POWER AUTHORITY OF THE STATE OF NEW YORK

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March 31, 1983
IPN-83-23

Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing

Subject: Indian Point Unit 3
Docket No. 50-286
Additional Information Regarding IE Bulletin No. 80-04
PWR Main Steam Line Break Analysis with Continued Feedwater Addition

Dear Sir:

Attachment I to this letter provides the Authority's response to a Franklin Research Center request regarding the subject item, transmitted to us via your letter dated January 21, 1982. Subsequently, the Authority was informed during a telephone discussion with members of your staff, held on June 11, 1982, of revisions made to your request. Accordingly, our response reflects the revised version of the request. The assumptions used in performing the subject analysis were detailed in our letter dated March 7, 1983 (IPN-83-18).

The Authority believes that this response will provide sufficient information for the resolution of the subject item.

Should you or your staff have any further questions regarding this matter, please contact Mr. P. Kokolakis of my staff.

Very truly yours,

J. P. Bayne
Executive Vice President
Nuclear Generation

IE11

Att.

cc: Resident Inspector's Office
Indian Point 3
U. S. Nuclear Regulatory Commission
P.O. Box 66
Buchanan, New York 10511

ATTACHMENT I

ADDITIONAL INFORMATION RELATED TO A MAIN STEAM LINE BREAK WITH CONTINUED FEEDWATER ADDITION (IE BULLETIN No. 80-04).

In order to clarify the scope of NRC's January 21, 1982 letter concerning the subject matter, on June 11, 1982 the Authority held a telephone conversation with NRC staff and its reviewing contractor (Franklin Research Center). The Authority was requested to submit to the NRC responses to the following items:

A. Provide the following information concerning your analysis of containment pressure response to a MSLB with continued feedwater addition:

1. An evaluation of the potential for a single active failure in the MFW system which could cause the greatest feedwater flow to the affected steam generator during a MSLB accident and a determination of MFW flow rate to the affected generator if a single active failure were to occur.

2. An evaluation of the potential for exceeding containment design pressure using the feedwater runout flow rate identified in Request 1 above. Provide justification for the assumptions made in the evaluations.

3. In the Authority submittal dated May 8, 1980, it was stated that the emergency procedures for the MSLB require identification of the affected steam generator and isolation of the AFW flow to that generator. Explain what is needed to be done to do this, including operator action and the times assumed for these actions. Provide justification for your assumptions.

B. Provide the following information concerning your analysis of reactivity response which results from a MSLB with continued feedwater addition.

1. An analysis of the core reactivity response to a MSLB considering the effects determined in Part A, Request 1.

<u>Response:</u> An evaluation of the transient response for the NSSS and the containment was performed for the single active failure of the main feedwater system feedwater control valve (FCV) during a main steam

line break (MSLB) as a function of initial reactor power level, break size and main feedwater addition. The containment pressure response was determined by the CONTEMPT code using the blowdown data calculated by the improved RETRAN-02,MOD-2 code for the NSSS transient response.

The RETRAN MSLB model was benchmarked against the IP-3 FSAR MSLB cases for the full break upstream and also downstream of the flow restrictor at the end of life (EOL) hot zero power (HZP) conditions (FSAR, Rev. 0, 7/82, Section 14.2.5.2 cases 6a and 6b).

The methodology used in the evaluation of the MSLB with continued feedwater addition, is described as follows:

1. For different plant power levels, the main feedwater flow characteristics were determined for steam generator pressure dependence.

2. Various break types and sizes were selected.

3. A matrix was used to determine the three worst cases that produced the highest steam blowdown inventory, which were then analyzed for the containment pressure response.

The single active failure assumed is that the FCV fails in an "as is" position. This assumption represents the worst possible single active failure that leads to a maximum feedwater flow into the steam generator.

The IP3 plant specific feedwater flow characteristics were developed for various initial power levels. The feedwater flow dependence on the steam generator pressure was determined for the "as is" failure of the FCV where the feedwater flow would increase as the generator pressure decreases.

The worst feedwater addition case was calculated to be the full break upstream of the main steam line flow restrictor at initial operating conditions at 70% rated power. For this worse case, the core remained subcritical throughout the transient because the negative Doppler reactivity feedback and the scram shutdown reactivity margin compensate for the positive reactivity feedback due to the moderator density increase caused by the overcooling transient.

Figure 1 shows the calculated core reactivity response. Figures 2 through 8 give the transient RCS pressure, average core temperature, cold leg temperature of the loop with the broken steam line, the broken steam generator pressure, feedwater flow, break mass flow rate and liquid level. The resultant feedwater flow rate dependence on the steam generator pressure is shown in Figures 5 and 6.

