(7-77)

Update Report - Previous Report Date 11-28-78

LICENSEE EVENT REPORT

CONTROL BLOCK: | | | | | | | (1) (PLEASE PRINT OR TYPE ALL REQUIRED INFORMATION)

0 1 | G A E I H 2 (2) | 0 0 - 0 0 0 0 0 - 0 0 (3) | 4 1 1 1 1 (4) | | (5)
LICENSEE CODE | LICENSE NUMBER | LICENSE TYPE | CAT

CON'T 0 1 | REPORT SOURCE L (6) | 0 5 0 0 0 3 6 6 (7) | 0 7 2 4 7 8 (8) | 0 2 0 9 7 9 (9)
DOCKET NUMBER | EVENT DATE | REPORT DATE

EVENT DESCRIPTION AND PROBABLE CONSEQUENCES (10)

0 2 During the heatup plateau of Unit 2 Startup Testing the average drywell temperature
0 3 exceeded the limit of 135° F as set forth in Tech. Specs. Section 3.6.1.7. Upon
0 4 discovery of this condition, reactor heatup was terminated in the effort to resolve
0 5 the problem.
0 6
0 7
0 8

	SYSTEM CODE	CAUSE CODE	CAUSE SUBCODE	COMPONENT CODE	COMP. SUBCODE	VALVE SUBCODE
0 9	A A (11)	B (12)	A (13)	Z Z Z Z Z Z (14)	Z (15)	Z (16)

(17) LER/RO REPORT NUMBER	EVENT YEAR		SEQUENTIAL REPORT NO.		OCCURRENCE CODE	REPORT TYPE		REVISION NO.
	7 8	—	0 0 6	/	0 3	L	—	2

ACTION TAKEN	FUTURE ACTION	EFFECT ON PLANT	SHUTDOWN METHOD	HOURS (22)	ATTACHMENT SUBMITTED	NPRD-4 FORM SUB.	PRIME COMP. SUPPLIER	COMPONENT MANUFACTURER
F (18)	F (19)	A (20)	A (21)	0 8 0 0	Y (23)	N (24)	A (25)	Z Z Z Z (26)

CAUSE DESCRIPTION AND CORRECTIVE ACTIONS (27)

1 0 Following reactor shutdown on 7-27-78 an investigation by Bechtel Power Corporation
1 1 and Georgia Power Company personnel revealed stratification of air temperatures in
1 2 the drywell. Analysis of the problems resulted in an outage from 8-20-78 to 9-15-78
1 3 as detailed in the attachment. The attachment was inadvertently left off Revision I
1 4 and is being transmitted as Revision 2.

	FACILITY STATUS	% POWER	OTHER STATUS (30)	METHOD OF DISCOVERY	DISCOVERY DESCRIPTION (32)
1 5	B (28)	0 0 0 (29)	N/A	C (31)	Startup Testing

	ACTIVITY RELEASED	CONTENT OF RELEASE	AMOUNT OF ACTIVITY (35)	LOCATION OF RELEASE (36)
1 6	Z (33)	Z (34)	N/A	N/A

PERSONNEL EXPOSURES

	NUMBER	TYPE	DESCRIPTION (39)
1 7	0 0 0 (37)	Z (38)	N/A

PERSONNEL INJURIES

	NUMBER	DESCRIPTION (41)
1 8	0 0 0 (40)	N/A

7902150363

LOSS OF OR DAMAGE TO FACILITY (43)

	TYPE	DESCRIPTION
1 9	Z (42)	N/A

PUBLICITY (45)

	ISSUED	DESCRIPTION	NRC USE ONLY
2 0	Y (44)	Press Release on Aug. 21, 1978 announcing outage.	

NAME OF PREPARER T. V. Greene, Supt. of Plt. Eng. PHONE: (912) 367-7781

PLANT E. I. HATCH UNIT II
PRIMARY CONTAINMENT COOLING MODIFICATION

During the heatup plateau of the Unit II Startup Program it was observed that the average drywell air temperature was exceeding the 135 degree limit as specified in the Hatch Unit II Technical Specifications. The Technical Specification violtion was first observed by Jeff Chumley, Georgia Power Test Engineer, while he was performing startup test HNP-2-10244, "Drywell Temperatures," on July 20, 1978. The arithmetic average at this time was determined to be 143 degrees F with the reactor at 160 psig and 370 degrees F.

To bring the drywell air temperature below the Technical Specification limit, all of the standby Drywell Cooling Fans were placed in service. Within three hours the average drywell temperature had been reduced to 132.5 degrees F, and in another 4 hours it had dropped to 124 degrees F.

The following morning, July 21, Bechtel was notified of the problem we were experiencing. Their mechanical design group asked us to begin monitoring drywell air temperatures on a regular basis while experimenting with various cooling and recirculation fan alignments.

Again, on July 23, the Technical Specification limit of 135 degrees F was exceeded when reactor pressure was increased to 525 psig. In an effort to decrease the drywell temperature, two of the Reactor Building coolers were taken out of service to reduce the load on the Reactor Building chillers. This brought the temperature down to 131 degrees F. As reactor pressure was increased to 500 psig at 480 degrees F the drywell temperature again exceeded 135 degrees F. Standby Gas Treatment and the Drywell Purge Fan were placed in service, as reactor pressure was lowered, in order to help reduce the drywell temperatures.

Bill Papproth of Bechtel arrived on site July 24 to analyze the Drywell Cooling System.

On July 26, management decided to bring the reactor to cold shutdown to allow Bechtel to enter the drywell for an inspection of the Drywell Cooling System.

Bechtel representatives and Georgia Power Company engineers and maintenance personnel entered the drywell of July 27 to begin their inspection. They found the rupture discs missing from the sacrificial shield which allowed the air, designed to flow in the annulus between sacrificial shield and the reactor insulation, to escape. They also discovered that the annulus was less than one inch wide where design had specified 3 inches, thus cutting down on the area for air flow from the Drywell Cooling System. See Figure 1 for schematic of the Drywell Cooling System.

Bechtel directed that several runs of temporary ducting be installed to redistribute the cool air at the bottom of the drywell to the hotter upper regions and duct the hotter air from the top of the drywell to the larger capacity coolers at the bottom.

Following the installation of the rupture discs and the temporary duct work per temporary DCR 78-212 the reactor was again brought critical on July 29. The reactor was brought to 365 psig on July 30 and eleven hours later the drywell temperature exceeded 135 degrees F. Reactor shutdown began immediately to allow Bechtel to do further work in the drywell.

From July 31 to August 3, under Bechtel's direction the following changes were made:

(1) Reversed the direction of air flow of 2T47-C002 A and B to force more air up through the annulus area per temporary DCR 78-223.

(2) Installed two thermocouples in the air gap between the sacrificial shield and reactor insulation, two thermocouples on reactor insulation and relocated temperature elements 2T47-N002, 2T47-N010 and 2T47-N001K per temporary DCR 78-232.

(3) Installed temporary 24 inch ductwork from fan 2T47-C001A to inlet of fans 2T47-B008 A&B and replaced existing suction ductwork for 2T47-C001A with flexible ductwork per temporary DCR 78-230.

