John D. O'Toole
Vice President

Consolidated Edison Company of New York, Inc.
4 Irving Place, New York, NY 10003
Telephone (212) 460-2533

October 18, 1985

Re: Indian Point Unit No. 2
Docket No. 50-247

Mr. Hugh L. Thompson, Jr., Director
Division of Licensing
Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Thompson:

The Enclosure to this letter provides additional information requested during discussions with members of your staff on October 11, 1985 regarding the removal of the Boron Injection Tank (BIT) at Indian Point Unit No. 2.

If you have any further questions, do not hestitate to call us.

Very truly yours,

John D. O'Toole

cc:

Office of Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 38
Buchanan, NY 10511

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Enclosure

Supporting Information Regarding Boron Injection Tank
Removal at IP-2

Consolidated Edison Company of New York, Inc.
Indian Point Unit No. 2
Docket No. 50-247

October, 1985

The purpose of this response is to provide additional information regarding the derivation/use of the FSAR containment pressure/energy curve and the basis for its conservatism.

The impact of Boron Injection Tank (BIT) elimination on containment pressure was addressed to assure the containment pressure remains below its design pressure (47 psig). The LOFTRAN computer code was used to generate the mass and energy release to the containment for a large double-ended steamline rupture. The case which was analyzed was initiated from hot full power with no BIT and utilized feedwater flow assumptions consistent with the most severe case analyzed in the Indian Point Unit 2 response to NRC IE Bulletin 80-04, "Analysis of a PWR Steamline Break With Continued Feedwater Addition." The total integrated energy release to the containment for this case was conservatively computed to be 276 x 10^6 BTU at 11 minutes.

The 43 psig is only reported in our August 2, 1985 submittal to be consistent with the original FSAR methodology and to show margin in the containment design. Hypothetically, assuming an instantaneous release to the containment and also taking no credit for containment safeguards and heat sink of the containment structures, the containment pressure was calculated to be 43 psig (per FSAR Figure 14.3-107), compared to the containment design value of 47 psig.

The Indian Point Unit No. 2 containment heat removal system consists of 2 spray systems and 5 containment fan cooler units. At the IP-2 containment design pressure of 47 psig the total heat removal capability assumed for each of the spray systems is 218x10^6 Btu/hr and 76.32x10^6 Btu/hr per fan cooler.

To assess the heat removal impact of the containment safeguards system, we conservatively assumed that the automatic heat removal function (fan coolers/spray) would begin at 200 seconds into the event. Typically, the fan cooler units would be fully operational at 60 seconds (startup on SI signal) and the spray systems at 120 seconds (startup on hi-hi pressure signal). At 200 seconds, the total energy released to the containment would be 234x10^6 BTUs assuming no heat removal. This instantaneous energy release would cause a containment pressure of approximately 36 psig (containment temperature of 254^{o}F) per FSAR Figure 14.3-107. From 200 seconds to 11 minutes an additional 42 x 10^6 BTUs is added to the containment (276 x 10^6 BTUs - 234x10^6 BTUs) or 329 x 10^6 Btu/hr. At a pressure of 36 psig each of the Fan Cooler Units can remove approximately 67x10^6 Btu/hr (see FSAR Figure 14.3-105) and each spray system can remove 193x10^6Btu/hr. Assuming the limiting case minimum containment safeguards system capability of only 1 spray and 3 fan cooler units, the total heat removal rate from 3 FCUs and 1 spray system at this containment pressure is approximately 394x10^6 Btu/hr, which exceeds the heat addition rate of 329x10^6 Btu/hr at 200 seconds and would have already resulted in mitigating (turning around) the containment pressure transient. Therefore, the energy released from a design basis steam line break incident, would actually cause a containment peak pressure less than 36 psig and a containment temperature of less than 254^{o}F.

FSAR Figure 14.3-107 was derived by Westinghouse as part of the original licensing basis of IP-2 based on the methodology shown in Attachment 1. This figure was used for the original FSAR main steam line break analysis as follows. For the mass energy release of $182x10^6$ BTUs in the original FSAR analysis a containment pressure of 27 psig was calculated and is shown as Point A in Attachment 1. The containment pressure calculated from the pressure/energy relationship from FSAR Figure 14.3-107 is conservative because it does not take into account the containment structural heat sinks or active heat removal capability. Thus Attachment 1 shows the energy absorption capability of the $2.6x10^6 ft^3$ free volume of the IP-2 containment at saturated conditions regardless of the mechanism, i.e., LOCA or Steam line break.

Attachment 1

Methodology to Derive Pressure/Energy Relation for a Dry Containment.

The base air pressure must be calculated based on the initial air mass. We also know that:

1. Air mass before the accident is equal to the air mass after the accident.

2. Total pressure = Air pressure + Steam pressure

3. Total energy = Air Energy + Steam energy

4. $P_{total} V = M_{total} R T$; $P_{air} V = M_{air} R_{air} T$

The pressure/energy curve is derived by calculating the total energy for various total pressures. Since total pressure equals air pressure plus steam pressure we assume various steam pressures and calculate the corresponding air pressure. We then iterate on steam pressure until the sum of steam and air pressures equals the total pressure. The example case shown here is at the last iteration.

For example:

Calculate the total energy for an assumed total pressure that equals containment design pressure of Indian Point Unit No. 2 (47 psig)

Total Pressure = 47 psig or 61.7 psia
Containment volume = 2.6×10^6 cu. ft.

