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Mr. John T. Collins
Regional Administrator, Region IV
Nuclear Regulatory Commission
611 Ryan Plaza Dr., Suite 1000
Arlington, Texas 76012

Dear Mr. Collins:

South Texas Project
Units 1 & 2
Docket Nos. STN 50-498, STN 50-499
Final Report Concerning
Heating, Ventilation and Air Conditioning Design

On May 8, 1981, pursuant to 10CFR50.55 (e), Houston Lighting & Power Company (HL&P) notified your office of an item concerning the consideration of certain faulted condition heat loads in the design of portions of the Heating, Ventilation and Air Conditioning (HVAC) system. Based on an assessment of preliminary thermal environmental data, it was identified that certain spaces and cubicles within the Mechanical-Electrical Auxiliary Building (MEAB) and the Fuel Handling Building (FHB) would likely require additional HVAC capacity.

On July 6, 1982, HL&P expanded the scope of this item to include two items regarding the use of fail open isolation dampers in the HVAC design and single failure criteria in the EAB supply air mixing box. There was a concern that the failure mode of isolation dampers had not been adequately assessed by Brown & Root, Inc. (B&R) in the HVAC design.

Attached is our Final Report regarding these items which provides the results of the evaluation that has been performed.

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If you should have any questions concerning this item, please contact Mr. Michael E. Powell at (713) 877-3281.

Very truly yours,

J. D. Goldberg for

G. W. Oprea, Jr.
Executive Vice President

MEP/mg
Attachment

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Revision Date 10-18-82

FINAL REPORT CONCERNING
HEATING, VENTILATION, AND AIR CONDITIONING DESIGN

INTRODUCTION

This final report presents an evaluation and corrective action for the following HVAC design deficiencies that have been reported pursuant to 10CFR50.55(e).

A. Lack of safety-related cooling in certain areas of Mechanical-Electrical Auxiliary Building and Fuel Handling Building.

B. Nonsafety-related pneumatic air controllers in safety-related HVAC systems.

C. Single failure of supply air mixing box in Electrical Auxiliary Building.

The above deficiencies have been reported to the NRC on May 8, 1981 and July 6, 1982. Five interim reports have been submitted to the NRC regarding the HVAC design.

DEFICIENCY A

Lack of safety-related cooling in certain areas of Mechanical-Electrical Auxiliary Building and Fuel Handling Building.

I. SUMMARY

A review was performed to determine if safety-related HVAC service was provided for all safety-related equipment. Several areas in the Mechanical and Electrical Auxiliary Building (MAB and EAB) and Fuel Handling Building (FHB) with safety-related equipment have been identified as not having safety-related cooling. It has also been identified that the existing cooling capacity of EAB HVAC system is not sufficient to meet the actual cooling load, since the system was sized on the basis of preliminary calculations. These results are the conclusion of an extensive review by Bechtel of turnover documentation in accordance with the transition procedure.

Corrective action is required to maintain the room ambient temperatures below the equipment qualification temperature and thereby prevent failure of safety-related equipment.

This deficiency is being resolved by adding new chillers to the existing EAB chilled water system, which serves as a centralized essential chilled water system, to provide the additional safety-related cooling to the above identified areas. New chilled water air handling units will be provided for all areas identified as not having safety-related cooling.

II. DESCRIPTION OF DEFICIENCY

In April, 1980, HL&P sent a letter to Brown & Root (B&R) which questioned the absence of safety-related HVAC service for the hot shutdown panel and the hydrogen monitors located in radwaste control room, and called for a review of safety-related HVAC requirements in other areas as well. A review was performed by B&R to determine if safety-related HVAC service was adequate for all safety-related equipment. In addition to the radwaste control room, several other areas were identified as requiring safety-related HVAC service. On May 8, 1981, pursuant to 10CFR50.55(e), HL&P notified NRC of this deficiency.

Subsequently, a detailed review was performed by B&R. In addition, in order to expedite resolution of this item, two consultants were engaged by B&R to perform system review, evaluation, and design recommendation activities. The reports by the consultants and B&R were included in the transition work packages transmitted to Bechtel. Bechtel has now completed the review of the overall STP HVAC design including the consultant's reports. Based on this review, Bechtel confirmed the areas identified by B&R and the consultants as requiring safety-related HVAC service and identified a lack of EAB cooling capacity.