(4) Sealed off CRD cavity area by the installation of a door at the CRD cavity entrance to allow cavity area to be pressurized to help in the moving of air up through the annulus area per temporary DCR 8 [illegible].

(5) Installed wedges between the sacrificial shield and reactor insulation to increase the air gap of the annulus to increase air flow.

(6) Inspected reactor insulation for proper installation.

(7) Reduced chilled water flow to the lower drywell cooling units, 2T47-B008 A & B and 2T47-B009 A&B, to increase flow to upper cooling units, 2T47-B007 A&B.

(8) Carl Sox of Environmental Balance Corporation rebalanced drywell cooling fans air flow per Bechtel's instructions.

Reactor was brought to 500 psig and 470 degrees F on August 4 to evaluate the Drywell Cooling System. Drywell average air temperature again exceeded 135 degrees F approximately 32 hours after the reactor went critical. Reactor was again brought to cold shutdown, on August 5, for additional changes.

The following changes were made under Bechtel's instructions on August 5 and 6:

(1) Blade pitch on fans 2T47-B007 A&B were increased, to increase air flow through these units by approximately 50%, per TER 78-6.

(2) The supply ducts to the CRD cavity from 2T47-B008 A&B and 2T47-B009 A&B were blanked off to direct more air up through the annulus and up to the hotter upper regions of the drywell per TER 78-6.

(3) A sheet metal ring was intalled around the reactor skirt to isolate the annulus from CRD cavity area per TER 78-6.

(4) Existing temporary flexible duct was removed from 2T47-C001A and replaced with a temporary sheet metal suction bell. 2T47-C001B was also fitted with suction bell per TER 78-6.

(5) The 2T23 instrumentation in drywell was put back in service to provide additional temperature readings.

On August 7, reactor was brought to 575 psig and 485 degrees F for evaluation of changes made in drywell thus far. Drywell temperature exceeded 135 degrees F about 30 hours after reaching 575 psig. The reactor pressure was then reduced to 400 psig on August 9 to maintain drywell temperature at approximately 130 degrees F, while management was waiting word from NRC for a Techincal Specification change which would allow use of a volumetricly weighted formula for computing average drywell air temperature.

Due to a problem with the drywell to torus vacuum breakers the reactor was brought to cold shutdown on August 11.

While the reactor was down the following additional changes were made per TER 78-8:

(1) The bottom of the reactor vessel insulation was flashed so that air could not flow between reactor vessel and insulation which could cause higher heat transfer from the reactor vessel to the drywell thus placing a greater load on the Drywell Cooling System.

(2) The reactor stabilizer covers were removed in hopes of increasing air flow in the annulus area.

(3) The reactor/dyrwell bellows was insulated to decrease the amount of heat flux from reactor vessel to drywell air.

(4) Temporary temperature elements were installed by request of Transco, RPV insulation supplier, to evaluate insulation and to estimate heat load.

(5) The annulus between the sacrificial shield wall and the RPV insulation was checked for debris which might have blocked air flow. Several items, including a welder's brush and miscellaneous trash, were found in the air space and removed.

(6) Air flow readings were taken to determine air flow being supplied to annulus and amount leaving annulus at the top of the sacrificial shield. It was found that 13,500 cfm was being supplied to the annulus but only approximately 650 cfm exhausting at the top, which showed a substantial amount of air leakage from the annulus through the sacrificial shield penetrations.

Following the completion of the items above, the reactor was broght critical on August 14, after being down for three days. Also on August 14, Max Manary, Plant Manager, received word from the NRC that the volumetric weighting for drywell temperature averaging was acceptable.

On August 16, 32 hours after going critical and at 1005 psig, the drywell temperature reached 134.7 degrees F and all the standby cooling fans had to be started to reduce drywell temperature. Reactor pressure was reduced to 940 psig and drywell cooling returned to normal configuration. At this lower pressure the drywell was maintained at 132 degrees F.

Plant management decided on August 19, to bring the reactor to cold shutdown to allow construction to enter the drywell and make permanent modifications to the Drywell Cooling System. The reactor was in cold shutdown on August 20, and all startup testing for Hatch Unit II was discontinued until the completion of the Drywell Cooling Modification Outage.

DRYWELL COOLING OUTAGE
August 20 to September 15

To best describe the outage and what was done, a before and after look at the Drywell Cooling System design will be presented here, which will encompass all work done to the system per DCR 78-270.

ORIGINAL DRYWELL COOLING DESIGN

Figure 1 shows the original Drywell Cooling System design schematically. The original fan line up was to have the following fans running: 2T47-B007A, 2T47-B008A, 2T47-B009A, 2T47-C001A, 2T47-C002A and 2T47-C002B with the other four fans in standby. With this line up, 4000 cfm was being supplied to the CRD cavity area by 2T47-B008A and 2T47-B009A, 4000 cfm was being exhaust the CRD cavity area by recirculation fans 2T47-C002A and 2T47-C002B. Fans 2T47-B008A and 2T47-B009A were also to supply a total of 8000 cfm to the annular space between the sacrificial shield and the reactor vessel insulation. This 8000 cfm was to travel up the annulus picking up heat lost from the RPV insulation, thus reducing sacrificial shield temperature, until it reached the top of the sacrificial shield where it would exit into the upper drywell region at elevation 185'. The remaining 38,000 cfm supplied by 2T47-B008A and 2T47-B009A was directed at other loations of drywell between the 130' and 158' elevations. Air movement between elevations 158' and 185' was to be by natural circulation. In the upper elevation of the drywell, 2T47-B007A supplied 5000 cfm through a ring header in the drywell dome and 1000 cfm into the drywell below the bellows at elevation 200'. Recirculation fan - C001A removed 5000 cfm from the drywell dome through a single inlet and 1000 cfm from below the bellows at elevation 200' and discharged the total 6000 cfm down the drywell at elevation 182' just below the - B007A intake. The four standby fans were only to come on if an operating fan failed or if the air temperature in the CRD cavity area exceed 148 degrees F.

Chilled water flows to the fans were as follows:

B007A	- 53 gpm
B008A	- 213 gpm
B009A	- 213 gpm
Total	- 479 gpm

The chilled water is supplied by the Reactor Building chillers which also supplies the Reactor Building and Radwaste Building area coolers. The ductwork in the drywell was fabricated from ASTM A 167, stainless steel sheet, Type 304, No. 2D finish.

REVISED DRYWELL COOLING DESIGN

As a result of the experimentation and data analysis between July 20, 1978 and August 20, a final design was formulated by Bechtel that would optimize the Drywell Cooling System with the least amount of down time for the reactor. A reactor outage was necessary due to high temperature and radiation levels in the drywell and the length of time needed to do the work. Also the northeast drywell hatch plug had to be removed to allow the transfer of equipment and materials in and out of the drywell. A 28 day outage was approved by Georgia Power Company management to implement design change 78-270.

