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50-388 Susquehanna Steam Electric Station, Unit 2, Pennsylva 05000388
AUTH.NAME AUTHOR AFFILIATION
KEISER,H.W. Pennsylvania Power & Light Co.
RECIP.NAME RECIPIENT AFFILIATION
RUSSELL,W.T. Region 1, Ofc of the Director

SUBJECT: Forwards rept re calculations of reactor bldg temps following accident,per 881213 telcon w/R Blough.Util determination that original Bechtel Power Corp calculations not calculated for most limiting situations.

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JAN 17 1989

Mr. William T. Russell
Regional Administrator, Region 1
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia PA 19406

SUSQUEHANNA STEAM ELECTRIC STATION
REACTOR BUILDING TEMPERATURE
PLA-3132 FILE R41-2/A17-10

Docket Nos. 50-387
and 50-388

Dear Mr. Russell:

Pursuant to 10CFR50.9, Pennsylvania Power & Light Company notified Mr. R. Blough of your office on December 13, 1988, concerning our determination that original Bechtel calculations of Reactor Building temperatures following an accident were not calculated for the most limiting situations. The attached report is provided at Mr. Blough's request.

If you have any questions, please contact Mr. Edward A. Heckman, Licensing Group Supervisor, at (215) 770-7904.

Very truly yours,

H. W. Keiser

Attachment

cc: NRC Document Control Desk (w/original)
Mr. J. P. Durr - NRC Region 1
Mr. F. I. Young - NRC Resident Inspector
Mr. M. C. Thadani - NRC Project Manager
Mr. Jack Weyandt
Bechtel Power Corp.
1610 Medical Drive
Pottstown, PA 19464

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BACKGROUND

In support of the Appendix R Project in early 1987, PP&L was performing steady state temperature analyses for a variety of off-normal HVAC operating conditions. The purpose of the analyses was to demonstrate safe shutdown of the units in the event of a plant fire with minimal HVAC systems available. PP&L chose to use the Environmental Conditions Analysis Program (ECAP) developed, verified, and validated by Gilbert Commonwealth, Inc (G/C).

ECAP is a steady state temperature model that accounts for heat losses/gains from outside walls, adjacent rooms, piping, mechanical equipment, electrical equipment, and air conditioning/ventilation systems. ECAP is capable of analyzing up to 200 zones (rooms) simultaneously.

Since G/C was loading all the data, PP&L also requested them to run the post-accident analysis (LOCA/LOOP). During this mode of operation, the normal reactor building HVAC system isolates and the Recirculation Fans and SGTS start to assure that effluent air is filtered. With the exception of the ECCS Pump Room and Emergency Switchgear Room Unit Coolers, there is no cooling provided to the building. The results of this analysis indicated that many areas of the reactor buildings would experience post-accident temperatures in excess of those stated in the FSAR Table 3.11-6 "Normal and Maximum Plant Environmental Conditions". The only areas where high temperature did not appear to be a problem were in the ECCS pump rooms. The information contained in Table 3.11-6 was used as the basis for the environmental qualification of safety related equipment.

In an attempt to understand the difference between the ECAP analysis and the temperature limits specified in the FSAR, PP&L reviewed Bechtel calculation #200-16 which was used to determine the post-accident Reactor Building bulk air temperature.

The Bechtel model was a transient analysis that provided "post accident Reactor Building bulk air temperature" vs. time. The analysis modeled the Unit 1 Reactor Building and the common Refueling Floor as one large "zone". This analysis also assumed that the worst case was a LOCA/LOOP and a failure of all Division II equipment. The Bechtel model concluded that the bulk mean reactor building air temperature peaked at 104F at 2 days after the accident. It was this result that was used as input into the FSAR Table 3.11-6 and ultimately as a basis for environmental qualification of many of the components located in the Reactor Building.

PROBLEM DEFINITION

PP&L reviewed the Bechtel calculation in detail and discovered several potential problems with the assumptions used. To confirm the validity of these potential problems, PP&L contracted Bechtel to review their analyses. Bechtel concluded that:

> "Although the review of the calculation did not indicate any gross discrepancies, there were a number of effects that were not included. These effects have a tendency to balance each other out and in and of themselves would not justify a reanalysis.