DISCUSSION OF FINDINGS:

Finding (1)

Bechtel conducted a multi-discipline review of HVAC system requirements. From this review, safety-related equipment was confirmed to be provided with safety-related cooling with the exception of areas as listed in Table-1. Table-1 also identifies the "user" equipment and associated trains in each area.

The addition of safety-related HVAC service to areas listed in Table-1 is based on the requirement to maintain temperatures below the environmental qualification parameters of any safety-related equipment. New safety-related HVAC systems will provide the required environment.

The rationale for selecting each area listed in Table-1 is listed below.

(a) Electrical Penetration Spaces in EAB

In addition to class 1E cables, this area has the containment high range area radiation monitors and 15KV reactor coolant pump class 1E cubicles. Presently there is no provision for cooling in this area.

(b) Radwaste Control Room in MAB

Hydrogen monitors for the containment atmosphere are located in the radwaste control room and are required to operate following an accident. B&R had also identified the auxiliary shutdown panel which was previously located in the radwaste control room; however, this shutdown panel is now being relocated in an EAB area with existing safety-related HVAC service.

The radwaste control room is presently served by the nonsafety-related MAB main supply and exhaust system powered with non-1E electrical power, which may not be available following an accident.

(c) Boric Acid Transfer Pump and CVCS Valve Cubicles in MAB

The boric acid transfer pumps and CVCS valves are used to supply boric acid from the boric acid tanks to the CVCS charging pumps for reactor coolant boration. Boration is required for safe shutdown.

The boric acid transfer pump and CVCS valve cubicles are presently served by the same nonsafety-related MAB main supply and exhaust system as in (b) above.

(d) Reactor Make-up Water Pump Cubicle in MAB

These pumps could be required for emergency replenishment of water in the Spent Fuel Pool, and in the Component Cooling Water System (CCWS) surge tank if the Demineralized Water System is not available.

The reactor make-up water pump cubicle is presently served by the same nonsafety-related MAB main supply and exhaust system as in (b) above.

(e) Spent Fuel Pool Cooling Pump Cubicles

The Spent Fuel Pool Cooling and Cleanup System (SFPCCS) pumps are required to remove decay heat generated by spent fuel assemblies stored in the spent fuel pool. The pumps are required at some time following a loss of offsite power and are powered by a class 1E power supply.

The spent fuel pool cooling pump cubicles are presently cooled by the nonsafety-related FHB supply system with non-1E electrical power, which may not be available following an accident.

(f) Containment Isolation Valve Cubicles in FHB

The containment isolation valves that are open for emergency core cooling and for containment spray (See Table-1) have electric motor drive actuators and have a safety function to perform after the accident. All the valves must close eventually for containment isolation, whether at the end of recirculation phase or for isolating an out-of-service train. The qualification temperature of the valve actuator should not be exceeded before its safety function is required.

The three encapsulated isolation valves for the containment emergency sumps located in these same cubicles are also vulnerable to excessive environmental temperatures. These normally closed valves must open at the end of the safety injection phase so the recirculation phase can begin, then close after the recirculation phase is completed for containment isolation. The valves are supplied by Westinghouse, and the actuators have a qualification temperature corresponding to post-LOCA inside containment parameters. These areas are presently served by the nonsafety-related FHB HVAC system which may not be available following an accident.

(g) Electrical Auxiliary Building Chiller Area in MAB

The EAB chillers are safety-related and are required to operate following an accident to maintain the design environmental conditions in the control room envelope and the remaining EAB.

This chiller area is presently served by the nonsafety-related MAB main supply and exhaust system, which may not be available following an accident.

(h) Electrical Penetration Exhaust Fan Area

The electrical penetration area exhaust is presently classified as a safety-related system. The exhaust fan area, located in the MAB is served by the nonsafety-related MAB main supply and exhaust system, which may not be available following an accident. However, the exhaust fan system is going to be downgraded to nonsafety-related as a result of HVAC system design changes and as such does not require safety-related HVAC services.

Finding (2)

As part of the transition work package EM-551 from B&R, Bechtel did a detailed review of the EAB cooling loads. As a result of this review it has been determined that the actual building cooling load is higher than the existing system capacity. Originally the system was sized on the basis of preliminary calculations by B&R. Subsequently these calculations were reperformed by one of the two consultants engaged by B&R. A review of these calculations indicates that the system cooling capacity is undersized. Cooling load calculations by Bechtel are presently underway for the purpose of equipment sizing.