Figure 2 shows the resulting Drywell Cooling System design. The present fan line up is: 2T47-B007A, 2T47-B007B, 2T47-B008A, 2T47-B009A, 2T47-C001A, 2T47-C001B, 2T47-C002A, and 2T47-C002B running with 2T47-B008B and 2T47-B009B in standby. The only logic change needed to accomplish this was to remove the interlock between 2T47-B007A and 2T47-B007B which prevented both fans from running simultaneously.

All of the temporary ductwork, installed during the previous short outages, was removed from the drywell before the actual installation of the modified ductwork began.

A ring header extending 90 degrees around the drywell from east to south was tied into the existing discharge duct of B007A as seen in Figure 3. This ring header delivers 6500 cfm to the upper drywell through two outlets as seen in Figure 4.

Fan 2T47-B007A also delivers 1500 cfm to the ring header in the drywell dome. (The resister which previously delivered 1000 cfm, just below the bellows, was closed). The rated capacity of fans 2T47-B007 A&B is now 8000 cfm due to the change in pitch of the blades made August 5 and 6, per TER 78-6. Fan 2T47-B007B was modified in a similar manner as 2T47-B007A with the same air flows.

The most extensively changed portion of the Drywell Cooling System was the upper recirculation fans 2T47-C001 A and B. The existing 7.5 hp fans were removed and replaced with 30 hp - 12,000 cfm capacity fans. The two Joy Fans purchased were received with 480 volt motors and 4 blade rotors. The motors were removed and sent to Reliance (the manufacturer) to be rewound for 600 volt duty. The 4 blade rotor was not sufficient to produce the desired performance curve, so the twelve blades were removed from the original 2T47-C001 A&B fans and installed on the new rotors. When the rewound motors were back on site, the fans were reassembled and mounted on test stands in the maintenance shop to be balanced under the direction of a Joy Manufacturing Company representative. After the successful completion of fan balancing, the two new fans were installed where the original fans had been removed at elevation 185. New cable and conduit was also required due to the larger motors. The ductwork for 2T47-C001 A&B was completely redesigned. The new design included two 24" discharge ducts, see Figure 5 one each from the fan outlets at elevation 185' down to elevation 128', see Figure 6 (typical of both fans). The suction ductwork was also modified to take suction just below the bulkhead at elevation 203' rather than from the drywell dome area. The intent of these changes was to move as much of the hot air from the top of the drywell down to the lower levels where the higher capacity cooling units were.

Two additional 24" supply ducts were added, one each from 2T47-B008A and 2T47-B009A, see Figure 7 and 8, to supply 6000 cfm each to the middle elevations of the drywell, see Figure 9. The supply ducts to the CRD cavity were left blanked off per TER 78-6.

The lower recirculation fans 2T47-C002 A&B were left with their flow directed into the CRD area per DCR 78-223.

Following the completion of ductwork and fan installation, Carl Sox of Environmental Balance Corporation rebalanced the Drywell Cooling System per the new PFD issued by Bechtel.

Other changes made included the installation of reflector shields on RTD's that were in areas of high heat radiation so that a more accurate air temperature could be recorded. The RTD's which had the reflector shields installed where 2T47-N002, 2T47-N003, 2T47-N009, 2T47-N010, 2T47-N014 and 2T47-N015. In addition to the shields, temperature elements 2T47-N002, 2T47-N010, 2T47-N014 and 2T47-N015 were relocated approximately one foot farther away from the vessel into the air stream. From the data recorded by TER 78-8 concerning the annulus air gap air flow, it was found that most of the cooling air being supplied to the annulus was being lost around the penetrations through the in service inspection doors. To alleviate this problem, neoprene gasket material and flashing was installed on the following doors: 2B11-N2A through 2B11-N2H, 2B11-N2J, 2B11-N2K, 2B11-N8A and 2B11-N8B. The CRD cavity door added by DCR 78-231 was fitted with hinges so that entrance into the area would be less difficult. The stabilizer covers removed by TER 78-8 were reinstalled per original design. The wedges between the sacrificial shield and reactor insulation were left in place to maintain the needed air gap. The increased chilled water flow to 2T47-B007 A&B was left as balanced on August 3. The flashing around the reactor skirt and at the bottom of the reactor insulation as well as the bellows insulation was left as installed per TER 78-6 and 8. Two additional fans, designated as 2T47-C0[illegible] A&B, were to be added into the new 24" supply ducts from 2T47-B008A and 2T47-B009A, however delivery was such that installation during the 28 day outage was not possible. New cables were pulled out side the drywell in anticipation of their arrival and need. Bechtel has determined from data taken during plant operation, since the outage, that these fans will not be required.

The outage lasted 26 days, two days less than scheduled. The outage went very smoothly throughout due to the cooperation by Power Generation Department Outage Coordinators and Maintenance Department, Construction Department and their contractors, and the on site Bechtel representatives.

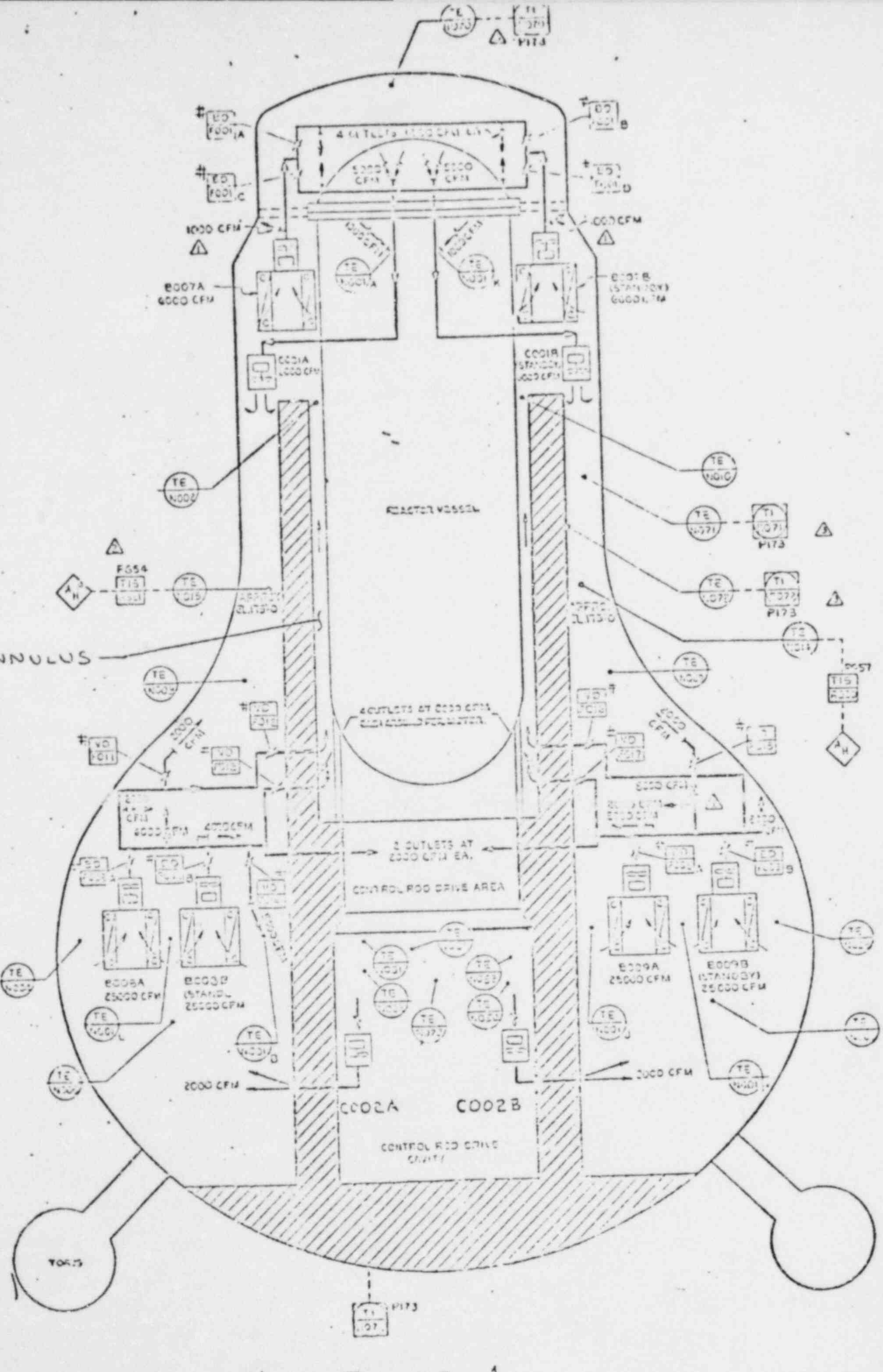
At present, the modified Drywell Cooling System is maintaining the average temperature between 128 degrees F and 130 degrees F at rated temperature and pressure.