Various conservatisms were used in the RETRAN transient analysis to maximize the blowdown inventory. The RETRAN calculations modeled the containment as an infinite volume therefore resulting in no back pressure. The same assumption used in the FSAR for the Moody choking response, FL/D set equal to zero, leads to the blowdown of steam only, without water entrainment. Also, the communication between the intact loops with the broken steam generator loop via the main steam header before the MSIV closure was included to add more mass into the containment through the break, consistent with the FSAR methodology.

The CONTEMPT model was also benchmarked against the FSAR worst MSLB case which was the full break upstream of the flow restrictor at hot zero power. Then the three worst blowdown cases that were determined by the RETRAN results were evalauted for their containment response. These cases were:

1. The three square foot split break at hot zero power with the large initial generator water inventory, with auxiliary feedwater flow (main feedwater is not used at HZP conditions).

2. The three square foot split break at 100% power initial conditions, where the main feedwater flow reached the boiler feedpump runout conditions within the first minute of the transient.

3. A full break upstream of the flow restrictor at 70% power initial conditions, where the maximum feedwater flow continued throughout the entire transient without runout conditons being reached. This maximum blowdown case is also the same maximum feedwater flow case, as stated above.

Of the three worst blowdown cases analyzed, the maximum containment pressure was calculated to be 44.6 psia. This value is well below the containment design pressure of 62.0 psia. Accordingly, the integrity of the containment is not violated during this postulated accident. It was found that the peak pressure occurred within a hundred seconds of the beginning of the transient. Manual operator actions was not relied upon in the analysis. Figure 9 gives the containment pressure as a function of time for the worst blowdown conditions as described above, and minimum containment safeguards (i.e., one containment spray train and three fan coolers).

Plant IPS

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Date 3/4

Computer

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FIGURE 1. CORE REACTIVITY RESPONSE

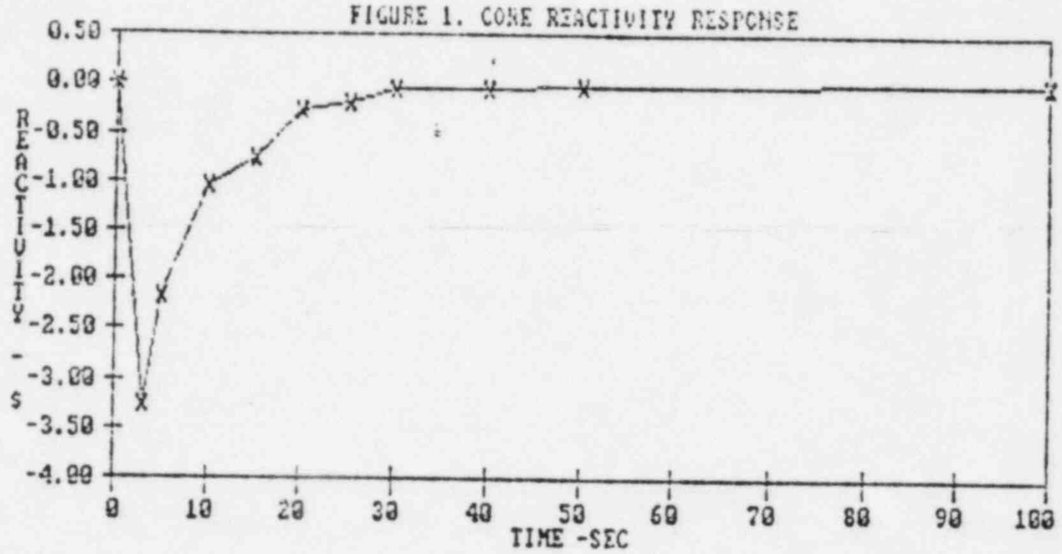
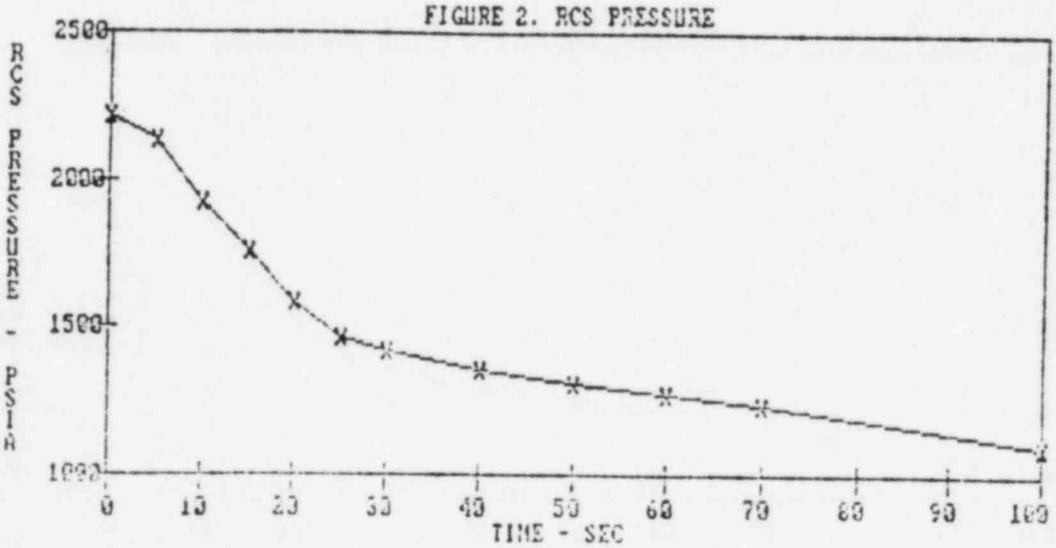


