Safety Guide 7. We recommend that such a meeting be arranged to discuss some of these matters as our review continues.

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for Containment Safety
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Enclosure
As stated

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REQUEST FOR ADDITIONAL INFORMATION
GRAND GULF NUCLEAR STATION, UNITS 1 & 2

1. PSAR Section 6.2.1.3.5 references GE Topical Reports NEDO-10320 and NEDO-10320 Supplement 1 as the analytical model used to evaluate the Grand Gulf containment response to loss-of-coolant accidents.

   (a) Since this model was originally developed for other BWR pressure suppression vent configurations, clarify which sections of the reports are still applicable and being used to evaluate the Mark III containment configuration proposed for the Grand Gulf Nuclear Station.

   (b) For those parts of the containment analytical model which have been revised for the Grand Gulf analysis, provide a detailed description of the new model including its basis, the assumptions and equations used in the analysis, and the parameter values used to apply the model to the Grand Gulf design.

   (c) Discuss the specific parts of the analytical model or parametric values which you feel require experimental substantiation or confirmation by the large scale test program planned by the General Electric Company.

   (d) Describe the procedure to be used to establish or confirm the analysis or parametric values in (c) above.

   (e) Discuss the bases of the proportionality constants (scaling factor) used in scaling various parts of the test facility and demonstrate that the test facility may be considered to be a valid simulation of the Grand Gulf and other Mark III Type containments.

2. Table 6.2.1 and Section 6.2.1.2.2 of the PSAR provide comparisons of the maximum calculated values of containment design parameters and their design values. However, there appears to be a lack of sufficient technical bases by which design margins were established and there will be no significant Mark III test data until late 1973 to evaluate these margins. Therefore, provide a complete discussion justifying the design margins for the containment and perform the following sensitivity analyses in order that we may make a preliminary assessment of the conservatism of your containment design:

Provide curves which illustrate the sensitivity of containment response to each of the following parameters:

(a) vent resistance factors
(b) drywell net free volume
(c) containment net free volume
(d) vent areas
(e) vent submergences
(f) drywell air carryover rates to the containment
(g) blowdown flow and energy rates
(h) suppression pool temperatures
(i) steam bypass leakages between the drywell and containment
(j) core heat due to delay in control rod insertion.

Each plot should show containment and drywell pressure responses as a function of time for a range of values of the parameter under consideration. Aside from the parameter under consideration all other initial conditions and variables should be as assumed in the PSAR analysis of containment response to the DBA-LOCA. Each of the (a) through (i) parameters should be specified as to the nominal value used in the PSAR analysis, the manner by which it was determined (e.g., calculated or experimental) and an estimate of the accuracy to which the value of the parameter is known.

3. Discuss the assumptions used in calculating the blowdown energy and mass rates provided on page 6.2-26 of the PSAR and provide justification that these assumptions maximize the energy input to the containment. As the peak drywell differential pressure occurs at less than 1 second post-LOCA, special consideration should be given to those assumptions (i.e., water entrainment) which could have a significant effect on the short term blowdown rate.

4. In the discussion of a main steam line break accident (PSAR Section 6.2.1.3.2) it was stated that after 4.2 seconds the isolation valves in the broken line will have closed sufficiently so that the valve flow area will be equal to the flow restrictor area and after 5.5 seconds the closure of the valves will terminate flow from one side of the break. These parameters establish the effective break area profile for the accident. It appears that the above assumptions are a departure from previous BWR containment design analyses and therefore should be substantiated as follows:

    (a) As the isolation valves are designed for closing times from 3 to 10 seconds, discuss and reference any testing that has correlated valve closing times to the valve closing speed control setting. Specify the sensitivity of the valve closing speed control.

(b) PSAR Section 5.5.3 states that the isolation valves are designed and installed such that performance of the valves is enhanced for forward steam flow conditions. As the valves located in the broken steam line will experience reverse high flow conditions, discuss the capability of the valves to close in 5.5 seconds or less. Provide or reference appropriate experimental data which supports your position.

5. Discuss your assumptions used in calculating the blowdown mass rates and energies for the rupture of a recirculation line (PSAR page 6.2-12c) and justify them as being conservative for containment design purposes. Specifically consider:

   (a) your assumptions regarding the inventory of subcooled reactor coolant in the recirculation loops and reactor vessel downcomer regions which could yield higher, short term (less than 1 second) blowdown rates.

