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March 25, 1982

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Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Adensam:

In the Matter of the Application of ) Docket Nos. 50-390
Tennessee Valley Authority ) 50-391

Enclosed is a revised response to NRC question 450.1 on Watts Bar Nuclear Plant. This revision which addresses the 4-inch excess letdown line should resolve open item 79 of the draft Safety Evaluation Report.

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Regulation and Safety

Sworn to and subscribed before me
this 25th day of March 1982
Paulette H. White
Notary Public
My Commission Expires 9-5-84

Enclosure
cc: U.S. Nuclear Regulatory Commission
Region II
Attn: Mr. James P. O'Reilly, Regional Administrator
101 Marietta Street, Suite 3100
Atlanta, Georgia 30303

B001
1/1

450.1 Question
(15.6.2)

In evaluating the radiological consequences of the failure of small lines carrying primary coolant outside the containment, provide the following:

a. size and type of all small lines carrying primary coolant outside containment (including CVCS letdown line);

b. mass of reactor coolant released during accident;

c. summary of primary system iodine activity during the accident and its effects on the calculated accident consequences;

d. iodine transport mechanism and release path from the leak point to the environment;

e. isolation valve closure time and leakage rate;

f. detailed and chronological description of primary system response, including system response time, operator action, valve closure times, etc.;

g. figure indicating primary system pressure and temperature as a function of time during an accident; and

h. figure indicating leak rate from the failure of small lines as a function of time.

RESPONSE:

A. Size and type of all small lines carrying primary coolant outside containment (including CVCS letdown line):

1. Four 3/4" normally isolated (two normally closed inboard isolation valves and a normally closed outboard isolation valve on each) sampling lines.

2. 2" CVCS letdown line. There are three inboard isolation valves (FCV-62-72, -73, and -74) in parallel and one outboard isolation valve (FV-62-77) in series.

3. 4" CVCS excess letdown and seal water return line. The inboard isolation valve is FCV-62-61 and the outboard isolation valve is FCV-62-63.

4. Four 2" seal water supply lines. Two check valves in each line prevent backflow in these lines.

5. 3" normal charging line. Inside containment, this line contains three parallel check valve/flow control valve combinations in series with another check valve to prevent backflow in this line.

B. Mass of reactor coolant released during accident:

1. The sample lines are normally isolated and are only opened up to allow flow out of containment when a sample is being taken. If a line was broken, the operator would not be able to obtain a sample and would realize a problem existed and isolate the line precluding further inventory loss. Assuming the operator required 30 minutes to isolate the line, an ideal orifice, and full power operating conditions, the flow rate out of the break is 65 gpm and the total mass released is 1950 gallons.

2. Break of the CVCS letdown line. The normal letdown flow rate is 75 gpm (WBN FSAR Table 9.3-4). Assume the letdown=charging=75 gpm when the CVCS letdown line breaks downstream of the letdown heat exchanger (HTX). It is assumed that the flow out the break is limited to 75 gpm by the letdown orifice (ID of the orifice is 0.272 ±.002 inch). The inventory loss is seen in the volume control tank (VCT). Assume the VCT was at the high level alarm setpoint (65" increasing) before the break. At 5" decreasing, the VCT will be isolated (FCV-62-132 and -133 close) from charging pump suction. Suction is switched to the RWST. The mass lost from the VCT before isolation is 13500 pounds.

   On VCT low level, the operating instructions require the operator to isolate letdown. Assume the operator takes 10 minutes to isolate letdown charging flow from the RWST. The inventory lost is 6100 pounds before operator action. From the draft WBN tech specs the maximum isolation time for the letdown isolation valves is 10 seconds, therefore, 100 pounds is lost during valve transition time. The associated piping would also empty. For conservatism, assume 500' of piping is involved. Piping downstream of the letdown HTX is 3". Approximately 1500 pounds drains from the piping. Total mass of reactor coolant lost = 13500 lbs + 6100 lbs + 100 lbs + 1500 lbs = 21200 lbs.

3. Assume the excess letdown line breaks downstream of the seal water heat exchanger during the heatup mode. The reactor coolant inside the reactor vessel is assumed to be at 400 $lb/in^2g$ and 350$^oF$. (The system switches over to use of the letdown line only when the pressure and temperature are higher than this. Therefore, for a break of excess letdown line, this is the most conservative assumption to be made.)

