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SUBJECT: Forwards results of evaluation of capability of SGTS to operate due to postulated dual fuel pool boil event assumed to be caused by seismic event,per NRC 940307 request.

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MAY 04 1994

Director of Nuclear Reactor Regulation
Attention: Mr. C. L. Miller, Project Director
Project Directorate I-2
Division of Reactor Projects
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
ADDITIONAL INFORMATION IN RESPONSE TO
3/7/94 NRC REQUEST REGARDING EVALUATION
OF SGTS UNDER SEISMIC CONDITIONS **Docket Nos. 50-387**
PLA-4133 FILE R41-2 **and 50-388**

Reference: NRC Letter, J.W. Shea to R. G. Byram, "Request for Additional Information (RAI) Concerning Standby Gas" Treatment System Performance, Susquehanna Steam Electric Station, Units 1 and 2 (TAC No. 85337), dated March 7, 1994.

Dear Mr. Miller:

Via the referenced letter, the NRC requested that PP&L provide an evaluation of the capability of the Standby Gas Treatment System (SGTS) to operate due to a postulated dual fuel pool boil event assumed to be caused by a seismic event. The purpose of this letter is to transmit the results of our evaluation, which are provided in the Enclosure to this letter. Any questions regarding this submittal should be directed to Mr. J.M. Kenny at (610) 774-7904.

Very truly yours,

R.G. Byram

Attachment

090037

A001

cc: NRC Document Control Desk (original)
NRC Region I
Mr. G. S. Barber, NRC Sr. Resident Inspector
Mr. C. Poslusny, NRC Project Manager

Enclosure to PLA-4133

EVALUATION OF SGTS RESPONSE TO A SEISMIC EVENT

Pennsylvania Power & Light Company

May 2, 1994

1.0 OBJECTIVE

The purpose of this report is to document a summary of the evaluations performed of the SSES plant response to a postulated dual fuel pool boil event assumed to be caused by a seismic event. A LOOP is also assumed to occur coincident with the seismic event.

Specifically evaluated are the offsite dose consequences, impact on the operability of SGTS, impact on reactor building and control structure equipment.

Several analyses are required to describe all of the consequences. These require expertise in the radiological, structural, systems and HVAC analyses areas. Separate analyses have been performed in each of these areas. The referenced documents contain the details of each of these analyses. These analyses are summarized herein. Should more specific details than those provided herein be required, these documents should be reviewed.

It should be noted that this evaluation was not performed to evaluate the plant response to the scenario postulated in FSAR Appendix 9A. FSAR Appendix 9A assesses, in a conservative manner, the offsite dose consequences of a dual fuel pool event. Inputs and assumptions utilized in the Appendix 9A analysis were chosen to maximize impact on offsite dose. The inputs/assumptions and sequence of events were chosen solely to conservatively exhibit that the offsite dose consequences of a dual fuel pool boiling event are well within radiological limits. Reference 9 contains additional discussion of the applicable SSES limits and Licensing requirements.

It is not appropriate to utilize the same set of inputs/assumptions and event sequence to perform a plant response evaluation of the impacts of a postulated dual fuel pool boiling event caused by a seismic event. Use of the same set of inputs/assumptions and sequence for an assessment of plant response would result in unrealistic results. Therefore, the evaluations comprising the basis for the plant response evaluations summarized herein were not based on the set utilized for the Appendix 9A analysis. The inputs/assumptions and the event sequence which are utilized for this evaluation are detailed herein. The bases and conservatisms are identified.

2.0 CONCLUSIONS & RECOMMENDATIONS

Section 5.0 of this report contains the details supporting the conclusions identified herein.

2.1 RADIOLOGICAL

The offsite doses resulting from this event would be well within the Accident Dose limits of both 10CFR100 and SRP 9.4.2 **without taking credit for SGTS** operation during the event. Operation of SGTS for various times was also evaluated to assess the impact. It is concluded that it has little impact.

2.2 REACTOR BUILDING HVAC

Reactor building temperatures have been determined. The conditions have been used as input to assess the affect on reactor building equipment and SGTS.