"There is a question of whether or not the most limiting conditions were established in determining a bulk long term temperature for purposes of equipment qualification. The assumption of a loss of offsite power is consistent from a licensing standpoint but may not result in the highest long term temperature. A more likely event is that offsite power is available during the LOCA and in this situation would add significant heat loads. However, under this condition operating procedures could require that non-essential services be manually shut off."

Thus, the Bechtel review confirmed that the assumptions used in the calculation did not cover the worst case temperature profile. As a result, significant electrical heat loads were not included that could cause substantial increases in room temperatures. The three major assumptions which did not maximize building temperatures are:

1) LOOP not worst case - The Bechtel analysis assumed a LOCA/LOOP, which means that only Class 1E heat loads were considered. If no LOOP is assumed (ie: offsite power available), both 1E and non 1E heat loads would have to be considered. This increased heat load would cause an increase in the peak temperature calculated. Not only is a LOCA without a LOOP a worse case, it is also the more probable case.

2) Most limiting single failure - The Bechtel analysis assumed the most limiting single failure was complete failure of all Division II power/equipment. Thus, only Division I heat loads were considered. This assumption is not appropriate for this analysis since a) there is no single failure that would cause loss of all of Division II heat loads and b) the most limiting single failure is "no failure" as this would include heat loads from both division. This increased heat load would cause an increase in the peak temperature calculated.

3) Single zone model not adequate - The Bechtel model was a single zone model that assumed the Unit 1 Reactor Building and common Refueling Floor behaved as a single room. This assumption implied that the heat loads were uniformly distributed, the unit cooler heat removal was uniformly distributed, and that the cooling effect of the outside walls was shared equally between interior and perimeter rooms. The results of the ECAP analysis showed an approximately 60F variation in individual rooms. This wide variation indicated that the "single zone" assumption was not valid since all rooms do not behave uniformly.

PP&L concluded that based on the problems identified and the need for a transient model, a reanalysis of Reactor Building post accident air temperature was required. To do this, PP&L developed COTTAP (Compartment Transient Temperature Analysis Program) and had it independently verified by G/C. PP&L has since performed post accident transient temperature analysis using COTTAP and confirmed that under the worst case conditions some safety related equipment in the Reactor Buildings will be exposed to temperatures greater than those assumed for the existing environmental qualification. The results of this analysis will be discussed later under "Transient Temperature Analysis".

REPORTABILITY EVALUATION

PP&L Engineering initiated a Significant Operating Occurrence Report (SOOR) on July 17, 1987 to submit this issue for a reportability evaluation. Based on the information known at that time and the judged safety significance, PP&L concluded that the issue did not meet the threshold for reportability under 10CFR50.72/50.73 or 10CFR21. This was based in part on lack of specific information concerning actual temperatures and equipment affected. Without this, it was difficult to assess the likelihood that any required safety function would not be completed. PP&L justified continued operation based on engineering analyses that the likelihood of an event during the interim until a new analysis could be completed was very low, that the likelihood of fuel damage resulting in significant releases to secondary containment was also sufficiently low, and that a restart of Reactor Building HVAC could be achieved within a reasonable time thereby providing adequate cooling well before temperatures could exceed assumed EQ limits. The issue was brought to PORC and SRC and those bodies concurred with these conclusions. Although no formal report was required, based on the potential generic significance of the issue and on the then proposed regulations which were later to be codified as 10CFR50.9, a recommendation was made to inform the NRC. The NRC Project Manager and Senior Resident Inspector were then briefed concerning our findings and plans for further action. This concluded our original review for reportability.