   The volume control tank (VCT) will begin to drain out the VCT drainage line side of the break until the VCT reaches a low level (65" is the normal high level, 5" is the low level that initiates isolation). At this point, logic will close valves FCV-62-132 and -133, isolating the VCT, and open valves FCV-62-135 and/or -136 to permit the charging pumps to take suction from RWST. This takes about 26 minutes (VCT drainage and isolation). The mass of reactor coolant that is lost out the break from the VCT is 13445 lbs. During this same period, another 754 gallons (29 gpm for 26 minutes) = 6148 lbs of reactor coolant is drained out from the excess letdown line side of the break. The 29 gpm is a combination of 25 gpm from a 3/8-inch orifice in the excess letdown line plus 4 gpm from the reactor coolant pump (RCP) seals. This is a total of 13445 lbs + 6148 lbs = 19623 lbs of reactor coolant out the break in first 26 minutes.

After the VCT is isolated, the reactor coolant remaining in the piping will be flushed by "clean" water from RWST; however, excess letdown will continue to flow out the break. Since the pressurizer level remains stable, the operator knows that it is not the charging line that has broken. AOI-6 tells the operator to isolate both the letdown and excess letdown lines. The operator has ten minutes to take this action. During this operator action period, the excess letdown line will lose another 250 gallons = 2038 lbs and the RCP seals will lose another 40 gallons = 326 lbs. The total mass of reactor coolant lost during this period is 2364 lbs.

After isolation, the piping from the containment isolation valve (on the excess letdown line) to the break and from the VCT drainage line to the break will drain an additional 63 gallons = 514 lbs out the break.

Total mass of reactor coolant lost = 19623 lbs + 2364 lbs + 514 lbs = 22,500 lbs.

4 & 5. A break in the seal water supply lines or in the normal charging line will not result in a direct loss of reactor coolant from inside containment because of the check valves which prevent backflow in these lines. The flow out these breaks will be coolant which has passed through the CVCS, including the mixed bed demineralizers, the reactor coolant filter, and the volume control tank. Therefore, the specific activity of the coolant released through these breaks will be much less than normal reactor coolant.

Doses have been computed for releases from the 3/4" sample line break, item 1, the 2" CVCS letdown line break, item 2, and the 4" CVCS excess letdown and seal water return line break, item 3, and are shown in Table 450.1-1.

C. The normal makeup system can maintain pressurizer level and Reactor Coolant System pressure for a break through a 0.375 inch diameter hole resulting in a loss of approximately 17.5 lb/sec (WBN FSAR 15.3.1.1). Breaks in the small lines carrying primary coolant outside containment identified in part A of this question, result in loss rates less than or equal to the normal makeup flow. Loss rates due to breaks in the CVCS are assumed to be limited to 75 gpm by the letdown orifice located inside containment. Since all the breaks are isolated in 30 minutes or less there will be no affect on the primary system iodine activity during the accident. It is assumed that the iodine activity will be at tech spec limits during the entire course of the accident. Therefore, there will be no effect on the calculated accident consequences due to changes in the primary system iodine activity.

D. The coolant released through sample line breaks will be at high temperature and pressure (650°F and 2458 lb/in²g) and therefore, most of it will flash to steam. Essentially all of the iodine released through this break will become airborne in the auxiliary building. The iodine will flow through the auxiliary building into the normal ventilation system and released to the environment through the auxiliary building vent. Coolant released through the CVCS line breaks downstream of the letdown heat exchanger will be at a low temperature and pressure (150°F and 200 lb/in²g) therefore, it will not flash to steam. A small fraction of the iodine will become airborne due to partition from the liquid being released into the auxiliary building, and will be released to the environment through the auxiliary building vent.