   (b) the potential availability of uninterrupted feedwater flow which would increase the energy addition to the containment over the long term.

6. PSAR Section 6.2.1.3.7 describes the analytical model used to compute the long term containment response to a loss-of-coolant accident. Our review in this area indicates that the following modifications should be considered to provide a more accurate model and to account for design changes.

   (a) the initial conditions assumed in this analysis (pg. 6.2-17) indicated that containment and drywell pressures were equalized due to the operation of vacuum breakers. Since vacuum breakers have been eliminated from the containment design, your analysis should be revised to (1) return non-condensibles from the containment to the drywell by reverse flow through the vent system and/or (2) establish specific criteria to determine the conditions for opening the combustible gas control system recirculation inlet lines to equalize pressures.

   (b) the initial conditions should also be specific as to the time after the accident for which the long term analysis becomes valid.

(c) In the modeling of long term performance equation (1), page 6.2-21, indicates that the flow out of the reactor vessel, the flow out of the suppression pool, and the ECCS flow are all identical. However, information presented in other sections of the PSAR does not appear to support this position. Pages 6.2-18 and 6.2-33 indicate that for Case B either 2 LPCI and 1 HPCS or 1 LPCI, 1 HPCS, and 1 LPCS pumps will be operating. However, only the LPCI flow is directed to the RHR heat exchangers. Also, pages 6.2-18 and 6.2-32 state that the LPCI flow, after being cooled, can be returned to the suppression pool or injected into the reactor vessel as ECCS water. Clearly, the above considerations would indicate that the system cannot be modeled as a single loop of constant and equal flow rates as shown on Figure 6.2-16. Therefore, your model should be revised to account for the various possible flow paths under Case B, minimum safeguards, and the revised model used to determine the most conservative case for containment design purposes.

(d) Equation (5) on page 6.2-23 should include a heat term for the heat removed in condensing the drywell steam atmosphere and should account for any heat addition due to operation of the recombiners.

(e) Page 6.2-25 states that equations 6, 7, 8, & 9 can be solved for M_{AS}, M_{AD}, and P_s/P_D, yet on page 6.2-24 it was assumed that $P_s=P_D$. Please clarify.

(f) The term H, submergence of the top row of vents, appears in several equations on page 6.2-25. Discuss how values of this parameter are known, as it is not a constant and does not appear to be calculated each time step.

(g) Your long term model also assumes a single volume suppression pool at a uniform temperature throughout the pool. This does not account for the separate volumes of water which would occupy the drywell and the smaller volume left in the suppression pool, nor does it consider the temperature gradients associated with these volumes. Your model should be revised to more accurately describe the phenomena, or you should provide justification for your present model by demonstrating that it is a more conservative approach.

(h) The long-term model should account for operation of the containment sprays.

7. PSAR Section 6.2.1.3.9 provides a table of core decay heat rates used in the containment response analysis. Discuss the bases used to calculate these values and confirm that the bases are at least as conservative as the methods set forth in the October 1971 draft Proposed ANS Standard Decay Energy Release Rates Following Shutdown of Uranium-Fueled Thermal Reactors assuming an equilibirum fuel cycle and increasing the calculated heat inputs as follows:

   (a) For the time interval 0 to 10^3 seconds, add 20 percent to the heat released by the fission products to cover the uncertainty in their nuclear properties.

   (b) For the time interval 10^3 to 10^7 seconds, add 10 percent to the heat released by the fission products to cover the uncertainty in their nuclear properties.

   (c) For the time interval 0 to 10^7 seconds, calculate the heat released by the heavy elements (using the best estimate of the production rate for Grand Gulf 1 & 2) and add 10 percent to cover the uncertainties in their nuclear properties.

8. Page 6.2-3 of the PSAR is not clear as to the design value of drywell negative differential pressure.

   (a) State the design negative differential pressure of the drywell.

   (b) Compare the design value to the peak calculated negative differential pressure of 21 psi as to the available margin and the basis for the margin.

   (c) The PSAR states (pg. 6.2-8) that following reactor vessel reflood, ECCS flow out the break will condense drywell steam and cause a rapid depressurization. Provide the applicable experimental data and/or analytical models, assumptions, and parameter values used to calculate the condensation rate. Discuss the significance of a less rapid or incomplete depressurization of the drywell.