III. CORRECTIVE ACTION

A conceptual design to correct deficiency Finding (1) above was proposed in the B&R and consultants reports. Bechtel has reviewed the proposed design and agrees with the basic concept of providing safety-related chilled water and local air handling units to provide cooling in each room identified in Table-1. However, the overall chilled water system design developed by Bechtel is different from the B&R/consultants proposed design, since it is designed to correct both the above deficiencies, findings (1) and (2), and to resolve some of the open items in the B&R/consultants reports. Following is a description of the Bechtel design for corrective action to resolve the subject deficiency.

System Description

New chillers will be added to the existing EAB chillers to provide a centralized essential chilled water system. This system would serve the cooling load requirements of the EAB and all the areas identified in Table-1 during normal and emergency conditions.

The chilled water system will consist of three 50% trains A, B, and C, with two chillers per train, one existing EAB chiller and a second, new chiller in parallel. The new chillers will be water cooled with ECW, and served by the emergency power, just as the existing EAB chillers. The new chillers and

pumps will be located in the same area as the existing EAB chillers at El. 10'-0" of MAB. Each chiller train will be completely independent and physically separated from each other. The system will be sized for the maximum cooling load at any given time, with margin to serve future safety-related cooling requirements with two trains operating simultaneously.

The chilled water will be supplied to air handling units which basically consist of a cooling coil and supply fan. The number of air handling units and associated trains in each area will be based on the "user" equipment trains in the respective area, to account for single failure and provide redundancy, as given in Table-1.

IV. RECURRENCE CONTROL

The subject deficiencies mainly resulted from lack of interface with the "user" disciplines. The HVAC system design did not incorporate all the "user" requirements of safety-related cooling and cooling loads.

Bechtel will conduct future project activities in a manner which should preclude the types of deficiencies resulting from interdiscipline information exchange. This will be accomplished by the use of Bechtel Engineering Department Procedures which will be followed in the performance of future design activities for the project. These procedures are based upon those used effectively for engineering activities performed at other major nuclear projects. The effective use of these procedures is assured by the on-project indoctrination, training, monitoring, and the Quality Assurance Audit Program.

V. SAFETY ANALYSIS

If this deficiency had remained uncorrected, the environmental temperature in the subject areas (listed in Table-1 and EAB, including control room envelope) could have increased above the equipment qualification and/or habitability temperature for the control room, resulting in a possible failure of equipment or loss of control room habitability. Since the equipment in the subject areas is safety-related, this deficiency could have jeopardized the safe operation of the plant.

DEFICIENCY B

Nonsafety Pneumatic Air Controllers in Safety-Related HVAC Systems

I. SUMMARY

All automatic dampers in safety-related HVAC systems are operated pneumatically, and the instrument air system serving these dampers is nonsafety-related.

This deficiency will be resolved by providing dampers that are operable following an accident or by providing a fixed balanced system to meet the building pressure requirements.

The cause of this deficiency is that the existing design concept utilizing nonsafety-related pneumatic dampers and controllers did not adequately address the possible failure modes of these devices under accident conditions.

II. DESCRIPTION OF DEFICIENCY

On July 6, 1982, pursuant to 10CFR50.55(e), Houston Lighting & Power Company (HL&P) notified the NRC of two items regarding the use of fail open pneumatic dampers at the discharge of redundant supply fans. Following an accident these dampers are assumed to be inoperable and the failure mode (fail-open or closed) is not appropriate in certain cases where it could result in degradation of the system safety functions, as described below.

1. Pneumatic fail open dampers at the discharge of redundant fans in parallel, resulting in back flow through redundant fan.

2. Pneumatic modulating control dampers for air flow or building pressure control, resulting in radiological impact or loss of building pressure, respectively.

3. The pneumatic isolation dampers for EAB outside air intakes fail open during accident conditions, and do not have redundancy in series. In the case of a toxic gas release condition concurrent with a loss of instrument air, this could result in loss of control room habitability.

HL&P's Incident Review Committee (IRC) determined that these items should be considered as part of a generic concern regarding the use of nonsafety-related pneumatic air controllers in safety-related HVAC systems.

This was followed by a Fifth Interim report which addressed all the deficiencies identified under the above generic concern, based on an initial review by Bechtel of the overall HVAC design. Subsequently Bechtel has completed the review, which confirms the findings reported in the Fifth Interim report. See the interim report for description of the findings and safety analysis.