The following is concluded:

2.2.1 The recirculation plenum water accumulation rate will cause the plenum accumulation to begin spilling over into plenum connected ducting, including the SGTS duct, before the SGTS duct condensation reaches its analyzed limit. The spillover occurs 51 hours after event occurrence. This is considered to be the analyzed limit. Spillover is unanalyzed and considered to be undesirable.

2.2.2 The reactor building conditions created by the assumed event as analyzed only cause equipment located on the refueling floor area to exceed the previously evaluated environmental conditions. The limiting equipment has been evaluated and determined to be capable of performing its design function for up to 30 days.

2.3 SGTS

The water accumulation rate for the limiting SGTS duct section is determined to reach the analyzed limit 36 hours after start of pool boiling, and 71 hours (approximately 3 days) after event occurrence.

2.4 SGTS ROOM HVAC

The SGTS room temperatures have been determined. The conditions have been used as input to assess the affect on the equipment in the room. It is concluded that the resulting temperature of the SGTS room would be within the maximum normal operating temperature of the SGTS room at the time in which the recirculation plenum reaches the analyzed limit.

3.0 ASSUMPTIONS/INPUTS

3.1 GENERAL

The following assumptions\input data are applicable to all aspects of the analysis.

3.1.1 It is assumed for this analysis that loss of spent fuel pool cooling to both units occurs as the result of a seismic event. Additionally, a Loss-Of-Offsite-Power (LOOP) is assumed to occur coincident with the seismic event.

3.1.2 RHR fuel pool cooling mode is assumed to be unavailable. This assumption is necessary to assure dual fuel pool boiling occurs. With RHR fuel pool cooling mode available, the fuel pools are not expected to boil.

3.1.3 This analysis is based on sequential unit refueling outages which are much shorter than past and current schedule practice. This shortens the time to boil and increases the boiloff rate. Unit 1 is assumed to be in an outage, since this maximizes the condensation rate in the SGTS duct due to lower assumed temperatures in the unit during an outage. This is due to the duct being routed through the Unit 1 reactor building (Zone I). The period of time in which the plant is in this configuration is small. It would more likely be in a configuration where both units are operating. With both units operating, the event would progress at a slower rate than determined herein. Also, future operation is planned to be with the pools crosstied and not isolated as is evaluated herein. The time sequence of events for the scenario analyzed is as follows:

<u>TIME</u>	<u>EVENT</u>
T = 0	Unit 2 Shutdown for Refueling & Inspection Outage (RIO), 1/3 core offload fills Unit 2 pool.
T = 100 days	Unit 1 Shutdown for RIO, Unit 2 at 100% Power Unit 1 & 2 spent fuel pools isolated with FPC&CU systems operating with 550 GPM demineralized flow for each pool. Normal demineralizer flow is 600 GPM per reference 2, thus the assumption of 550 GPM is conservative. The water volume for Unit 1 fuel activity leakage is the reactor coolant system volume. (10,100 ft^3) Unit 1 RWCU is operating with 135 GPM flow through each demineralizer for a total 270 GPM demineralizer flow. This is a typical flow value.
T = 102 days	Unit 1 Reactor Pressure Vessel (RPV) Head Removed. (This is a typical time duration for head removal.) The refueling water volume for Unit 1 fuel activity leakage is the reactor pressure vessel, moisture separator pit and the reactor cavity. (85,326 ft^3)
T = 105 days	Open Unit 1 Fuel Pool Gates (Typical) The refueling water volume for Unit 1 fuel activity leakage is the reactor pressure vessel, moisture separator pit, the reactor cavity and Unit 1 spent fuel pool. (134,016 ft^3)

Unit 1 & 2 FPC&CU systems still operating with 550 GPM demineralized flow for each pool.

T = 106 days Remove Cask Pit Gates, Begin Unit 1 Core Offload (Typical)

The refueling water volume for Unit 1 fuel activity leakage is the reactor pressure vessel, moisture separator pit, the reactor cavity, cask pit and Unit 1 and 2 spent fuel pools. (192,504 ft^3)

One FPC&CU system operating with one demineralizer and 550 GPM flow for refueling water volume as noted above.

T = 111 days Isolate Unit 1 (Zone I) from the recirc plenum. Zones II & III are aligned to the recirc plenum.

T = 115 days Complete Unit 1 Core Offload (Typical)
RWCU system shutdown.