E. Isolation valve closure time and leakage rate:

| Valve No. | Function | Max Isol. Time (sec) | Valve Size(in) | Max Leak Rate |
|---|---|---|---|---|
| FVC-43-22 | Sample RC Outlet Hdrs | 10[1] | 3/4 | 0.0038 cfh[3] |
| FVC-43-23 | Sample RC Outlet Hdrs | 10[1] | 3/4 | 0.0038 cfh[3] |
| FVC-43-11 | Sample PRZR Liquid | 10[1] | 3/4 | 0.0038 cfh[3] |
| FVC-43-12 | Sample PRZR Liquid | 10[1] | 3/4 | 0.0038 cfh[3] |
| FVC-43-75 | Boron Analyzer | 5[1] | 3/4 | 0.0038 cfh[3] |
| FVC-43-77 | Boron Analyzer | 5[1] | 3/4 | 0.0038 cfh[3] |
| FCV-62-72 | Letdown Line | 10[1] | 2 | 0.0010 cfh[3] |
| FCV-62-73 | Letdown Line | 10[1] | 2 | 0.0010 cfh[3] |
| FCV-62-74 | Letdown Line | 10[1] | 2 | 0.0010 cfh[3] |
| FCV-62-77 | Letdown Line | 10[1] | 2 | 0.0010 cfh[3] |
| FCV-62-61 | RCP Seals | 10[1] | 4 | 0.0200 cfh[3] |
| FCV-62-63 | RCP Seals | 10[1] | 4 | 0.0200 cfh[3] |
| FCV-62-132 | VCT Outlet Isol Vlv | 10[2] | 4 | * |
| FCV-62-133 | VCT Outlet Isol Vlv | 10[2] | 4 | * |

[1] Values come from the July 15, 1981, WBN draft tech specs
[2] Values come from Westinghouse drawing 115E001
[3] Values come from the Preop Test TVA-2C

*The Westinghouse valve specs require these valves to be tested to meet the leakage criteria of 3 cc/hr/nominal inch valve diameter (.0004 cfh) before being shipped and installed. No other values are available.

F,G,H.

The line sizes provided in the response to part A of this question have been evaluated in terms of primary system response. The range of line sizes are from 3/4 inch to 4 inches. Detailed and chronological descriptions of primary behavior and system response to small breaks of these sizes are included in Westinghouse Topical Report WCAP-9600, "Report on Small Break Accidents in Westinghouse NSSS." Specifically, Section 3.1 of WCAP-9600 includes a detailed description of primary behavior as well as transient plotted information such as primary system pressure and temperature, leak flow rate, and numerous other plant parameters. WCAP-9600, section 3.1, includes this information for a number of break sizes. The plant analyzed for the WCAP-9600 cases was a 4-loop, 3411 MW, non-UHI plant. The applicability of these transients for UHI plants (e.g. Watts Bar) is extensively discussed in WCAP-9639, "Report on Small Break Accidents for Westinghouse NSSS with Upper Head Injection." For breaks greater than 2 inches, UHI plant transients analyzed in WCAP-9639 apply. The one inch diameter case described in WCAP-9600 is applicable to the 3/4 inch sampling line failure.

The 2 inch diameter case in WCAP-9600 is applicable to failure of the CVCS letdown lines. The 4 inch diameter case provided in WCAP-9600, section 3.1, plus the applicability discussion and transient analyzed in WCAP-9639, section 2.1, is generally applicable to the expected primary behavior for both the 3-inch charging line and the 4-inch CVCS excess letdown line failure scenarios. It should be noted that these cases are extremely conservative since loss rate will be limited by the letdown orifice located in the CVCS letdown line inside containment (see discussion in part C of this question).

## TABLE 450.1-1

## DOSES DUE TO RELEASES FROM SMALL LINE BREAKS

<u>3/4" Sample Line Break</u>

1950 gallons released, 100-percent iodine airborne

| | |
|---|---|
| EAB Whole Body Dose | $2.8 \times 10^{-2}$ rads |
| EAB Thyroid Dose | $1.0 \times 10^{1}$ rads |
| LPZ Whole Body Dose | $6.4 \times 10^{-3}$ rads |
| LPZ Thyroid Dose | $2.3 \times 10^{0}$ rads |

<u>2" CVCS Letdown Line Break</u>

21200 pounds released, 10-percent iodine airborne

| | |
|---|---|
| EAB Whole Body Dose | $2.0 \times 10^{-2}$ rads |
| EAB Thyroid Dose | $1.3 \times 10^{0}$ rads |
| LPZ Whole Body Dose | $4.7 \times 10^{-3}$ rads |
| LPZ Thyroid Dose | $3.0 \times 10^{-1}$ rads |

<u>4" CVCS Excess Letdown and Seal Water Return Line Break</u>

22500 gallons released, 10-percent iodine airborne

| | |
|---|---|
| EAB Whole Body Dose | $2.2 \times 10^{-2}$ rads |
| EAB Thyroid Dose | $1.4 \times 10^{0}$ rads |
| LPZ Whole Body Dose | $5.0 \times 10^{-3}$ rads |
| LPZ Thyroid Dose | $3.2 \times 10^{-1}$ rads |