III. CORRECTIVE ACTION

With reference to the Fifth Interim report the following are the corrective actions to resolve the subject deficiencies.

A. Nonsafety-Related Pneumatic Air Controllers in Safety-Related HVAC Systems

All automatic dampers in safety-related HVAC systems are operated pneumatically, and the instrument air system serving these dampers is nonsafety-related. Following an accident these dampers are not operable and the failure mode is not appropriate in some cases since it could result in degradation of the system safety functions. At present, concern for the following areas has been identified:

a) The pneumatic dampers at the discharge of parallel redundant fans or air handling units fail open during an accident condition, thereby resulting in back flow/recirculation through the standby fan or unit. This condition exists in the following cases:

1. EAB main supply air handling units. Impact on safety function is partial loss of cooling to safety-related equipment and loss of control room pressurization.

2. IVC supply fans. Impact on safety function is partial loss of cooling to safety-related equipment.

3. Fuel Handling Building (FHB) exhaust fans. Impact on safety function is reduction of exhaust flow with potential radiological release consequences in a post-LOCA condition.

4. Electrical penetration area exhaust fans. Backflow/recircu-tion through the standby fan could result in the current design, however the electrical penetration area exhaust system is being down-graded to nonsafety-related, since it is not required to maintain the negative pressure in the penetration space as a safety function.

Corrective Action for Item A(a)1 to 4:

Pneumatic dampers at the discharge of parallel redundant fans or air handling units in all cases reported will be replaced with an isolation damper with the correct failure mode. These dampers will remain closed when the corresponding fan is not operating and open when the fan is energized, thereby preventing backflow through the standby fan.

b) The safety-related control dampers have been provided with nonsafety-related pneumatic instrument controls. Consequently, during an accident condition without assumed loss of instrument air, these instrument controls could malfunction, resulting in erroneous operation of control dampers. This condition exists in the following cases:

1. EAB mixing box dampers resulting in loss of cooling to safety-related equipment.

2. EAB/Control room pressurization dampers resulting in loss of pressurization.

3. Electrical penetration area and FHB pressure control dampers resulting in loss of negative pressures.

4. FHB exhaust air flow control dampers resulting in reduction of exhaust air and potentially increased radiological impact.

Corrective Action for Item A(b)1 - Mixing box dampers:

The mixing boxes will be deleted as described in the corrective action for Deficiency C.

Corrective Action for Item A(b)2 - Pressurization dampers:

The make-up air to the control room system will be balanced to provide the required minimum outside air to maintain positive pressure.

Corrective Action for Item A(b)3 - Control dampers:

The electrical penetration area exhaust system is being down-graded to nonsafety-related, since it is not required to maintain the negative pressure in the penetration space as a safety function.

The make-up air to the Fuel Handling Building will be balanced to provide the required airflow rates to maintain negative pressure.

Corrective Action for Item A(b)4 - Exhaust control dampers:

The FHB exhaust fans will be provided with backdraft dampers at the fan discharge thereby preventing backflow.

c) The pneumatic isolation dampers for EAB outside air intakes fail open during accident conditions, and do not have redundancy in series. In the case of a toxic gas release condition concurrent with a loss of instrument air, this could result in loss of control room habitability.

Corrective Action for Item A(c):

The EAB outside air intake dampers will be provided with safety-related actuators designed to place the dampers in the fail-closed mode. Following an accident, dampers can be opened for emergency plant operation.

IV. RECURRENCE CONTROL

In the future design process full consideration will be given to the failure modes of pneumatic dampers, when using them in safety-related systems. This will be accomplished by the use of Bechtel Engineering Department Procedures which will be followed in the performance of future design activities for the project. These procedures are based upon those used effectively for engineering activities performed at other major nuclear projects. The effective use of these procedures is assured by the on-project indoctrination, training, monitoring, and the Quality Assurance Audit Program.

DEFICIENCY C

Single Failure of Supply Air Mixing Box in Electrical Auxiliary Building (EAB)

I. SUMMARY

The EAB HVAC system consists of a dual duct (hot and cold) supply air system with a mixing box at the supply terminal for each room. The deficiency of concern is that, in certain areas with more than one train of safety-related equipment, there is no redundancy in the supply air mixing boxes. A failure associated with the mixing box in these areas would degrade cooling and result in temperatures higher than that to which equipment has been qualified. This could jeopardize operation of two or more trains of equipment in these areas.