T = 127 days Core Reload Begins (Currently this occurs later. Starting core reload earlier in the outage sequence results in higher decay heat loads when the pools are isolated later in the sequence. This results in higher boiloff rates and offsite doses, as compared to those which would occur had the sequence been based on a current outage schedule. This adds conservatism to this analysis.)

T = 133 days Unit 1 RWCU placed into operation with 270 GPM demineralized flow.

T = 135 days Unit 1 Core Reload Complete; Cask Pit and Fuel Pool Gates Installed and SFP's are Isolated. (Typical)

The refueling water volume for fuel activity leakage is the Unit 1 spent fuel pool. (48,690. ft^3)

SEISMIC EVENT OCCURS WHICH CAUSES THE LOSS OF BOTH UNITS FPC&CU SYSTEMS. A LOOP IS ALSO ASSUMED TO OCCUR. NORMAL HVAC SYSTEMS ARE NOT FUNCTIONAL. THE REACTOR BUILDING RECIRCULATION SYSTEM AND SGTS AUTOMATICALLY STARTS AS RESULT OF THE LOOP MIXING ZONES II AND III ONLY. (ZONE I IS ISOLATED FROM THE RECIRCULATION PLENUM DUE TO THE OUTAGE.)

At T = 135 days + 35 hours

Unit 1 Pool Begins To Boil (Utilizes conservative Time to Boil Methods, thus adds conservatism to this assumed sequence). Recirculation system fans are turned off prior to start of boiling.

At T = 135 days + 52 hours

Unit 2 Pool Begins To Boil (Utilizes conservative Time to Boil Methods thus adding conservatism to this assumed sequence).

Notes:

(1) There is effectively no difference relative to SFP cooling capabilities between a unit at power with an isolated SFP and one in an outage with an isolated SFP and a full core in the RPV. It will be necessary to provide cooling to two separate locations in each unit. Thus, with the above assumed scenario, Unit 1 is in an outage and Unit 2 is operating at 100 % power.

(2) The above sequence provides for a conservative analysis with regard to SFP heat load, time-to-boil, and boil-off rate to maximize the impact of the event.

(3) Attachment 1 contains the time to boil and evaporation rate calculation.

3.1.4 It is assumed that makeup water is available for the spent fuel pool after boiling begins and the volume of water in the boiling pool remains constant. ESW is a seismically designed system which will be accessible in this scenario. The reactor building source term will be no more than that occurring during normal plant operation because of the essentially nonexistent source term created by this event. Cooling effects of the ESW flow are accounted for in the HVAC analyses and not in the radiological analysis.

3.1.5 All heat in the fuel is assumed to be transferred to the water; none is lost to the environment. This is conservative because this elevates the boiloff rate.

3.1.6 Outside daily average design temperature air has been assumed when assessing the "cooling" impact of reactor building inleakage on refueling floor temperatures. No credit for inleakage cooling is taken for Zone II. These conditions are 73°F and 98% RH and are appropriate for long term transient analyses which is consistent with other SSES design base analyses. Zone II inleakage is assumed to be 800 cfm and Zone III 1845 cfm, of which only 1000 cfm is credited for cooling the refueling floor. Assumption of daily average conditions is appropriate since this is a transient 30 day analysis in which the temperature would cycle between night and day conditions.

3.1.7 The outside air supply to the SGTS train is assumed to be at the design basis peak condition for the plant of 92°F db and 78°F wb due to the short term nature of the SGTS train operability analysis. Note that this is not used in a transient analysis in contrast to the use of assumption 3.1.6 and thus use of peak temperature conditions is appropriate.

3.2 RADIOLOGICAL

The following assumptions\input data applicable to the radiological analysis were used. These assumptions are deemed to be conservative, bounding, and consistent with design basis accident assumptions identified in Regulatory Guides (e.g., Regulatory Guide 1.3, 1.25 etc.).

3.2.1 Based upon the assumed sequence of events identified above, the iodine activity contribution to the refueling water volume from the Unit 2 fuel and fuel pool water will be negligible compared to the activity from Unit 1. Since the Unit 2 shutdown occurs 100 days before the Unit 1 shutdown, and since the longest-lived iodine isotope is I-131 with a half-life of 8.05 days, the iodine activity source terms from the Unit 2 outage will be negligible due to radioactive decay. Thus, only the most recent unit refueling activity source terms (defined as Unit 1) are considered for the dose analysis.