See Attachment I for conclusions drawn by Bechtel regarding existing system performance and future changes required.

W. H. Chenault

W. H. Chenault

WHC/rc



4 OUTLETS 1000 CFM EA.
1000 CFM
E007A
6000 CFM
E007B
(STANDBY)
6000 CFM
C001A
6000 CFM
C001B
(STANDBY)
REACTOR VESSEL
ANNULUS
4 OUTLETS AT 2000 CFM
2 OUTLETS AT
2000 CFM EA.
CONTROL ROD DRIVE AREA
E008A
25000 CFM
E008B
25000 CFM
E009A
25000 CFM
E009B
(STANDBY)
25000 CFM
2000 CFM
C002A
C002B
CONTROL ROD DRIVE
CAVITY
P173

FIGURE 1

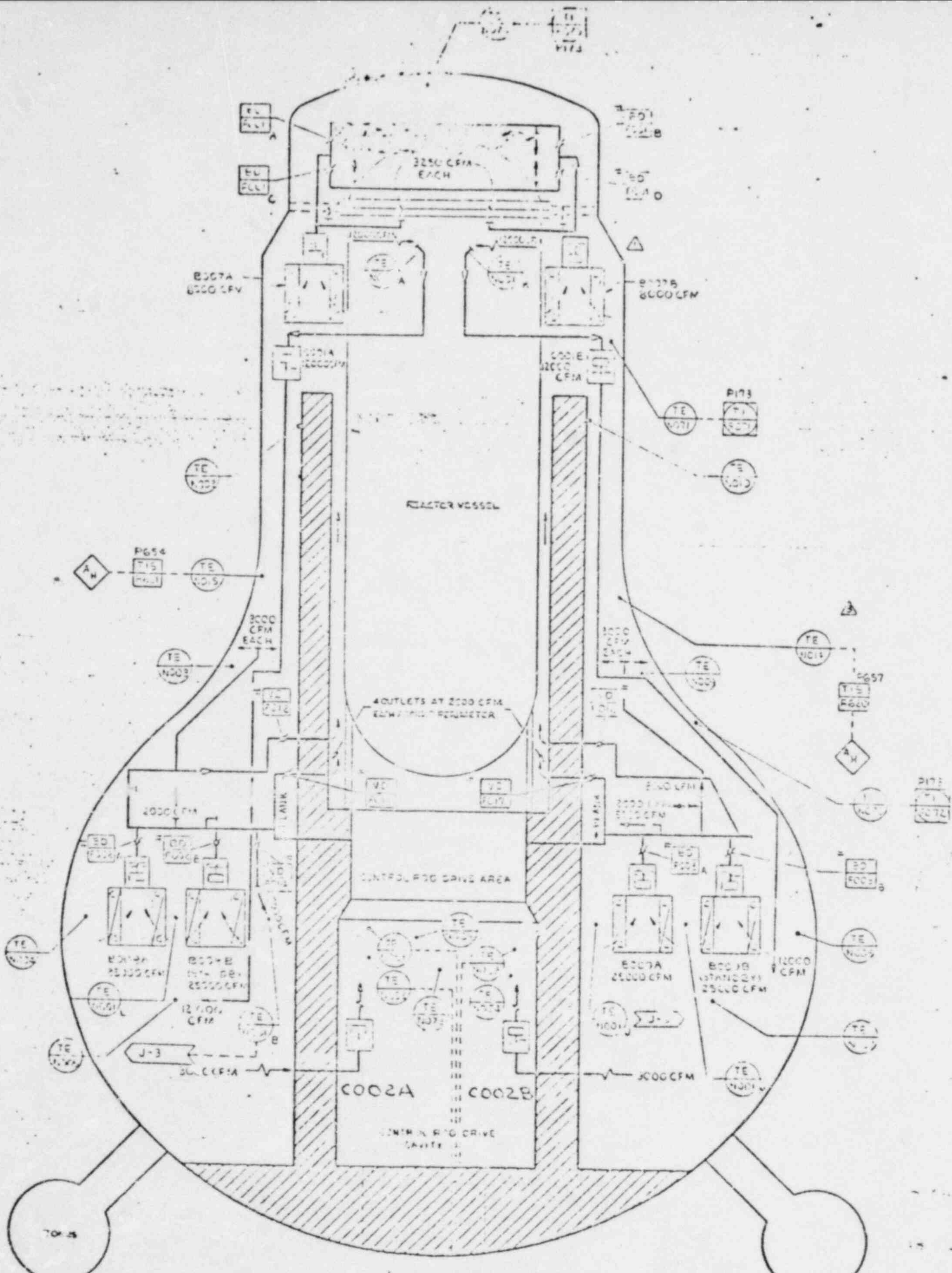
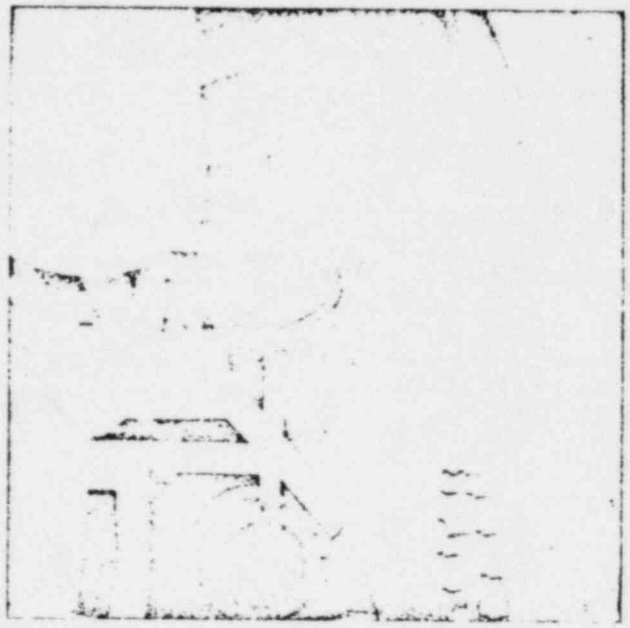