EXISTING SYSTEM DESIGN

During normal plant operation the Reactor Building ventilation system (referred to herein as RB HVAC) maintains the building/room temperature at an acceptable level. Reactor Building Chilled Water is used by the Supply Fans to cool the outside air prior to supplying it to the Reactor Building. Air within the building is exhausted to the environment via two exhaust fan systems, one filtered and one unfiltered. The unfiltered exhaust fans do not filter the air since it serves clean plant areas. The filtered exhaust fans exhaust air from plant areas that have the potential for radioactive release/contamination. All exhaust air is monitored prior to release to the environment via the vent stack SPINGS. The RB HVAC System results in approximately 2.5 air changes per hour. This system is not safety related nor seismically designed.

In the event of a Secondary Containment Isolation, the normal Reactor Building ventilation systems are isolated and the recirculation fans and SGTS start to maintain Secondary Containment Integrity. Since there is no cooling provided to the general building areas, it is during this mode of operation that the problem of elevated Reactor Building temperatures (Zones I, II, and/or III) could occur. The conditions that could cause a Secondary Containment isolation, either directly via isolation logic or indirectly via procedural actions are:

1) LOCA's - Secondary Containment (Zones I, III or II, III) will isolate directly via the isolation logic on High Drywell Pressure or RPV Low Level 2. It could also be isolated indirectly via the procedural actions specified in EO-100-104 (EO-200-104) in the event of high radiation on the refueling floor.

2) Zone III High Radiation - Secondary Containment (Zone III) will isolate directly via isolation logic on Zone III Ventilation Exhaust High Radiation. It could also be isolated indirectly via the procedural actions specified in EO-100-104) in the event of high radiation on the refueling floor. (Note: A Zone III isolation does not result in unacceptable temperatures.)

3) Loss of Offsite Power - A LOOP, either by itself or in conjunction with an accident, will cause a direct isolation of Secondary Containment (Zones I, II, III) due to the loss of RPS logic which generates an isolation signal on all three zones.

TRANSIENT TEMPERATURE ANALYSIS

After the problems in the Bechtel analysis were identified in mid-1987, the need for a new dynamic multi-compartmental temperature model became apparent. Therefore, PP&L developed the COTTAP computer model (Compartment Transient Temperature Analysis Program). This model accounts for heat loads resulting from outside walls, adjacent rooms, piping system, mechanical equipment, electrical equipment, and HVAC systems. COTTAP is capable of providing temperature vs. time profile for up to 200 individual rooms. The model was verified by Gilbert Commonwealth, Inc.

This program was used to predict the post accident Reactor Building temperatures for 3 design base cases. They are:

Case 1 - Unit 1 LOCA; Offsite Power Available; Single Failure - ESW Loop B; SGTS/Recirc. Aligned to Zones I & III

Case 2 - Unit 1 LOCA; Loss of Offsite Power; Single Failure - ESW Loop B; SGTS/Recirc. Aligned to Zones I, II, & III

Case 3 - Unit 1 LOCA; Offsite Power Available; Single Failure - Unit 2 False LOCA Signal; SGTS/Recirc. Aligned to Zones I, II, & III

These cases are believed to be the worst set of conditions from a temperature standpoint as they tend to maximize heat loads while reducing the heat removal mechanisms. All these cases are valid design basis events. The results of this analysis are documented in Calculation M-RAF-024. This calculation determined that certain heat loads must be eliminated from the reactor building in order to limit the temperature rise. It was further determined that these loads would not have to be eliminated until 24 hours following a postulated design base accident. Subsequently, a procedure was developed, and made part of the Emergency Plan Implementing Procedures (EP-IP-055). EP-IP-055 requires the Emergency Director to either shed non-essential electrical loads in the Reactor Building of the Unit involved in the postulated accident, or restore mechanical cooling. This decision will not have to be made until 24 hours after the postulated accident occurred. Note that this load shed is effected by exercising 2 breakers in the turbine building, and has the effect of creating a Loss of Offsite Power condition in the reactor building, a situation which has been previously analyzed.

In all 3 cases there are rooms whose peak temperature is expected to exceed the limiting EQ component temperature. Therefore, under worst case conditions, some safety related equipment in the Reactor Building could be exposed to temperatures greater than those previously used by the EQ Program for post accident qualification.