3.2.2 Activity leakage from the spent fuel after shutdown is based on the full power design fuel leakage rate decayed for the time after shutdown. The following leakage rates are used and are based on a design offgas release rate of 100,000 µCi/sec of noble gases after 30 minutes decay:

Isotope	**Fuel Design Leakage Rate At Shutdown (µCi/sec)**
I-131	700
I-132	9400
I-133	4900
I-134	28,000
I-135	7900

Since the temperature of the fuel during spent fuel pool boiling is expected to be well below reactor operating temperature, the use of the above "at power" leakage rates " is considered to be extremely conservative. It is assumed that all of the defective fuel rods in the core are transferred to the spent fuel pool.

3.2.3 The activity released from the fuel is assumed to be uniformly mixed in the refueling water volume. The refueling water volume for fuel activity leakage will change throughout the outage depending on whether the fuel pool and cask pit gates are installed or not. The refueling water volumes used are indicated in the assumed event sequence described above. When the caskpit gates are opened, activity leakage from Unit 1 spent fuel pool is mixed with the Unit 2 spent fuel pool water. As a result, both fuel pools will contribute to offsite dose once boiling begins.

3.2.4 Credit is taken for activity reduction in the refueling water due to operation of the Reactor Water Cleanup and Fuel Pool Cooling and Cleanup systems. A decontamination factor of 10 for the RWCU and SFPC&CU demineralizers is assumed for iodines.

3.2.5 An iodine spiking factor of 100 for spent fuel leakage is assumed to result from boiling of the spent fuel pool. It is conservatively assumed that the activity concentration in the refueling water at the time fuel pool boiling begins instantaneously increases by a factor of 100.

3.2.6 The activity release rate from the pool depends on the evaporation rate and the iodine carryover fraction at the pool surface. The evaporation rate during heatup of the spent fuel pool water (after loss of cooling but prior to boiling) is bounded by the evaporation rate at initiation of boiling. It is conservatively assumed that the evaporation rate during heat up is the same as that during boiling. The evaporation rate at the start of boiling is conservatively assumed for all subsequent time periods during which boiling occurs. No credit is taken for a reduction in the evaporation rate after boiling begins due to decreases in the spent fuel decay heat rate.

3.2.7 The iodine carryover from pool surface to steam is assumed to be 2%; this is the design basis iodine carryover assumed for reactor coolant to steam at full power operation.

3.2.8 The activity released from the spent fuel pool water is assumed to be released immediately to the environment. No credit is taken in the refueling area for iodine plateout on walls and equipment or for washout by condensing water vapor. No credit is taken for radioactive decay of airborne activity due to holdup in the refueling area. An iodine filter efficiency of 99% is assumed for the SGTS filter for the time it is in operation.

3.2.9 The start of this event is assumed to be when fuel pool cooling is lost (sequence day 135). The dose is determined for as long as thirty days after the event occurs (sequence day 165). Atmospheric dispersion factors and breathing rates used in the accident method analysis are the same as used in FSAR Chapter 15 and are as follows:

Post-Accident Time Period (hrs)	Breathing Rate (m^3/sec)	Atmospheric Dispersion Factor (sec/m^3)
0 - 8	3.47-04	2.18-05
8 - 24	1.75-04	2.82-06
24 - 96	2.32-04	1.43-06
96 - 720	2.32-04	1.08-06

3.3 HVAC

3.3.1 The reactor recirculation fans are turned off sometime prior to boiling. SGTS is restarted.

3.3.2 Condensation occurs on the refueling floor, walls, and roof only. This is a conservative assumption since equipment in Zone III would provide surface area on which condensation would also occur.

3.3.3 Zone I air temperature (air outside of the SGTS duct) is assumed to be 80°F and remains constant for the duration for the duct condensation calculation. The air is stagnant due to the LOOP which causes the loss of the HVAC system. This is considered to be a conservative value as summer conditions have been assumed while SSES scheduled outages occur in the spring and fall. The temperature would more likely be on the order of 90-100°F since Zone I cooling has been lost and since the duct are located high in the building where the temperature would be the highest.