FIGURE 2. RCS PRESSURE



STATE OF NEW YORK

Project 183

Subject MSLB with Continuous feedwater A70 Result

Date 3/4 1983

Computed by mcf

Checked by bsl

FIRGURE 3. AVERAGE CORE TEMPERATURE

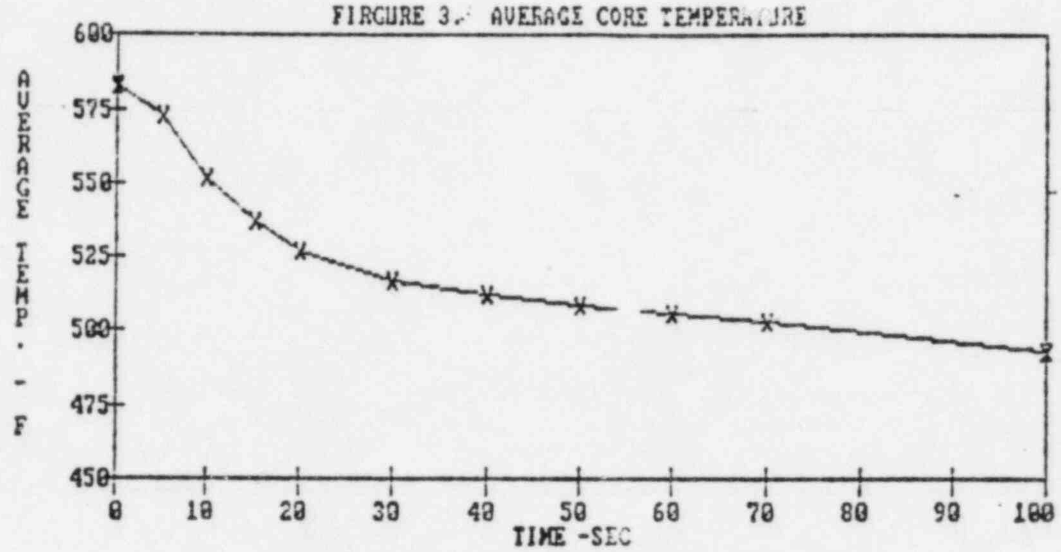
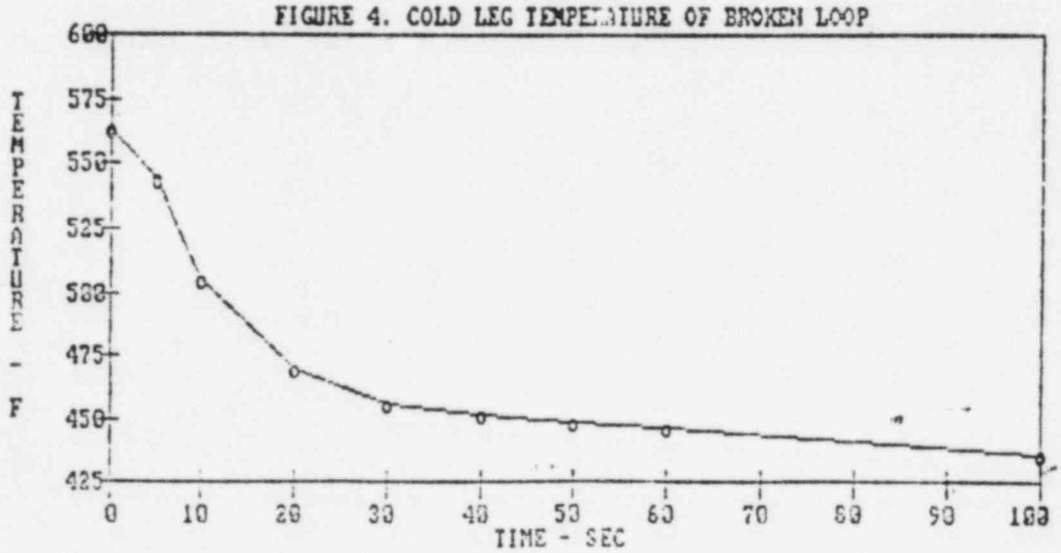