3250 CFM EACH
B007A 8000 CFM
B007B 8000 CFM
REACTOR VESSEL
P654
P173
3000 CFM EACH
4 OUTLETS AT 2000 CFM EACH AT ROOT PERIMETER
CONTROL ROD DRIVE AREA
B008A 25000 CFM
B008B (STANDBY) 25000 CFM
12000 CFM
3000 CFM
C002A
C002B
CONTROL ROD DRIVE CAVITY
TORUS
J-3

FIGURE 2

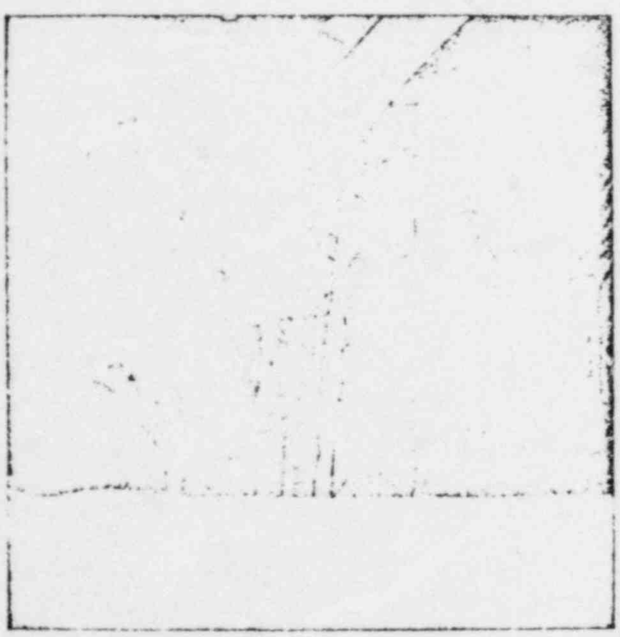
EXISTING 2T47-B007A DISCH. DUCT AND NEW 90° RING HEADER @ EL. 195'

FIGURE 3



90° RING HEADER FROM THE DISCHARGE OF 2T47-B007A @ ELEVATION 199'

FIGURE 4

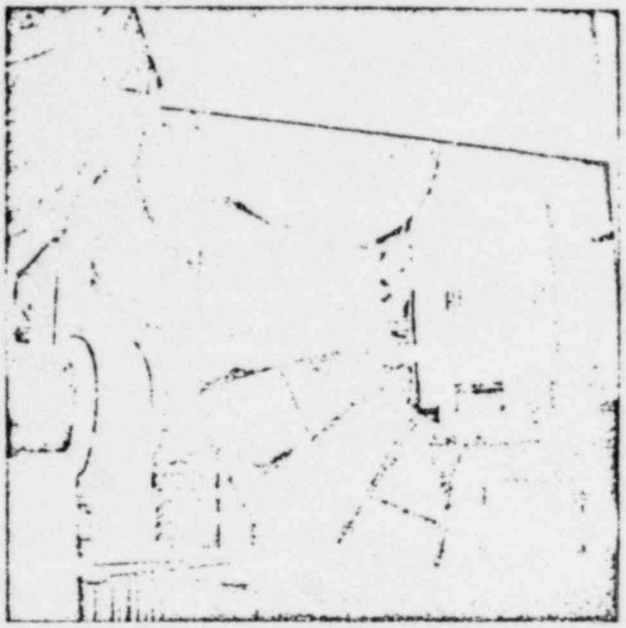


24" RETURN AIR DUCT FROM 2T47-C001B TO EL. 128'. SHOWN @ EL. 158'

FIGURE 5

2T47-C001A DISCHARGE DUCT FROM EL. 185' TO BELOW EL. 128' @ 2T47-B007A [illegible]

FIGURE 6



NEW 24" SUPPLY DUCT FROM EXISTING 2T47-B008A&B DUCT @ EL. 140' GOING TO EL 175'

FIGURE 7

NEW 24" SUPPLY DUCT FROM EL. 140' TO EL. 175'. SHOWN @ EL. 158'.

FIGURE 8

TOP OF 24" SUPPLY LINE. FROM 2T47-B009A&B @ EL. 161'. ONE OUTLET NORTH AND SOUTH

FIGURE 9

REFLECTOR SHIELD INSTALLED OVER EXISTING DRYWELL AIR TEMPERATURE RTD

FIGURE 10

ATTACHMENT 1 p.

Bechtel Power Corporation

15740 Shady Grove Road
Gaithersburg, Maryland 20760
301-948-2700

October 6, 1978

Mr. M. Manry
Georgia Power Company
Production Department
P.O. Box 442
Baxley, Georgia 31513

Dear Mr. Manry:

E. I. Hatch Nuclear Plant Unit 2
Bechtel Job 6511-020
Drywell Cooling System Modifications
and Post-Modification Testing
File: A-29.3/SS-2102-160/SS-2115-2/B-GP-5899

As you are aware, subsequent to accomplishing the drywell cooling system ductwork modifications, the air handling equipment was balanced by Environmental Balance Corporation. We have reviewed the data supplied by Environmental Balance, and find the system balance reported, to be acceptable.

Also, we have reviewed the drywell temperature data acquired during the post-modification testing period and we draw the following conclusions:

A. Additional modification will be required, during the first refueling outage, for the ductwork above the reactor well bulkhead, to enhance air distribution in the volume over the RPV head (see attached sketch) and,

B. In order to regain cooler redundancy, the RPV insulation system problems must be corrected, at least for the insulation above the top of the sacrificial shield wall. (i.e. - above el. 188'0") Refer to problems report attached, for more information.

Enclosed is a summary report of the Drywell Cooling System Problems.