3.3.4 Condensation which wets the walls of the duct will not impact the condensation rate. This is a conservative assumption since the water film would add a film coefficient term resisting heat loss.

3.3.5 To be conservative, the second pool is assumed to begin boiling 5 hours after the first rather than 17 hours as described in the sequence.

4.0 METHOD

4.1 RADIOLOGICAL

Accident Dose

The SFPBOIL computer code was used to evaluate offsite doses for this event and is the same methodology that is used to evaluate the fuel pool boiling scenario currently in Appendix 9A of the FSAR. The SFPBOIL computer code is a single node activity balance code which evaluates activity releases and the resulting offsite doses for a boiling spent fuel pool. The code is capable of evaluating activity production due to spent fuel leakage and activity losses due to radioactive decay, cleanup and water boil-off. The input data for the SFPBOIL program is based on the data provided in the timing sequence of events given in Section 3.1.3 of this report. A separate analysis is performed for the Unit 1 and Unit 2 spent fuel pools since each pool will have different activity levels after fuel pool cooling is lost. Cases were evaluated with and without the RWCU system operating in determining the activity source terms in the spent fuel pool water at the time boiling begins.

This analysis did not address in-plant doses and the accessibility of equipment located in the reactor building. Such an evaluation is not necessary since the in-plant doses from this scenario would not prevent personnel access to the reactor buildings.

The results of this analysis were compared to the dose limits of 10CFR100 and SRP 9.4.2.

4.2 HVAC

Calculation of the reactor building, control structure and refueling floor conditions during a dual fuel pool boiling event was accomplished by use of the Compartment Transient Temperature Analysis Program (COTTAP) code. The average refuel floor temperature is calculated as described in reference 10. Condensation modeling was calculated utilizing the Uchida correlation.

Reactor building (reference 25) and control structure (reference 26) temperature conditions were evaluated for impact on the equipment therein.

Cooling affects of inleakage on the refueling floor was accounted for in a conservative manner. In the recirculation plenum, Zone II and Zone III airstreams are mixed and the resulting airstream properties are those assumed to enter the SGTS suction duct. Total flow into the SGTS duct is the sum of the Zone II and III inleakage and the volumetric flow occurring off of the boiling pools minus the rainout and condensation rate occurring on the refueling floor.

A significant amount of moisture will accumulate in the recirculation plenum. The amount of moisture that accumulates in the plenum was determined. The rainout occurs due to the mixing of the warm moist refueling floor airstream and the relatively cool Zone II airstream. Any condensation which may occur on the plenum walls would be relatively insignificant as compared to the rainout.

Moisture accumulation in the SGTS ductwork is also of concern. The source of moisture is condensation and to some extent mist.

Moisture accumulation in the reactor building sump as a result of the collection of the condensation occurring on the refueling floor was also assessed.

4.3 SGTS EVALUATION

To assess the impact on SGTS, duct drawings were reviewed to determine the duct location(s) in which duct condensation will collect. These were confirmed by a plant walkdown. Volumes of the low point duct sections were determined. The rate of condensation collection was calculated (as described above) and correlated to a duct low section volumetric fill rate. Duct water level as a function of time was then determined. Duct structural capability was reviewed and compared to the condensation weight. An assessment of impact of condensation on duct pressure drop was also made. With the above developed information, an assessment of impact on SGTS was made. The filter train conditions were evaluated and assessed for impact on SGTS operation.

4.4 ENVIRONMENTAL EVALUATION

Environmental Qualification Assessment Reports (EQARs) are used to identify the 100-day post-accident room temperature limits for Class 1E equipment. If a room temperature during fuel pool boiling during a seismic event scenario does not exceed the maximum room temperature used in the EQAR, the equipment in that room is assumed to be operable for at least 100 days.

Previous analyses have shown that all Class 1E equipment is operable for at least 30 days following a fuel pool boiling with a LOCA/LOOP. If a room temperature for fuel pool boiling during a seismic event scenario does not exceed the room temperature used in these previous analyses, the equipment in that room is considered to be operable for at least 30 days.