This deficiency is being resolved by replacing the dual duct concept with single supply air duct. This involves deleting the mixing boxes and therefore eliminating the possibility of the subject active failure.

II. DESCRIPTION OF DEFICIENCY

This deficiency was identified along with "Deficiency B" as a result of initial BPC review of overall HVAC design, and reported in the Fifth Interim report. Subsequently BPC has completed the review, which confirms the findings reported. See the interim report for description of the findings and safety analysis.

III. CORRECTIVE ACTION

With reference to the Fifth Interim Report, this deficiency will be resolved by deleting the EAB HVAC dual duct concept and providing a single cold supply air duct. This involves deleting the mixing boxes and hot duct in the existing design. With deletion of the mixing boxes there is no active component in the supply duct system, which eliminates the possibility of the subject active failure.

The above corrective action involves complete revision of the existing duct layout in EAB and purchase of new reheat coils for certain areas requiring close temperature control. The reheat coils need not be safety-related; however, they will be provided with safety-related isolation controls.

IV. RECURRENCE CONTROL

The recurrence control is similar to that for Deficiency B. In addition, consideration of single active failure criteria is part of the HVAC system design criteria.

TABLE-1

NEW SAFETY-RELATED HVAC COOLING REQUIREMENT

BLDG.	Location (1) ROOM #	ELEV	ROOM NAME	USER EQUIP TRAINS	DESIGN RM TEMP. °F	NEW COOLING UNITS BY TRAINS A	B	C	USER EQUIPMENT LOCATED IN ROOM	USER EQUIP QUALIF TEMP °F Normal	Accident
EAB	001	10'0"	Electrical Penetration Space	A	104	1-100%			1. High range area radiation monitors	120	120
	201	35'0"	Electrical Penetration Space	B	104		1-100%		2. 15KV reactor coolant pump Class 1E cubicles	104	104
	301	60'0"	Electrical Penetration Space	C	104			1-100%	3. Class 1E Cables	104	104
MAB	033	10'0"	CVCS Valve Cubicle	A,B	104	1-100%	1-100%		CVCS Valves; (2)	104	104
	044	10'0"	CVCS Valve Cubicle	C	104			1-100%	XCV21B, XCV113B.		
	226	41'0"	CVCS Valve Cubicle	A,C	104	1-100%		1-100%	XCV112C. XCV112B, XCV113A.		
	067-1	10'0"	EAB Chiller Area	A	120	1-100%			EAB Chillers & New Safety-Related Chillers	120	120
	067-2	10'0"	EAB Chiller Area	B	120		1-100%				
	067-3	10'0"	EAB Chiller Area	C	120			1-100%			
	018	20'0"	Boric Acid Transfer Pump Cubicle	A,C	104	1-100%		1-100%	Boric Acid Transfer Pumps	120	120
	062	20'0"	Reactor Make-up Water Pumps Cubicle	A,B	104	1-100%	1-100%		Reactor Make-up Water Pumps	120	120
	217	41'0"	Radwaste Control Room	A,C	104	1-50%	1-50%	1-50%(3)	H_2 Monitoring Equipment	104	104
FHB	007	4'0"	Isolation Valve Cubicle	A	104	1-100%			Containment Isolation Valves (2):	104	104
	008	4'0"	Isolation Valve Cubicle	B	104		1-100%		XSI004 A,B,C (HHSI)		
	009	4'0"	Isolation Valve Cubicle	C	104			1-100%	XSI018 A,B,C (LHSI)		
									XCS001 A,B,C (CS)		
									XSI016 A,B,C	104	168 (4)
	106	21'11"	Spent Fuel Pool Pump Room	B	104	1-100%			SFPCCS Pumps	104	104
	107	21'11"	Spent Fuel Pool Pump Room	C	104		1-100%				

NOTES

(1) Room numbers listed are as shown on Bechtel architectural drawings.
(2) Valve numbers listed are as shown on Bechtel P&IDs. Valves are supplied by Westinghouse.
(3) Consideration will be given to providing two 100% units, if required due to space limitation.
(4) Based on Westinghouse Specification G-952850-0 for 100,000 seconds, and 285°F at 100 seconds Post-LOCA.