9. PSAR Section 6.2.1.3.7 states that during the long term response of the containment, ECCS water will spill out the pipe break and flood the drywell up to the top of the weir wall. Provide the following additional information concerning this phenomena:

   (a) Since the drywell floor does not have a liner, discuss the potential for water leakage from the drywell and depletion of suppression pool inventory. Specify all sumps, drains, or piping which could provide leakage paths from the drywell floor to the outside of containment.

(b) Discuss the design features which are provided to monitor suppression pool inventory during the post-accident period.

10. The discussion of vent areas on pg. 6.2-4 of the PSAR requires clarification. Clearly demonstrate, with the aid of drawings if necessary, how the net free vent area (552 ft^2) and the net free vent annulus area (528 ft^2) are calculated. Provide drawings which detail the weir wall, vent, and suppression pool geometry and which indicate the safety/relief valve discharge line routing and support.

11. Provide the following additional information concerning the containment spray system:

    (a) Provide complete details of the analyses performed to size the containment sprays.

    (b) For the spectrum of potential energy releases to the drywell discuss the restrictions on use of the containment sprays due to interlocking with other functions of the Residual Heat Removal System.

    (c) PSAR Section 6.2.5.5 states that there is a time delay which ensures that the hydrogen mixing system will not be initiated until the resulting bypass energy is within the capability of the containment spray system. Specify the time delay and demonstrate that this will be an allowable time to start recirculation for the spectrum of potential energy releases to the drywell.

12. Clarification of PSAR Section 6.2.1.3.3, describing intermediate size primary system breaks, is required as follows:

    (a) The value of vent submergency used in the analysis, 9'10", does not appear to agree with information given on PSAR page 6.2-4, which would yield 8'10" as the submergence.

    (b) The PSAR states that pressurization of the containment will be terminated after about 250 seconds and would stabilize at about 7 psig. However, Figure 6.2-12 shows the containment pressure steady at about 3 psig.

13. Specify the range of primary system break sizes which are considered "small breaks" as discussed in PSAR Section 6.2.1.3.4.

14. Clarify the statement on page 6.2-16 of the PSAR which says that for drywell design purposes the combination of primary system pressure and containment pressure which produces the maximum superheat condition is used.

15. Why are sensible heat energy inputs to the suppression pool, as shown on Figure 6.2-17, only evaluated down to 212°F?

16. Provide details of the calculations of the net positive suction head for the three RHR pumps as tabulated in Table 6.3.4. Include your assumptions for suppression pool water level.

17. Figure 6.2-14 shows a peak suppression pool temperature of 182°F while the design basis of the containment heat removal system is to limit peak temperature to 185°F. Discuss the basis for selection of the design temperature of 185°F. Justify the adequacy of a 3°F margin and since containment pressure is a function of suppression pool temperature, relate the significance of pool design conditions to containment design parameters.

18. Discuss the various responsibilities and interactions between the General Electric Company, Bechtel Corporation and Mississippi Power and Light Company for the Grand Gulf containment design. Discuss the extent of participation and independent assessment which will be performed by Bechtel and Mississippi Power and Light for the large scale Mark III testing program.

19. Specify the source of supply air for all pneumatic systems located in the containment or drywell and specify any separate containment control air systems, if provided. Justify that your calculations of containment pressure response to a design basis loss-of-coolant accident are conservative assuming that all Category II air lines located within primary containment fail at the time of the design basis loss-of-coolant accident.

20. Describe the suppression pool liner coating materials to be used for your plant, the qualification testing of the materials that has been performed and the test results, data on the use of the material on other plants, if applicable, and proposed surveillance programs which will monitor the condition of the coatings and liner metal during the lifetime of the plant. Also indicate if inhibitors or chemical additives are used in the suppression pool water.

21. The following items requiring correction have been noted in our review:
    (a) parameters listed on pg. 6.2-21 and on Figure 6.2-16, e.g., m_{do}, qHx, q_d, q_e, do not have consistent definitions or units.

    (b) page 6.2-11 refers to the drywell and containment pressures stabilizing at 12 and 7 psia, respectively. These pressures should be in units of psig. A similar correction is necessary on pages 6.2-14 and 6.2-15.

(c) page 6.2-12 refers to vacuum breakers equalizing pressures. As vacuum breakers are not included in the design, this statement should be corrected.

(d) Table 6.2.3, Case B, Long Term shows one LPCS and no LPCI pumps operative while page 6.2-18 indicates that either 2 LPCI or 1 LPCI and 1 LPCI would be operative.

(e) In Table 6.2.5, item #5, maximum positive differential pressure occurs, and #14, containment reaches peak pressure, are not consistent with Figures 6.2-9 and 6.2-15.