5.0 RESULTS

5.1 RADIOLOGICAL

This evaluation is contained in reference 19. Activity concentrations in the spent fuel pool water at the time loss of fuel pool cooling occurs are as follows:

Isotope	Activity Concentration In Spent Fuel Pool Water At The Time Of Loss Of Fuel Pool Cooling (Ci/m^3)	
	RWCU Operating	RWCU Not Operating
I-131	8.26-04	1.10-03
I-132	0.	0.
I-133	8.31-14	1.12-13
I-134	0.	0.
I-135	0.	0.

It can be seen from the above results that operation of the RWCU system results in a small decrease in the activity levels in the spent fuel pool when loss of fuel pool cooling occurs.

Offsite doses were evaluated for activity releases from each pool and for various SGTS operating times ranging from no operation to operation for 7 days after fuel pool boiling begins. Results of these calculations are summarized in the following table.

	30 Day Thyroid Inhalation Dose At Low Population Zone (Rem)		
SGTS OPERATING TIME (FROM EVENT OCCURRENCE)	DOSE DUE TO RELEASES FROM UNIT 2 POOL	DOSE DUE TO RELEASES FROM UNIT 1 POOL	TOTAL DOSE
0	8.64-E06	2.96-E03	2.97-E03
35 Hours (Start of Unit 1 Fuel Pool Boiling)	3.7-E06	2.95-E03	2.95-E03
51.7 Hours (Recirc. Plenum Limit Reached)	3.71-E06	2.73-E03	2.73-E03
30 Days	8.64-E08	2.96-E05	2.97-E05

Note that these results exhibit that the non-outage pool (second pool to boil) effectively provides no contribution to offsite dose.

5.1.1 Post-Accident Doses

Regulatory dose limits for this event are as follows:

10 CFR 100 (Design Basis Accidents)

Site Boundary(2 hours): 25 Rem whole Body
300 Rem Thyroid Inhalation

Low Population Zone(30 day): 25 Rem Whole Body
300 Rem Thyroid Inhalation

NUREG-0800, SRP 9.4.2 (Fuel Pool Area Ventilation Systems)

All portions of the systems whose failure may result in the release of radioactivity which causes an offsite dose of more than 0.5 Rem to the whole body or its equivalent to any part of the body shall be classified seismic Category I and safety related.

As can be seen from the above table, the doses are well within the regulatory limits.

5.2 REACTOR BUILDING HVAC

5.2.1 The HVAC analysis assumes the following initial zone temperatures:

Zone I = 80°F
Zone II = 100-104°F
Zone III = 100°F

The Zone II and III temperatures are based on normal operating maximum temperatures. These initial conditions are assumed to exist from initial isolation and alignment of Zones II and III to the recirculation plenum with the recirculation fans on until shutdown of the recirculation fans sometime prior to boiling. Once boiling of the first pool begins, the conditions calculated are as tabulated below. Zone I conservatively will remain at 80 F since it is isolated from the other two zones.

<u>RECIRCULATION INLET TEMPERATURE & CORRESPONDING PLENUM CONDITIONS (°F)</u>

TIME AFTER BOILING BEGINS (HOURS)	ZONE III	ZONE II	RECIRC PLENUM
4	127	110	123
10	157	110	147
20	177	110	164
30	187	110	173
36	190	110	175
260	198	120	186

The above results are determined in references 11, 20 and 21. Note that the conditions corresponding to 4, 30 and 36 hours were utilized as input to the SGTS duct and train evaluations.

5.2.2 Water accumulation in the recirculation plenum was determined. The water accumulated is primarily due to rainout. Rainout is the difference in mass of water at supersaturated conditions and saturated conditions. The SGTS duct and Zone I and II supply duct come up through the bottom of the recirculation plenum. A 4 inch lip exists which will keep the accumulated water in the plenum until the plenum water level reaches 4 inches. Using the 4 inch level, it is determined in reference 21 that it will take 16.7 hours after the first pool begins to boil for 4 inches to accumulate in the plenum, thus 35 +16.7 = 51.7 hours after event occurrence.

5.2.3 Based on reference 22, the temperatures used in reference 15 for a LOCA/LOOP envelop the temperatures for the seismic event, with the exception of the refueling floor (Room I-810). The maximum temperature on the refueling floor is 197.63°F for a seismic event, compared to 171°F for a LOCA/LOOP. The higher temperature reduces the post-accident qualification for pressure differential transmitters PDT07554A1, A3, B1, B3 from 100 days to 30 days, per reference 16. The qualified life for the PDTs is 40 years at 100°F for both post-accident temperatures.