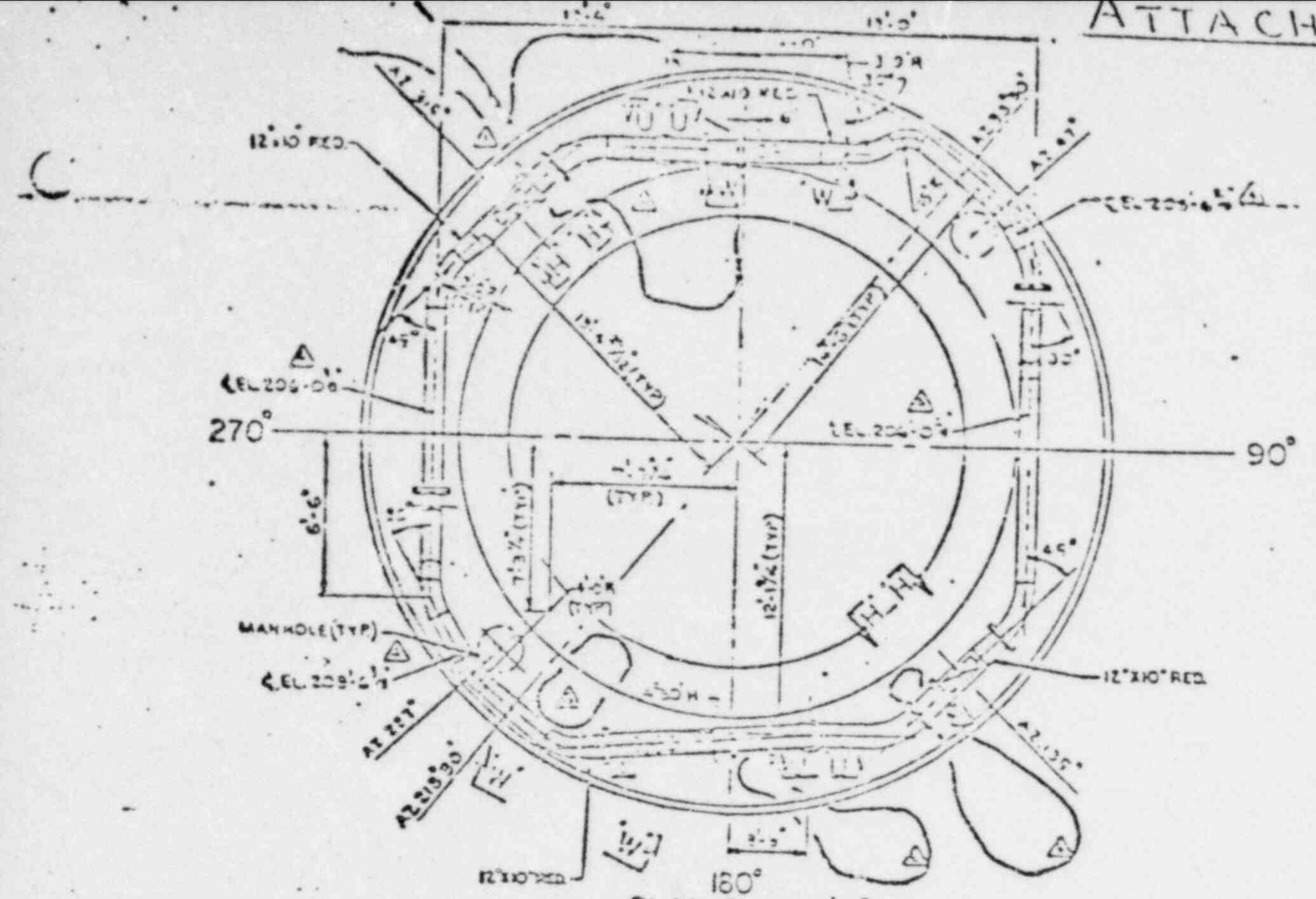
If we may be of service in the future, please advise.

Very truly yours,

T J McDonald

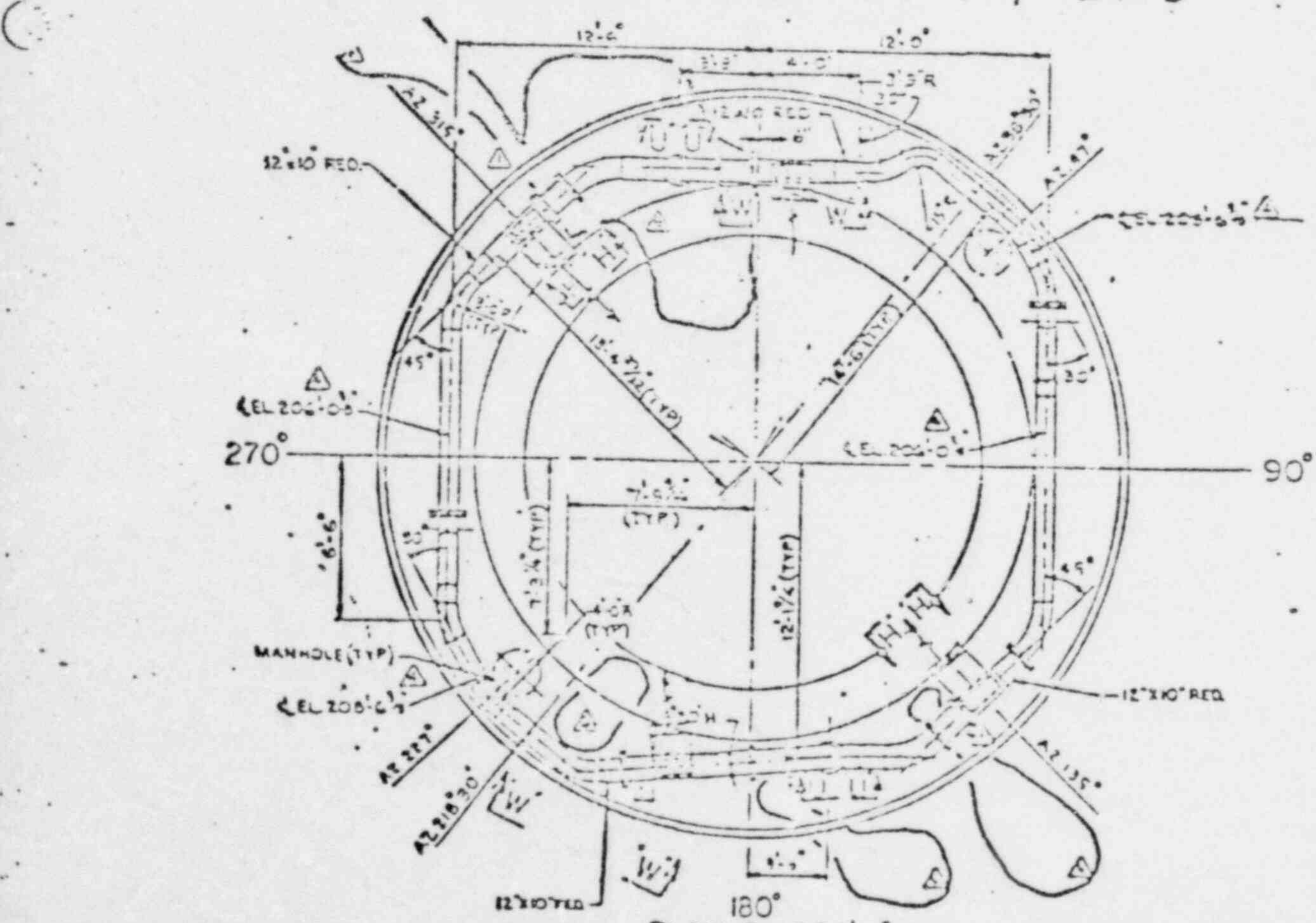
T. J. McDonald
Project Engineer

MSD:WJP:dln
Enclosure
cc: V. C. Valekis, w/encl.
W. A. Widner, w/encl.
J. R. Jordan, w/encl.
H. H. Gregory, III, w/encl.