AFFECTED EQUIPMENT

A list of potentially affected equipment is attached. This list provides the following information:

EQ BINDER - This is PP&L's identification of the auditable file required by 10CFR50.49. Nine binders are involved.

COMPONENT - A description of the type of equipment involved. There are ten to twenty types of equipment involved, depending on what is counted as a type. For example, the panel, MCC and Switchgear binders qualify several different types of relays as well as other sub-components.

PLANT I.D. NO. - These are the unique device numbers of the individual pieces of equipment involved. There are 43 items for Unit 1, 79 for Unit 2, and 2 common to both units making a total of 124 for the plant.

CASE 3G PEAK TEMP. - This is the peak temperature for which the equipment should now be qualified, as determined in Calculation M-RAF-024. In general, the postulated post DBA temperature rises asymptotically to this value during the 100 day post event duration used as a design basis for EQ.

ORIGINAL EQ TEMP. - This is the temperature to which the equipment was qualified by the binder in the first column.

REVISED EQ TEMP. - This is the temperature for which operability and qualifiability has been justified by analysis. The PP&L calculation number which documents the analysis is given in parenthesis after the temperature.

The affected equipment is located in our EQ Zones R1m, R1k and R1p (refer to FSAR Table 3.11-6). The original temperatures in these zones (105 and 109 degrees F) do not constitute a harsh environment. However, these zones were designated as harsh because the TID exceeds 10,000 RADs. None of these zones are HELB areas.

As the last column of the attachment shows, the analysis performed demonstrates operability at temperatures above the required values. From a technical perspective, the equipment is deemed qualifiable for the new conditions. However, the analyses were based on preliminary COTTAP results and have not been incorporated into the EQ Binders. Therefore, we have not met all of the programmatic and administrative requirements necessary to declare the equipment qualified.

RE-REVIEW FOR REPORTABILITY

On October 20, 1988, the results of these analyses were documented in NCRs for each unit. The NCRs prompted another review for reportability based on the new information resulting from the COTTAP analyses. Based on the conclusions that the affected equipment remains operable, that it will perform its safety function, and that it is qualifiable, no substantial safety hazard was deemed to exist. PP&L again concluded that no report was required pursuant to 10CFR50.72/50.73 or 10CFR21. However, in the interim, 10CFR50.9 became effective. Due to the potential generic significance of this issue, a report appeared to be required. A recommendation to report pursuant to 10CFR50.9 was approved on December 12, 1988, and the report was made to NRC Region 1 the following day.

JUSTIFICATION FOR CONTINUED OPERATION

PP&L prepared a revised justification for interim operation in support of the NCRs on each unit. Copies of the NCRs and JIOs were forwarded to Mr. Durr of Region 1 on December 13, 1988. Based on the ability to shed nonessential loads or restore cooling within 24 hours following an accident in accordance with procedure EP-IP-055, operation was justified until the fourth refueling outage on Unit 2 which is scheduled to end on March 26, 1991. These dates were based on the time needed to reestablish the qualification of the affected equipment and to install any related modifications. Since insufficient time was available to properly design and procure equipment for modifications in support of the 1989 outages, the following pair of outages were established as the appropriate milestones.

CORRECTIVE ACTION PLAN

PP&L plans to review our qualification analyses against the results of the final version of calculation M-RAF-024, revise them if necessary, and add them to the EQ Binders to re-establish the qualification of all equipment, other than those discussed below. We do not expect, however, this review and finalization process to result in new technical problems since the analyses done to the preliminary COTTAP results were done to temperatures which are the same as or higher than the final values.

We expect to have the analysis review and binder revision process complete by 6/30/89 for all of the affected binders except EQDF-33 and EQDF-34.

The final resolution for the equipment in EDQF-33 and 34 may involve plant modifications for reasons other than equipment qualification and these may not be complete until the end of 1990. While we believe the equipment is qualifiable, these other considerations to modify the plant to eliminate the use of this equipment or relocate it to a mild environment would render a decision to pursue an extensive qualification program imprudent.