The Functional Evaluation of the PDTs was discussed in reference 15. No other equipment was affected by higher temperatures from boiling fuel pools caused by a seismic event.

5.2.4 Reference 11 determines the condensation rates occurring on the refueling floor. The condensation rate varies with time during the event due to the heat up of the floor airspace and subsequent increase in temperature of the condensation surface. The maximum condensation rate occurs when the refueling floor airspace temperature is 157°F. The maximum condensation rate is 8600 lbm/hr.

Reference 17 evaluates condensate drainage during fuel pool boiling scenarios. For a given refueling floor condensation rate, condensation collection rate in the reactor building sumps and subsequent overflow to adjoining areas is assessed. It determines the height of water and thus time for a given collection rate in which the water tight doors preventing spillover to adjacent rooms would be reached. Thus, to assess the impact of this event with the above refueling floor condensation rate, reference 17 methods will be used.

@ 157°F; $v = .01638\ ft^3/lbm$ per reference 18
8600 lbm/hr (.01638 ft^3/lbm) (1hr/60min)(7.48 gal/ ft^3) = 17.56 gpm

This is equivalent to the "boiling rate" in reference 11, thus entering the chart in the reference identifies that it will take 45 days in Unit 1 and 38 days in Unit 2 to reach the water tight door limit. Note that reference 11 assumed all of the boiloff from the pool(s) was available to condense whereas this evaluation is based only on the portion of the boiloff which condenses on the refueling floor.

Based on the above, it is deemed that condensation collection in the reactor building sump area will be contained such that it will have no impact on the plant.

5.3 SGTS

The event creates both high temperature and high moisture conditions in the SGTS suction duct, thus both these conditions are addressed.

The ducting contains six fire dampers. These fire dampers are rated for 285°F. Since the duct temperatures do not approach this value as exhibited in section 5.2.1 above, the dampers will not adversely affect SGTS operation.

The SGTS duct run from the recirculation plenum to the control structure is located in Zone I (Unit 1 reactor building) and Zone III (refueling floor). Three low sections exist in the ducting where duct condensation will collect. All three low sections are located in Zone I. Of these three, one is limiting in that it will fill with condensation faster than the other two. This limiting duct low section was evaluated. The evaluation is contained in reference 5.

Reference 5 determines that the limiting section would not adversely affect SGTS for minimally 36 hours after the first pool begins to boil, thus minimally 71 hours after the occurrence of the event.

The event creates both high temperature and high moisture content conditions at the train inlet. Thus these both are addressed.

Concerning the high moisture content, condensation collection in the SGTS train will accumulate until the loop seal is overcome at which time the condensation will begin to drain to the liquid radwaste system. The height of water in the train at the point when the loop seal is overcome will not adversely affect the SGTS train operation as documented in reference 6.

The SGTS train contains filters, heaters and a charcoal bed. The charcoal bed and heater section contain temperature sensors. The heater section temperature control circuit maintains a constant differential temperature across the heaters of 20°F. This assures acceptable air stream humidity entering the charcoal bed, thus assuring effectiveness of the charcoal bed. The heater also contains a thermal cutout set for 250°F (reference 7). An evaluation of this setpoint is contained in reference 8. The charcoal bed temperature circuit contains a high temperature inlet alarm set at 220°F. A high temperature set is also provided which is set for 410°F which will trip the SGTS fan in case of a charcoal bed fire. The airstream temperature approaches 127°F as determined in reference 5, thus the setpoints will not be approached. Note that only the high high temperature set at 410°F will shutdown the SGTS fan.

It is thus concluded that the airstream conditions entering the SGTS train during this event will not adversely affect the operation of the train as temperature limits and charcoal bed relative humidity limits will not be exceeded.

5.6 SGTS ROOM HVAC

The COTTAP room temperatures for the fuel pool boiling during a seismic event scenario was determined. At the time in which the recirculation plenum would reach the analyzed limit of 51 hours after event occurrence, the SGTS room temperature is determined in reference 21 to be less than 104°F. This temperature is less than the 104°F maximum normal temperature for the room. Thus, the equipment would function as designed for as long as required to support SGTS operation.