FIGURE 4. COLD LEG TEMPERATURE OF BROKEN LOOP



IP3

MSLB with Continuous feedwater Flow [illegible]

Date 3/4/85

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Checked by DSS

FIGURE 5. BROKEN STEAM GENERATOR PRESSURE

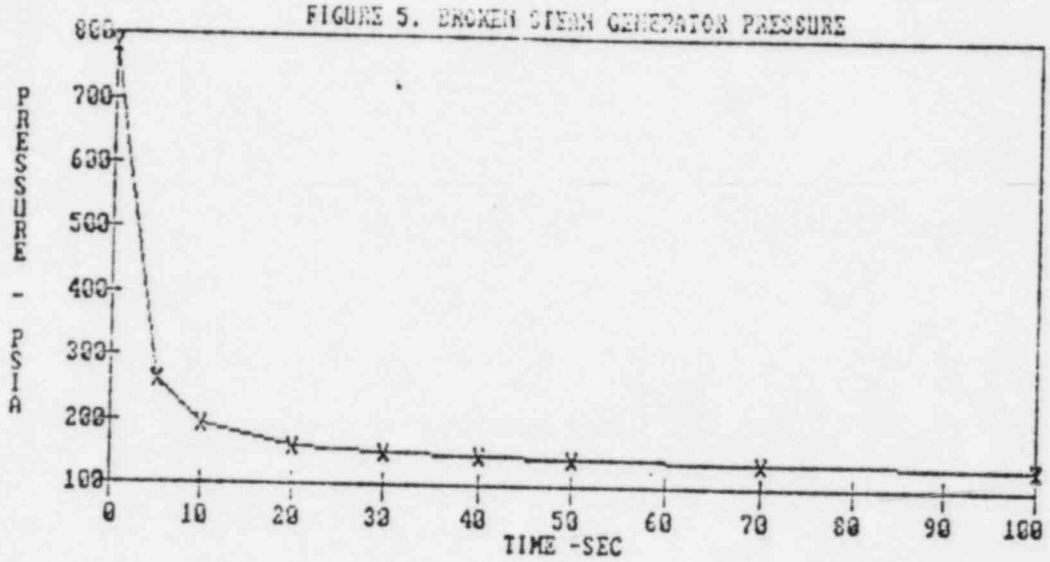