CONCLUSION

Generic Letter 88-07 provides the latest guidance from NRC on actions to be taken when potential deficiencies in environmental qualification are identified. These require the licensee to make a prompt determination of operability, to establish a plan with a reasonable schedule to correct the deficiency, to have a written justification for continued operation, and to evaluate for reportability. Although this condition is technically in noncompliance with 10CFR50.49, PP&L has followed the NRC guidance in the generic letter for handling such non-compliances. Therefore, continued operation is justified until equipment qualification can be reestablished.

EQ BINDER	COMPONENT	PLANT I.D. NO.	CASE 3G (*) PEAK TEMP. (°F)	ORIGINAL EQ TEMP. (°F)	REVISED EQ TEMP. (°F)
EQDF-22B	Comsip Control Panels	1C201A/B	118.34	104	130 (FC-C-JPB-019,Rev.0)
		1C221	118.67	104	130 (FC-C-JPB-019,Rev.0)
		1C235A/B	110.40	104	130 (FC-C-JPB-019,Rev.0)
		1C236A/B	110.40	104	130 (FC-C-JPB-019,Rev.0)
		1CB216A/B	120.16	104	130 (FC-C-JPB-019,Rev.0)
		TB1386	118.34	104	130 (FC-C-JPB-019,Rev.0)
		TB1C006	120.16	104	130 (FC-C-JPB-019,Rev.0)
		TB1C022	114.91	104	130 (FC-C-JPB-019,Rev.0)
		2C201A/B	123.08	104	130 (FC-C-JPB-019,Rev.0)
		2C221	123.08	104	130 (FC-C-JPB-019,Rev.0)
		2C235A/B	120.05	104	130 (FC-C-JPB-019,Rev.0)
		2C236A/B	120.05	104	130 (FC-C-JPB-019,Rev.0)
		2CB216A/B	120.16	104	130 (FC-C-JPB-019,Rev.0)
		2CB213	123.08	104	130 (FC-C-JPB-019,Rev.0)
		2CB236	123.08	104	130 (FC-C-JPB-019,Rev.0)
		2CB214	115.88	104	130 (FC-C-JPB-019,Rev.0)
		TB1122	123.08	104	130 (FC-C-JPB-019,Rev.0)
		TB2C006	115.88	104	130 (FC-C-JPB-019,Rev.0)
		TB2C022	115.88	104	130 (FC-C-JPB-019,Rev.0)
EQDF-29	ASCO & FCI HVAC Instrumentation	FSH17601A/B	110.40	119	130 (FC-C-JPB-012,Rev.0)
		FSH17602A/B	110.40	119	130 (FC-C-JPB-012,Rev.0)
		FSH17657A/B	110.40	119	130 (FC-C-JPB-012,Rev.0)
		FSH27601A/B	120.05	119	130 (FC-C-JPB-012,Rev.0)
		FSH27602A/B	120.05	119	130 (FC-C-JPB-012,Rev.0)
		FSH27657A/B	120.05	119	130 (FC-C-JPB-012,Rev.0)