PLAN EL. 206'-0"

AS SHOWN ON DRAWING H-26144, REV. 6



PLAN EL. 206'-0"

AS SHOWN ABOVE, MODIFIED TO ADD FOUR VENT DUCT RISERS AND 180° ROLLED DUCT AT W-W

EDWIN I. HATCH NUCLEAR PLANT
UNIT 2
GEORGIA POWER COMPANY

DRYWELL COOLING SYSTEM PROBLEMS

Background:

On July 19 and 20, 1978, Georgia Power Company informed Bechtel-Gaithersburg that they were experiencing difficulty with the drywell cooling system, a system which Bechtel-Gaithersburg had designed and provided. Specifically, the system could not be operated in a fashion which would maintain an average containment drywell air temperature of 135°F or less, as required by the plant technical specifications. On Sunday, July 23, 1978, a team of engineers was dispatched to the plant site to evaluate system performance.

Description of the System:

The drywell cooling system for HNP-2 is a chill water-to-air cooling system with a design of approximately 415 tons ($\sim 5 \times 10^6$ BTU/Hr) of heat removal capacity. The system (shown schematically on Bechtel Drawing H-26074) utilizes three (3) normal operating air-to-chill water coolers and three (3) normal operating air circulating fans.

As provided, the system represents a compromise with considerations given to equipment space availability and optimum system performance.

In order to provide proper air movement and cooling, the system relies on the principle that hot, or heated air rises and cold, or cooler air descends. Design parameters for the sacrificial shield inside diameter and the RPV insulation outside diameter were specified to provide a 3 inch air gap for ventilation cooling air flow from bottom to top. Based on an 80 BTU/Hr. heat loss from the insulation surface, and with 8000 Cfm cooling air at 75°F entering the base of the sacrificial shield, it was estimated that the air exit temperature to the upper drywell area would have been approximately 110°F (plus or minus 10°F).

Heated air within the upper drywell was anticipated to mix with the exiting air from the sacrificial shield annulus, and be cooled and exhausted by the air handling equipment provided. The volume above the reactor well floor, confined by the drywell head, was to be cooled by supplying 75°F supply air to the region, and then exhausted to the annulus created by the concentric configuration of the sacrificial shield and the cylindrical portion of the drywell.

The large volume within the spherical section of the drywell, as well as the CRD cavity within the RPV pedestal are served by two chill water cooling units which provide cooled air at a design temperature of 75°F to the base of the sacrificial shield, the upper CRD cavity and the elevation 127' and 150' (MSL) volumes.

Discussion of the Problems Encountered:

Upon arrival at the jobsite, and for a period of approximately 60 hours, an evaluation of system performance was conducted with the following findings:

a. Cooling Units 2T47-B007A and 2T47-B007B, located in the drywell upper volume (elevation 185' 0") were operating simultaneously, with a heat removal duty of approximately 1.1 million BTU/HR (almost twice the design specified capacity) per unit.

b. Cooling Units 2T47-B008A and 2T47-B009A, located in the drywell spherical volume (elevation 127') were operating at a heat removal duty of approximately 660 thousand BTU/HR (only about 30 percent of the design specified capacity) per unit.

c. Peak drywell temperatures were recorded as high as 250°F (near the reactor well bellows, el. 200') and simultaneously as low as 80°F (in the CRD Cavity).

On July 26, 1978, the unit was placed in a shutdown and cooled down condition, with the following course of action:

1. Provide a supply air header for cooling unit 2T47-B007A, to be located at ~ elevation 198', immediately below the reactor well bulkhead.

2. Provide discharge duct for circulating fan 2T47-C001B, to allow fan discharge to cooler suctions for cooling units 2T47-B009A and/or 2T47-B009B. (1-24" Elephant Trunk)

3. Eliminate exhaust air ducting for fan 2T47-C001B above elevation 190', to allow evacuation of the volume immediately below the reactor well bulkhead.

4. Provide 4000 cfm of supply air to drywell elevation 175', to provide cooling air injection at the main steam line chase volume. (2-16" Elephant Trunks)

During the period of plant downtime to effect the above modifications, an inspection of the drywell revealed that two closure devices at the base of the sacrificial shield had been omitted during plant construction. The omission of the closure devices (Rupture Discs 2T47-D001 A and B) resulted in the annulus cooling air bypassing the annulus and "short circuited" a cooling air flow of 8000 cfm, intended to be provided to the upper drywell volume. Additionally, the inspection revealed that the specified cooling air gap of 3", between the RPV insulation and the sacrificial shield had not been maintained, and the actual gap thickness was found to be non-uniform and varying from 0" in some locations to ½" in others. (This is due to the sacrificial shield not being plumb and also due to insulation not being installed as shown on engineering dwgs.).

In an effort to assess the ramifications of the lack of cooling air for the sacrificial shield, Civil and Nuclear Engineers at Gaithersburg were consulted. It was determined that the concrete within the sacrificial shield wall does not contribute to the stability of the structure, but is provided to shield the drywell components from the nuclear radiation emitted from the reactor core during plant operation. The temperature of the outer surface of the sacrificial shield will be monitored and the resulting data will be used to calculate concrete temperatures within the shield. Then the adequacy of the concrete with respect to neutron shielding can be evaluated.

It was also noted that the RPV flange bellows was uninsulated and as such conservatively transmits more than 100,000 BTU/Hr. to ambient. GPC agreed to insulate this shield.

During the evaluation of the shield, it was also determined that numerous holes had been provided in the RPV pedestal by the containment erector. These holes, or ports were provided to allow access to the vessel skirt hold-down bolting during vessel seating and torquing. These ports provide a path for air flow to and from the annulus and CRD Cavity. A review of the drywell cooling system design has revealed that these ports were not considered during the design phase, and may have contributed to poor system performance had the previously mentioned deficiencies not occurred.

In addition to the modifications above, Georgia Power Company Construction Management effected the installation of rupture discs. 2T47-D001 A and B.

Following the above repairs and modifications, the unit resumed startup testing, and the Bechtel engineering team proceeded to evaluate the effectiveness of the system modifications.

On July 30, 1978, with reactor coolant temperature at 488°F, the average drywell temperature was computed to be 135.2°F, and plant management decided to terminate the test program for additional modification.

The following additional modifications were effected:

1. Reverse the flow direction for fans 2T47-C002A and B, so that cooled air may be exhausted from elevation 118' 0" and pumped

to the CRD Cavity, to provide pressurization of the RPV pedestal and, via the hand-holes, the sacrificial shield annulus.

2. Provide a closure for the lower CRD Cavity access, to allow pressurization of the compartment via fans 2T47-C002 A and B, as mentioned above.

3. Provide discharge ducting and modify the suction duct network for fan 2T47-C001A, as previously described for fan 2T47-C001B.

4. Evaluate volume flow rates for cooling system units 2T47-C001A, C001B, B007A, B008B, and B009B.

5. With the advice of North Brothers, Inc. and Georgia Power Company Construction, open the RPV insulation-to-shield wall gap to the maximum possible width.