6.0 SUMMARY

Evaluations of the SSES plant response to a postulated dual fuel pool boil event assumed to be caused by a seismic event have been performed. A LOOP is assumed coincident with the seismic event. The offsite dose consequences, impact on the operability of SGTS, impact on reactor building equipment and impact on the control structure equipment have been assessed.

The calculated offsite doses resulting from this are well within the Accident Dose limits of both 10CFR100 and SRP 9.4.2 **without taking credit for SGTS** operation during the event. Various SGTS operating durations are evaluated.

The recirculation plenum water accumulation rate will cause the plenum accumulation to begin spilling over into plenum connected ducting, including the SGTS duct, before the SGTS duct condensation reaches its analyzed limit. The spillover occurs 51 hours after event occurrence and represents the analyzed limit.

The water accumulation rate for the limiting SGTS duct section is determined to reach the analyzed limit 36 hours after start of pool boiling, and 71 hours (approximately 3 days) after event occurrence.

The reactor building conditions created by the assumed event only cause equipment located on the refueling floor area to exceed the previously evaluated conditions. The affected equipment has been evaluated and determined to be capable of performing as designed during this event.

The SGTS room temperatures are determined to be within the maximum normal operating temperature of the SGTS room at the time in which the recirculation plenum reaches the analyzed limit.

REFERENCES:

1. M-FPC-010 R0 & M-FPC-014 R1 (Pool Volumes)
2. OP-135-001 R 16 (Fuel Pool Cooling)
3. NFE-B-NA-055 R1 (Heat Loads)
4. M-FPC-013 R0 (Fuel Pool Cooling Heat Exchanger Capacity)
5. EC-070-1003 R1
6. NCR 89-0427
7. SEIS
8. EWR 83-0076
9. PLA-4128
10. PLA-4112
11. EC-035-1001 R1
12. not used
13. not used
14. OT-93-DAM-004 R0
15. EC-EQQL-0525 R1
16. EC-EQQL-1003 R1
17. EC-035-0510 R1
18. ASHRAE FUNDAMENTALS ,1989
19. EC-RADN-1007 R1
20. EC-070-1002 R1
21. EC-034-1003 R1
22. M-FPC-015 R1
23. EC-EQQL-1007 R0
24. not used
25. EC-035-0513 R1
25. EC-070-1004 R0
26. EC-034-1004 R0

ATTACHMENT 1

RADIOLOGICAL TIME TO BOIL AND BOILOFF RATE CALCULATION:

1.0 Fuel Pool Heat Loads

Reference 3; (Note that this calculation of decay heat is based on a full fuel pool with all bundles operated under power uprate conditions for 18 months continuously.)

Unit 1; 35 days after cold shutdown assuming Nominal decay heat = 8.56 MBTU/HR

Unit 2; 135 days after cold shutdown assuming Nominal decay heat = 5.82 MBTU/HR

2.0 Time To Boil

Reference 1

Unit 1; T = 3011131*(210 - 110)/8.56E6 = 35 hours

Unit 2; T = 3011131*(210 - 110)/5.82E6 = 52 hours

3.0 Boiloff Rate

Unit 1; M = 8.56E6/971.6 = 8810 lbm/hr

Unit 2; M = 5.82E6/971.6 = 5990 lbm/hr

Notes:

(1) Values and methods are from the references as noted.

(2) Initial pool temperature of 110°F is assumed. This is appropriate since the fuel pool cooling system can maintain the pools at 110°F even with the design maximum service water temperature of 95°F, as seen from the results of reference 4 . Pool temperature assuming normal service water temperatures would be less thus lengthening the time to boil.

(3) No credit is taken for the decay of the heat load with time in the radiological analysis but is taken credit for in the HVAC analyses. (This represents a conservatism, however, very slight.)

(4) Time to boil calculation above is conservative as it assumes that all the heat goes to the water.

(5) Boiloff rates determined above were used for the radiological analysis.

(6) The HVAC analysis takes credit for cooling provided by ESW and takes credit for heat load decay with time. Because credit was taken for the above it also assumes the maximum decay heat instead of the nominal values used for the radiological evaluation.