EQ BINDER	COMPONENT	PLANT I.D. NO.	CASE 3G (*) PEAK TEMP. (°F)	ORIGINAL EQ TEMP. (°F)	REVISED EQ TEMP. (°F)
EQDF-33	ESGR Dx Cooling Unit	HV27203A/B	120.05	104	212 (FC-C-JPB-004,Rev.0)
		2K210A/B	120.05	104	130 (FC-C-JPB-004,Rev.0)
		PC27203A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PDSL27202A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PI27203A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PS27202A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PSH27202A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PSL27202A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PSV27201A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PSV27203A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PT27203A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		PY27203A1/A2/B1/B2	120.05	120	130 (FC-C-JPB-004,Rev.0)
		SV27201A1/A2/B1/B2	120.05	120	130 (FC-C-JPB-004,Rev.0)
		SV27202A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
		TSH27202A4/B4	120.05	120	130 (FC-C-JPB-004,Rev.0)
		2C288A/B	120.05	120	130 (FC-C-JPB-004,Rev.0)
EQDF-34	Bailey cards Rmt Shtdn Pnl	FY11207A1/B	118.34	104	125 (FC-C-JPB-021,Rev.1)
		FY21207A	123.08	104	125 (FC-C-JPB-021,Rev.1)
EQDF-04	ITE 480V MCC	1B219	118.67	104	130 (FC-C-JPB-023,Rev.0)
		1B237	118.67	104	130 (FC-C-JPB-023,Rev.0)
		1B247	118.79	104	130 (FC-C-JPB-023,Rev.0)
		1B216	120.16	104	130 (FC-C-JPB-023,Rev.0)
		1B226	114.91	104	130 (FC-C-JPB-023,Rev.0)
		1B229	113.25	104	130 (FC-C-JPB-023,Rev.0)
	120V/208V Dist. Panel	2B219	123.77	104	130 (FC-C-JPB-023,Rev.0)
		2B237	123.08	104	130 (FC-C-JPB-023,Rev.0)
		2B247	117.61	104	130 (FC-C-JPB-023,Rev.0)
		2B216	120.94	104	130 (FC-C-JPB-023,Rev.0)
		2B226	115.88	104	130 (FC-C-JPB-023,Rev.0)
		2B229	115.08	104	130 (FC-C-JPB-023,Rev.0)

EQ BINDER	COMPONENT	PLANT I.D. NO.	CASE 3G (*) PEAK TEMP. (°F)	ORIGINAL EQ TEMP. (°F)	REVISED EQ TEMP. (°F)
	120V/208V Dist. Panel (Cont'd)	1Y216	120.16	104	130 (FC-C-JPB-023,Rev.0)
		1Y226	114.91	104	130 (FC-C-JPB-023,Rev.0)
		1Y218	113.25	104	130 (FC-C-JPB-023,Rev.0)
		1Y236	113.25	104	130 (FC-C-JPB-023,Rev.0)
		1Y246	113.25	104	130 (FC-C-JPB-023,Rev.0)
		2Y216	120.94	104	130 (FC-C-JPB-023,Rev.0)
		2Y226	115.88	104	130 (FC-C-JPB-023,Rev.0)
		2Y218	115.08	104	130 (FC-C-JPB-023,Rev.0)
		2Y236	115.08	104	130 (FC-C-JPB-023,Rev.0)
		2Y246	115.08	104	130 (FC-C-JPB-023,Rev.0)
EQDF-09	G.E. 230VDC MCC & 250/125VDC Load Center	1D254	118.67	104	131 (FC-C-JPB-018,Rev.0)
		1D264	114.91	104	131 (FC-C-JPB-018,Rev.0)
		1D274	114.91	104	131 (FC-C-JPB-018,Rev.0)
		2D254	123.08	104	131 (FC-C-JPB-018,Rev.0)
		2D264	115.88	104	131 (FC-C-JPB-018,Rev.0)
		2D274	115.88	104	131 (FC-C-JPB-018,Rev.0)
EQEL-36	S&K/Amatek Flow Element	FE-E32-1N006B/F/K/P	113.25	104	156 (FC-C-JPB-016,Rev.0)
		FE-E32-2N006B/F/K/P	115.08	104	156 (FC-C-JPB-016,Rev.0)
EQEL-38	S&K/Amatek Transmitter	FT-E32-1N053B/F/K/P	113.25	104	116 (MC-C-FAC-017,Rev.0)
		FT-E32-2N053B/F/K/P	115.08	104	116 (MC-C-FAC-017,Rev.0)

EQ BINDER	COMPONENT	PLANT I.D. NO.	CASE 3G (*) PEAK TEMP. (°F)	ORIGINAL EQ TEMP. (°F)	REVISED EQ TEMP. (°F)
EQPL-J01	Dwyer. Diff. Press. Sw.	PSDL-07544A/B	114.57	104	116 (FC-C-JPB-011,Rev.0)

*Temperatures shown are for a LOCA in Unit 1. Equipment is to be qualified for the highest temperature for either unit to allow for the case where LOCA is in Unit 2. For example, all of the flow switches for both units in binder EQDF-2[illegible] must be qualified for 120.05°F.

RMH:tah
rmhmea106a