22. Discuss the proposed surveillance systems and administrative procedures by which the leak-tightness of the containment can be continuously monitored.

23. With respect to the reliability of containment isolation valves, describe the basis upon which the valves and valve operators will be selected.

24. For those containment isolation valves including those valves connecting the drywell to the containment and which have seats fabricated from a rubber-like material, specify:

(a) the number and type of valves,

(b) the long term life and service characteristics of the material, and

(c) any service experience with the material in other nuclear plants justifying its use in the containment environment.

25. Provide the following additional information concerning requirements for guard pipes on lines passing through the containment:

(a) For the reactor water cleanup system lines (PSAR page 6.2-9), specify what amount of blowdown fluid is an acceptable value for the containment and describe how the break detection and isolation systems limit possible blowdowns to this value.

(b) Substantiate your statement (PSAR page 6.2-9) that an instrument line rupture would release more fluid to the containment than TIP or CRD line ruptures. TIP line isolation arrangements should be included in Table 6.2.7 and on Figure 6.2-19a.

(c) Discuss your bases for not providing guard pipes on the standby liquid control line (#27, Table 6.2.7) and the reactor water sample line (#4, Table 6.2.7).

(d) Discuss more fully your justification for not providing guard pipes on the LPCI, LPCS, and HPCS lines, as it appears that there are other lines with similar isolation capability (e.g., RHR Shutdown Cooling Return lines) which are equipped with guard pipes.

(e) Specify the design temperature and pressure of the guard pipes.

26. Provide plan and section drawings which detail the arrangement of RHR system suction and return lines to the suppression pool. Demonstrate that this arrangement facilitates mixing of the return water with the total pool inventory before the return water becomes available to the suction lines. Discuss the design provisions which have been taken to preclude blockage or plugging of the RHR system suction lines.

27. Provide the following additional information concerning the hydrogen mixing and control system:

(a) specify the accuracy of the hydrogen concentration analyzers.

(b) discuss the uncertainty involved in determining the hydrogen concentration in (1) the drywell prior to the start of recirculation, and (2) the drywell and containment during the mixing period

(c) specify the hydrogen concentrations at which the recirculation and control systems will be started.

28. Since the hydrogen mixing system will also serve a vacuum relief function for the drywell, provide the following:

(a) Specify all plant conditions which could require operation of the recirculation lines for vacuum relief purposes. Also estimate the frequency of these conditions.

(b) Describe in detail how the mixing system will be used to relieve drywell vacuum. Include the number of valves opened, the differential pressure at which the valves will be opened, the capability of the operator to effectively respond to the conditions outlined in (a), and plant conditions for which the operator will not be allowed to open valves.

(c) Discuss the potential for a recirculation line(s) to be open prior to a loss-of-coolant accident and discuss the consequences of such an event.

(d) Specify the closing time of the mixing system valves.

(e) Figure 6.2-26 shows the relationship of allowable bypass area to primary system break area. Does the break area correspond to liquid or steam breaks?

(f) Assuming that the valves were not opened to relieve drywell vacuum, discuss the amount of suppression pool water which could flow into the drywell, and the consequences of such a loss in pool inventory on containment response to a loss-of-coolant accident.

30. PSAR Section 6.2.5.2.1 states that the relatively high discharge velocity of the recirculating fans and the effects of diffusion and convection will maintain uniform concentrations of hydrogen in the containment following a loss-of-coolant accident. Justify your position as follows:

(a) Describe the types of analyses that were performed to demonstrate adequate mixing throughout the drywell, containment, and all subcompartments.

(b) Discuss the bases used to establish the flow rate of the recirculation fans.

(c) Discuss additional means of ensuring mixing such as periodic actuation of the containment sprays.

(d) Discuss any limitations on the initiation of the mixing system due to pressure differentials between the drywell and the containment.

31. Deleted

32. Flow paths connecting various parts of the drywell may be restricted due to the arrangement of piping, gratings and equipment. Discuss the manner by which this effect was considered in calculating the drywell response to the loss-of-coolant accident.

33. Describe how the following containment design parameters were established:

(a) the distance between the drywell wall and containment wall;

(b) the distance between the weir wall and drywell wall;

(c) the vertical distance between rows of vents and the horizontal distance between columns of vents; and

(d) the submergence of each row of vents.