FIGURE 6. FEEDWATER FLOW INTO THE BROKEN GENERATOR

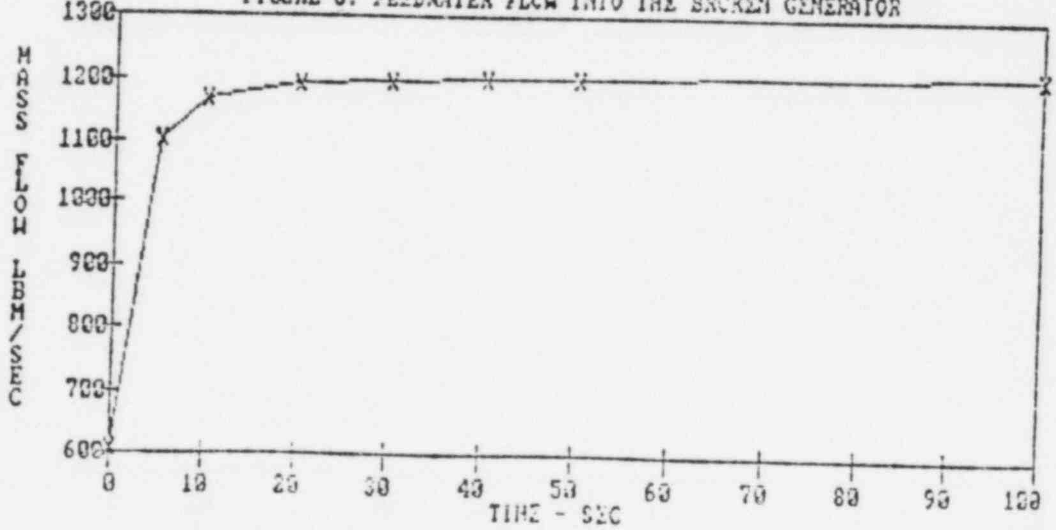

FIGURE 7. MASS FLOW OUT OF THE BREAK

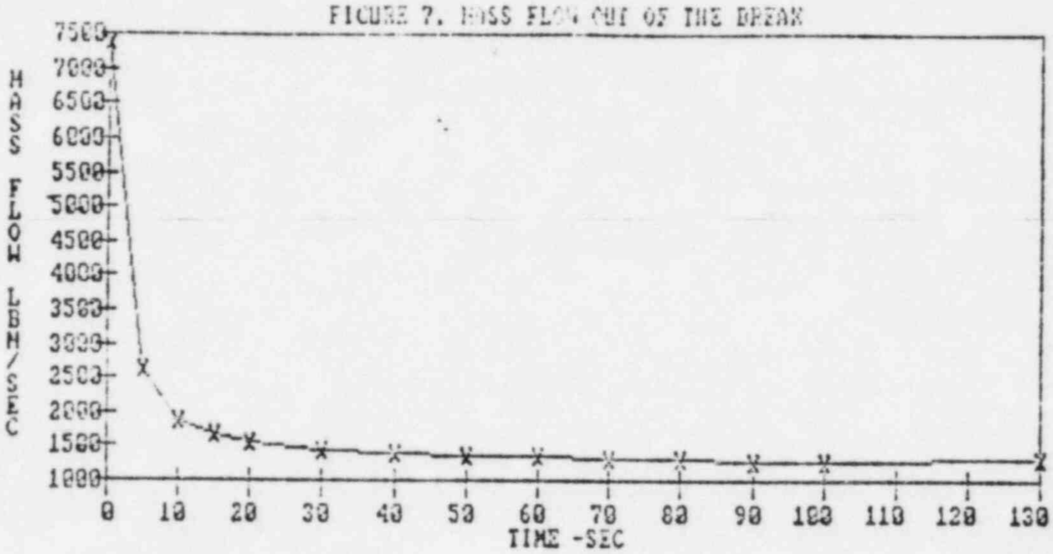

FIGURE 8. AVERAGE LIQUID LEVEL IN THE BROKEN GENERATOR (model level)

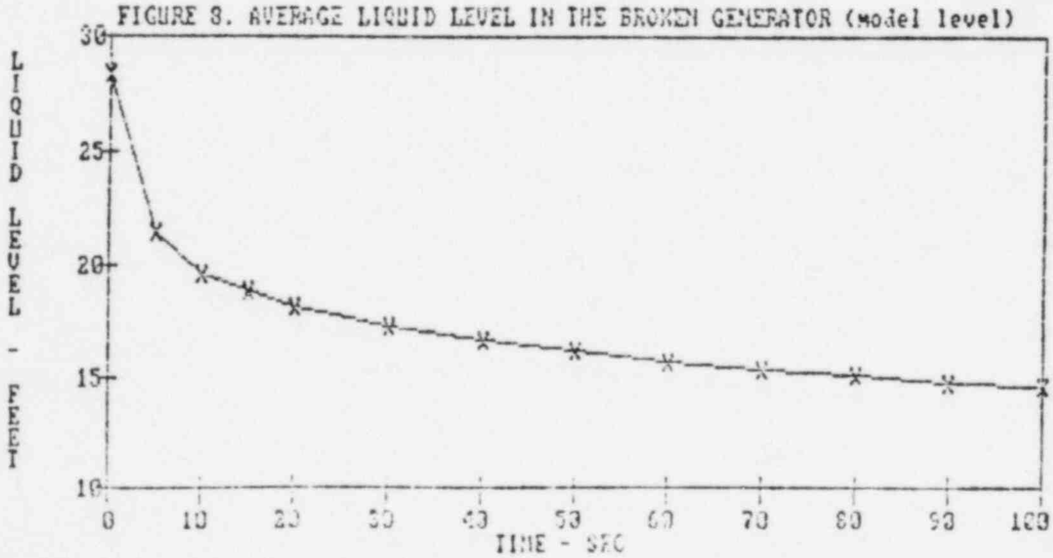

FIG. 9 CONTAINMENT PRESSURE RESPONSE