6. Measure air gap flows.

Prior to resuming plant testing, the total volume flow rates for the various paths are quantified as follows:

a. From 2T47-B008A/B to elevation 179' (MSL), 1600 cubic feet per minute. (Through a 16" elephant trunk)

b. From 2T47-B008A/B to the RPV insulation-to-shield wall air gap, 7,500 cubic feet per minute.

c. From 2T47-B009A/B to elevation 179' (MSL), 1300 cubic feet per minute (Through a 16" elephant trunk)

d. From 2T47-B009A/B to the RPV insulation-to-shield wall air gap, 6,000 cubic feet per minute.

e. From 2T47-C001A to Cooling Unit 2T47-B008B, 3,400 cubic feet per minute. (Through a 24" elephant trunk)

f. From 2T47-C001B to Cooling Unit 2T47-B009B, 3,000 cubic feet per minute. (Through a 24" elephant trunk)

g. RPV insulation-to-shield wall gap discharge, 1,200 cubic feet per minute.

Resuming plant heatup on August 3, 1978, we found drywell average temperature again exceeding 135°F, and in an attempt to correct the apparent heating problem Bechtel suggested reducing air flow to the RPV insulation-to-shield wall gap by closing first two volume dampers and then isolating the air gap completely. The intent was to reduce air leakage to annulus between RPV and insulation. The effect was not noticeable.

Stopping circulating fans 2T47-C002A and B proved to have no effect on reducing the average drywell temperature; however, the reduction of CRD Cavity pressurizing air also had no effect on CRD Cavity temperature. On August 4, 1978, the plant was again shutdown for further ventilation modifications.

Through the period August 5 through August 7, 1978, the following modifications were effected:

1. Supply air ducts to the CRD Cavity were closed with in-duct blanking gaskets.

2. Construction debris was removed from the RPV insulation-to-shield wall air gap, to the extent possible.

3. Discharge ducting from circulating fan 2T47-C001A was re-connected to the fan discharge flange.

4. Suction ducting for fans 2T47-C001 A and B, including suction bells, were fabricated and installed, to allow exhausting air from the refueling bellows.

5. RPV pedestal bolting ring holes were covered to provide pressurization of the RPV insulation-to-shield wall air gap.

6. Insulation was installed on the RPV refueling bellows.

7. Obvious openings in the RPV insulation can were closed with sheet metal plates.

8. Temperature elements 2T47-TE-N002, N014 and N015 were relocated away from the shield wall.

9. Temperature elements 2T47-TE-N014, N015, N003 and N009 were shielded from the unpainted shield wall.

10. Thermocouples were installed to monitor the following locations:

    a. RPV insulation-to-shield wall air gap temperature at elevations 145 and 190

    b. Shield wall interior temperature at elevation 190 and 145

    c. Insulation surface temperature at elevation 190 and 145, interior and exterior

    d. Inservice Inspection gap temperature at elevation 190 and 145

    e. Shield wall exterior temperatures at elevations 160, 170, and 180, and

    f. RPV refueling bellows surface temperature.

Resuming plant testing operations on August 7, 1978, in lieu of utilizing an arithmetic average temperature, a change to plant technical specifications allowed volumetric weighting of the drywell air temperatures. Although the peak temperatures within the containment were greater than desired, the average drywell temperature was calculated to be less than 135°F (i.e., 133°F) with a reactor coolant temperature of 545°F (rated).

On August 21, 1978, plant operations were curtailed to allow installation of permanent ductwork and modifications of insulation and instrumentation. The following work was accomplished:

1. Sixteen (16) gauge, 24 inch nominal diameter stainless steel ductwork was installed to provide;

   a. Air distribution to elevation 175'0" (MSL) from cooling units 2T47-B008 A (B) and 2T47-B009 A (B) and,

   b. Heated air transport from elevation 200'0" (MSL) to elevation 120'0" (MSL) via circulating fans 2T47-C001 A & B.

2. Twenty-two (22) inch nominal diameter ductwork was also added to cooling units 2T47-B007 A and B to provide cooled air distribution at elevation 190'0" (MSL).

3. Circulating fans 2T47-C001 A and B, originally specified as Joy Manufacturing Co. Model 23-17.5-1750, were replaced with Model 23-17.5-3500, acquired from Philadelphia Electric Company's Limerick station. This was accomplished to provide an increase in exhaust air flow rate, from 6,000 cfm to 12,000 cfm.

4. Fan blades in cooling units 2T47-B007A and B were adjusted to provide a nominal air volume flow rate of 8,000 cfm per unit.

5. In an effort to reduce the convection heat transfer within the inservice inspection volume bounded by the RPV insulation and the RPV shell, North Brothers, Inc. applied stainless steel flashings at insulation penetrations for nozzles N8A and B, N11A and B, N12A and B, and N16A and B.

6. To reduce the shield wall to RPV insulation annulus cooling air bypass flow, inservice inspection door penetrations seal flashing was installed at doors N8A and B and N2A,B,C,D,E,F, G,H,J, and K.

7. To enhance air temperature sampling, RTD's 2T47-TE-N002, N010, N014, and N015 were relocated and reflective shield cans were installed on RTD's 2T47-TE-N003, N009, and the aforementioned, to reduce and/or eliminate radiant heat gain of the sensor probe.

Following the post-modification balancing of the drywell cooling system, the plant was returned to start-up testing operation. As of this date, (October 2, 1973), the unit has achieved 20% thermal power and average drywell temperatures have typically not exceeded 127°F. Peak containment temperatures below the reactor well bulkhead is ~ 167°F, in the vicinity of elevation 200'0" (MSL). The containment temperatures are distributed as follows:

Elevation (MSL)	Average Temperature (°F)
190'0"	143 (average of 3 RTD's)
175'0"	126.5 (average of 2 RTD's)
158'0"	152.3 (average of 3 RTD's)
130'0"	126 (average of 8 RTD's)

Pre-modification containment temperatures were distributed as follows:

Elevation (MSL)	Average Temperature (°F)
190'	175.7 (average of 3 RTD's)
175'	152.5 (average of 2 RTD's)
158'	146.3 (average of 3 RTD's)
130'	106.75 (average of 8 RTD's)

And, containment peak temperature prior to the modifications was recorded as high as 256°F.

Due to the difficulties associated with accurately estimating the interior surface temperature of the shield wall and thus determing sacrificial shield concrete temperatures, Georgia Power Company has agreed to install (on both the outer & inner surface of the sacrificial shield) temporary thermocouples in the vicinity of the N16A and B doors. Data provided by these thermocouples will allow an accurate determination of shield wall concrete temperatures. Estimates to date indicate concrete to be ≤ 200°F, below elevation 175'0".

To regain redundancy in the upper drywell volume cooling units (2T47-B007 A and B) the convection currents within the inservice inspection annulus must be eliminated/reduced. As previously stated, these convection currents result in failure of the RPV insulation to perform its intended function, thus causing excessive heat transfer to the upper drywell. Transco, Inc., the insulation supplier, has stated that it is possible to do at least two things, in the interest of reducing vessel heat loss. These are:

1. Add a convection air break (i.e., baffle) at, or near the top of the sacrificial shield wall within the inservice

inspection annulus, or

2. Eliminate the inservice inspection annulus above the sacrificial shield wall and apply the vessel insulation directly to the RPV outside diameter.