34. The containment pressure response profile, Figure 6.2-9, indicates that choked vent flow may be experienced for a time period following vent clearing. Specify whether the vent flow at this time is choked or unchoked and discuss in detail the analytical techniques used to determine the condition of the flow. Provide a curve of vent flow versus time corresponding to Figure 6.2-9.

35. Provide curves of suppression pool water level as a function of time (0 to 10^6 seconds) for the design basis loss-of-coolant accident. These curves should illustrate the level of water in the containment, the weir wall annulus, and the drywell, and all relevant assumptions should be clearly stated.

36. Assuming that both recombiners are unavailable and that purging is the only means for post-accident combustible gas control, specify the required times and rates of purging and demonstrate that the combined accident radiological dose due to containment leakage and purging does not exceed 10 CFR 100 guidelines.

37. Describe and discuss the possible plant conditions where the containment and drywell ventilation, purge and cooling systems may be essential, following an accident, in order to prevent or mitigate the consequences of the accident. In addition, the above response should also include a discussion of the range of failures or malfunctions considered during the design as well as the specific design criteria that will be followed in order to be assured that no failure or malfunction to the system will result in offsite exposures comparable to those in 10 CFR 100.

38. Provide the required information shown in the attached table or reference as appropriate:

1. <u>General Information</u>

A. Drywell

1. Internal design differential pressure, psi
2. External design differential pressure, psi
3. Design temperature, °F
4. Free Volume, ft^3

5. Design leak rate %/day @ psig
6. Design ambient temperature range (min./max.), °F
7. Volume of water necessary to flood drywell to top of wier wall, ft^3

B. Containment

1. Internal design pressure, psig
2. External design differential pressure, psi
3. Design temperature, °F
4. Air volume, minimum, ft^3, maximum, ft^3
5. Suppression pool water volume, minimum, ft^3; maximum, ft^3
6. Suppression pool surface area, ft^2
7. Suppression pool depth, ft
8. Design leak rate %/day @ psig
9. Design service water temperature range (min./max.), °F

C. Vent System

1. Number of vent holes
2. Diameter of vent holes, ft
3. Drywell wall - weir wall distance, ft.
4. Net free vent area, ft^2
5. Net free vent annulus area, ft^2
6. Drywell wall thickness, ft
7. Vent submergences, minimum, ft
   maximum, ft
8. Vent system resistance factors

D. Containment Spray System

1. Number of pumps for spray system
2. Capacity per pump, gpm
3. Spray flow rate for drywell, lb/hr
4. Spray flow rate for containment, lb/hr
5. Spray inlet temperature, °F
6. Spray thermal efficiency, %

E. Containment Cooling System

1. Number of pumps
2. Capacity per pump, gpm
3. Number and type of heat exchangers for containment cooling system
4. Heat transfer area per heat exchanger, ft^2

5. Overall heat transfer coefficient, Btu/hr-ft^2-°F
6. Secondary coolant flow rate per heat exchanger, lb/hr
7. Secondary coolant inlet temperature, °F

II. Combustible Gas Control System

A. Design Parameters

1. Mass of zirconium in fuel cladding, lb
2. Mass of aluminum in containment and drywell, lb
3. Aluminum surface area in containment and drywell, ft^2
4. Mass of zinc in containment and drywell, lb
5. Zinc surface area in containment and drywell, ft^2
6. Hydrogen dissolved in reactor coolant, equivalent scf

B. Recombiner System

1. Number and type of recombiners
2. Design flow rate per unit, cfm
3. Hydrogen removal efficiency, %
4. Hydrogen concentration when recombiners start, % volume
5. Time when recombiners start, days
6. Location (inside or outside containment)

C. Purge System

1. Hydrogen (or oxygen) concentration when purge is initiated, volume %
2. Time when purge is initiated, days
3. Purge rate, scfm

D. Recirculation System

1. Time when recirculation starts, hours
2. Number of recirculation fans
3. Capacity per fan, cfm
4. Pressure differential at which inlet lines open for vacuum relief, psi

III. Assumptions for Accident Analyses

A. Reactor Coolant System

1. Reactor power level, MWt
2. Average coolant pressure, psig
3. Average coolant temperature, °F
4. Mass of reactor coolant (liquid), lb

5. Mass of reactor coolant (steam), lb
6. Volume of water in reactor vessel, ft^3
7. Volume of steam in reactor vessel, ft^3
8. Volume of water in recirculation loops, ft^3