Assume steam partial pressure = 42.8 psi
The corresponding saturation temperature = $271^{o}F$

Now for air: $P_{air} V = M_{air} R_{air} T$
As V, mass of air and R remain the same the following relationship holds:

P/T = constant or $P_2/T_2 = P_1/T_1$

Now P_1 = 15.0 psia, $T_1 = 580^{o}$ R and $T_2 = 731^{o}R$

Or P_2 = 18.9 psia

Or P_{total} = 42.8 + 18.9 = 61.7 which is equal to the containment total pressure and thus no further iteration is required.

Calculation of energy is as follows:

$U_{air} = 0$ @ 0^oR
$U_{air} = m \times C_v \times$ delta temperature
$U_{air} =((15.0x144x2.6E+06)x(.171)x731)/(53.36*580))$

Or, $U_{air} = 22.68 \times 10^6$ BTUs

$U_{steam} = U_g \times V \times 1/$ specific volume
However $V = 2.6 \times 10^6$ ft^3 less water volume of 26000 ft^3 in sumps at the time of peak pressure (assumed at 400 seconds)
$=(1093 \times (2.6 \times 10^6 - 26000)/9.91$
$=283.9 \times 10^6$ BTUs

Or Total energy at the total pressure of 47 psig:
$= 306 \times 10^6$ BTU

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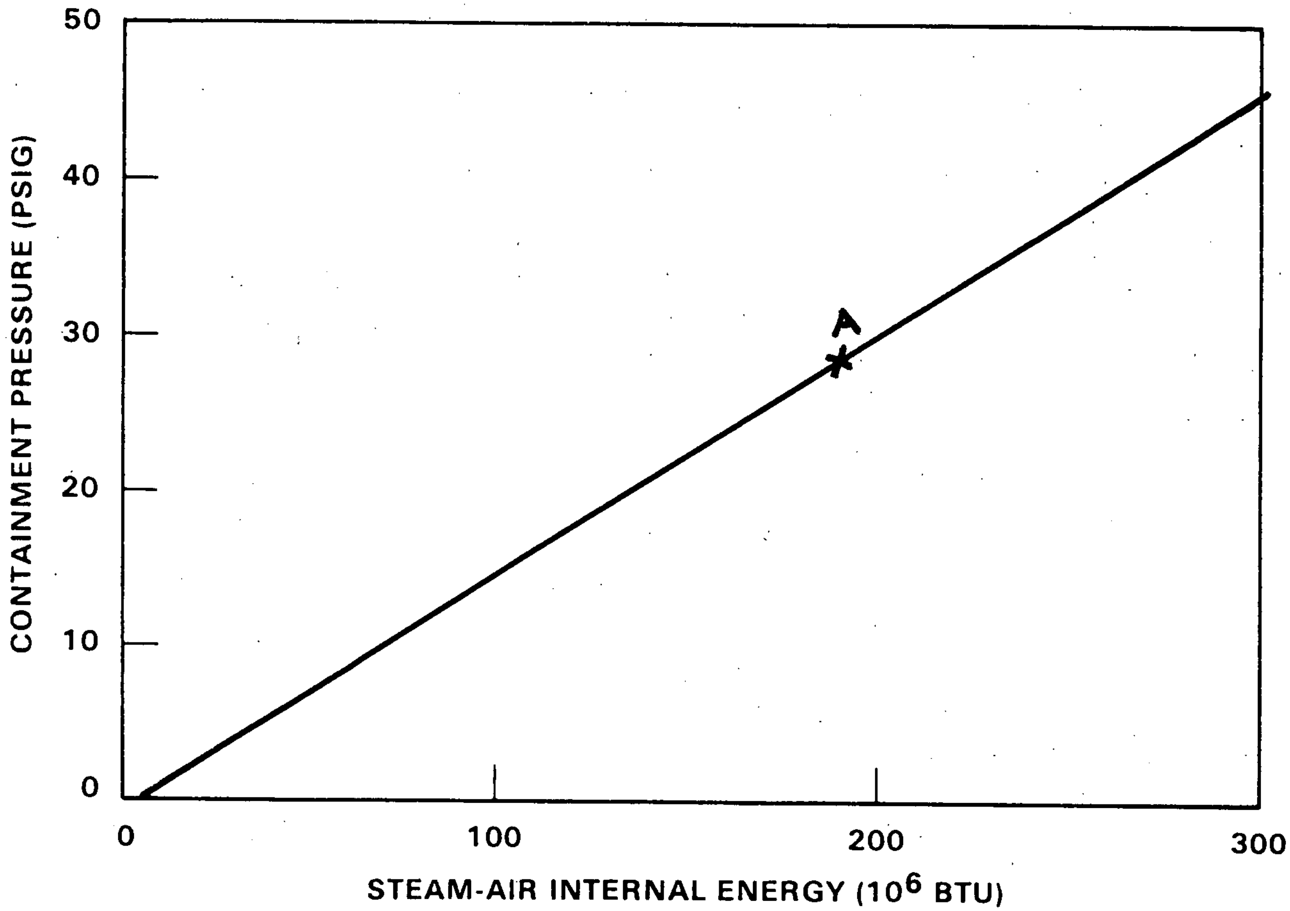

Containment Capability Study Pressure vs Steam-Air Internal Energy