B. Initial Energy (in Btu)

1. Reactor coolant
2. Fuel and cladding
3. Core internals
4. Reactor vessel metal
5. Reactor coolant piping, pumps & valves
6. Drywell structures
7. Drywell air
8. Drywell steam
9. Containment air
10. Containment steam
11. Containment water

C. Drywell

1. Pressure, psig
2. Temperature, °F
3. Relative humidity, %

D. Containment

1. Pressure, psig
2. Air temperature, °F
3. Water temperature, °F
4. Relative humidity, %
5. Air volume, ft^3
6. Water volume, ft^3
7. Vent submergences, ft

E. Recirculation Loop Break

1. Recirculation pipe ID, inches
2. Effective total break area, ft^2
3. Blowdown data, time (sec), flow (lb/sec), enthalpy (Btu/lb)
4. Name of blowdown code

F. Main Steam Line Break

1. Main steam pipe ID, inches
2. Effective total break area, ft^2
3. Blowdown data, time (sec), flow (lb/sec), enthalpy (Btu/lb)
4. Name of blowdown code

G. Energy Sources

Tabulate the following parameters:

1. decay heat rate (Btu/sec) as a function of time
2. primary system sensible heat rate (Btu/sec) to the containment as a function of time
3. metal water reaction heat rate (Btu/sec) as a function of time
4. heat rate from other sources (Btu/sec) as a function of time

H. Subcompartment Pressure

1. Name of subcompartment
2. ID of ruptured pipe, inch
3. Effective total break area, ft^2
4. Volume of subcompartment, ft^3
5. Vent area of subcompartment, ft^2
6. Vent area flow coefficient
7. Vent area resistance factor
8. Blowdown data, time (sec), flow (lb/sec), enthalphy (Btu/lb)
9. Name of blowdown code

I. Structural Heat Sinks

1. Number of heat sinks
2. Heat sink data,
   heat sink
   material
   area (ft^2)
   thickness (ft)
   thermal conductivity (Btu/hr-ft-°F)
   specific heat (Btu/°F-lb)
   density (lb/ft^3)

IV. Results of Accident Analysis

A. Plot as a function of time (0 to 10^6 seconds) the results of the analysis for each accident case:

1. drywell pressure, psig
2. drywell temperature, °F
3. drywell differential pressure, psi
4. containment pressure, psig
5. containment air temperature, °F
6. suppression pool temperature, °F
7. vent flow, lb/sec
8. specific volume of vent flow, ft^3/lb

B. Tabulate the following parameters for each accident case:

1. maximum drywell internal differential pressure, psi
2. time of maximum drywell internal differential pressure, sec
3. maximum drywell atmosphere temperature, °F
4. maximum containment pressure, psig
5. time of maximum containment pressure, sec
6. maximum containment atmosphere temperature, °F
7. maximum suppression pool temperature, °F
8. maximum drywell external differential pressure, psi
9. time of maximum drywell external differential pressure, psi
10. duration of blowdown, sec
11. energy balance of sources and sinks at time of maximum drywell internal differential pressure, end of blowdown, at time of maximum containment pressure, and at end of post-accident period (in Btu).
    a. Reactor coolant
    b. Fuel and cladding
    c. Core internals
    d. Reactor vessel metal
    e. Reactor coolant piping, pumps, and valves
    f. Blowdown enthalphy
    g. Decay heat
    h. Metal-water reaction heat
    i. Drywell structures
    j. Drywell air
    k. Drywell steam
    l. Containment air
    m. Containment steam
    n. Suppression pool water
    o. Heat transferred by heat exchangers
12. name of containment code

C. Subcompartment pressures

1. Maximum subcompartment pressure, psig
2. Maximum pressure differential across subcompartment wall psi
3. Time of maximum pressure differential across subcompartment wall, sec
4. Maximum jet force on subcompartment wall, lb
5. Name of subcompartment code

#39 Provide a detailed evaluation of through-line leakage or direct leakage which could bypass the boundary region of the Standby Gas Treatment System (SGTS). Include:

a. The fraction of the total containment leakage which is assumed to enter the boundary region of the SGTS.

b. The fraction of the through-line leakage assumed to terminate within the boundary region of the SGTS.

c. The fraction of through-line leakage assumed to terminate in the auxiliary building.

d. The fraction of through-line leakage assumed to be discharged directly to the atmosphere.

e. Identify the specific leakage paths from the containment for the above.

Discuss the tests and frequency of tests proposed to detect and limit the above leakages.