

November 9, 1984

Docket No. 50-247

MEMORANDUM FOR: Chairman Palladino  
 Commissioner Roberts  
 Commissioner Asselstine  
 Commissioner Bernthal  
 Commissioner Zech

FROM: Darrell G. Eisenhut, Director  
 Division of Licensing  
 Office of Nuclear Reactor Regulation

SUBJECT: BOARD NOTIFICATION (BN-84-178 ) POTENTIAL REACTOR  
 VESSEL FLAW AT INDIAN POINT UNIT NO. 2 (IP-2)

In accordance with the NRC procedure for Board Notification, the following information is being provided directly to the Commission. The Boards and parties are being informed by copy of this memorandum.

Board Notification BN-84-163 dated September 25, 1984 provided the board with Consolidated Edison's September 21, 1984 response to previously forwarded staff questions regarding the IP-2 reactor vessel flaw. Board Notification BN-84-169, dated October 12, 1984, informed the Board and provided a transcript of a meeting held in Bethesda on Wednesday, October 3, 1984 to discuss the above subject with Consolidated Edison Company and their consultants.

Enclosures 1-3 provide the NRC Consultant's (Sandia National Laboratory, Oak Ridge National Laboratory, South West Research Institute) formal conclusions regarding the IP-2 reactor vessel flaw following review of the September 21, 1984 response and the October 3, 1984 meeting.

The Board was notified of our Safety Evaluation concerning the IP-2 reactor vessel flaw by Board Notification BN-84-171 dated October 18, 1984.

Original signed by  
 Darrell G. Eisenhut

Darrell G. Eisenhut, Director  
 Division of Licensing  
 Office of Nuclear Reactor Regulation

Enclosure:  
 As stated

cc:  
 See next page

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The Commission

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cc:

J. P. Gleason, ASLB

Dr. O. H. Paris, ASLB

F. J. Shon, ASLB

Parties to Hearing

OPE

OGE

EDO

SECY (2)

ACRS (10)



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

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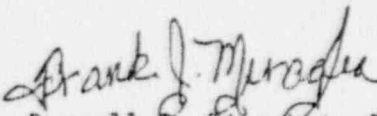
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The Commission

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OPE

OGE

EDO

SECY (2)

ACRS (10)

Rec'd 10/11/84  
12.50 PM

Sandia National Laboratories

Albuquerque, New Mexico 87185

October 11, 1984

Mr. Louis Frank  
USNRC  
Materials Engineering Branch  
Washington, DC 20555

Dear Mr. Frank:

Subject: Ultrasonic Evaluation Results of the Reported Indication  
in Indian Point Unit 2 .

A meeting was attended on October 3, 1984 at NRC Bethesda, Md. at which Consolidated Edison presented data from which they concluded the maximum size of the indication at Indian Point 2 at vessel location 245 degrees. They presented data taken from mockups which were constructed with various reflectors to demonstrate the pitch-catch and delta techniques and to determine if the ASME section XI ultrasonic sizing techniques exaggerated the vessel indication size. Their conclusion was that the indication was indeed exaggerated by section XI sizing and from their analysis the maximum size was 0.26 inches deep and 0.85 inches long. The initial size reported by Consolidated Edison for this indication by section XI sizing was 2.03-inches deep and 1.96 inches long. Since the 0.26" by 0.85" size is just below code allowable for which an augmented inspection of this indication is required in the near future, it was necessary to review the data and analysis to find out if their maximum size dimensions were justified.

After reviewing all the data presented by Consolidated Edison regarding the mockups and the vessel data, it is my conclusion that the maximum size of the indication could be larger than the 0.26" by 0.85" dimensions.

Depth Dimension: Consolidated Edison concluded that the maximum depth was 0.26" by considering the exaggeration factor of the machined slots of 0.3" and 0.5" deep in the mockup. The average depth exaggeration for these slots was 7.79 times with a standard deviation of 3.34 times. Dividing the section XI depth of 2.03" by 7.79 gives the 0.26" depth. However, if the standard deviation is considered in the analysis the maximum depth possible is given by dividing 2.03" by (7.79-3.34) which gives a 0.46 inch depth.

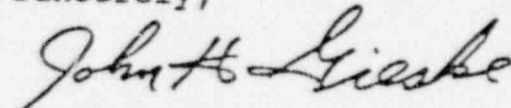
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Considering the data collected by the delta technique where the uncertainty in transit time was established to be +/- 2 microseconds the tip diffracted longitudinal wave transit time could be as low as 129.6 microseconds. This yields a depth determination of 0.26" but any uncertainty in the vessel wall thickness at the indication would be added to this value. There is reason to believe that the vessel wall thickness varies from 8.9" to 9.0" at this location. Therefore the maximum depth by the delta technique could be 0.36". There is also a second smaller pulse at 30 microseconds later in time which is present in the delta technique data for the vessel. This signal is most likely due to the shear wave diffraction signal from the tip of the indication. Calculations yield a depth of 0.39" for the indication using the 30 microsecond delay between the longitudinal and shear wave tip diffracted signals.

Therefore, from consideration of all available data, the conclusion is that a conservative depth dimension would be near 0.5 inches.

Length Dimension: Consolidated Edison concluded that the maximum length was 0.85" by considering the length exaggeration factor of the flat bottom rectangular slots of 0.3, 0.5, 1.5, and 2.0 inch depth in the mockup. They obtained a length exaggeration of 1.109 inches for these slots. Therefore they concluded that the section XI length of 1.96 inches could be reduced by 1.109 inches to give 0.85 inches. First of all, the factor 1.109" is not a conservative value since one can subtract it from one of the determined lengths of the 0.3" deep slot in the mockup (1.789") and obtain a length of 0.68" which is smaller than the machined length of that slot of 1.0". Secondly, the square corner slots of the mockup present an ideal reflector of considerably more reflecting surface near the edges of the slot than is ever possible for a crack-like reflector with rounded edges. Therefore the exaggeration factor for length determined from the mockup is not appropriate as applied to the vessel indication. Since no other data is given to support a length reduction from that determined by section XI, it seems appropriate to assume that the length could be 1.96 inches long.

Sincerely,



J. H. Gieske  
Nondestructive Testing Technology  
Division 7552

## OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX X  
OAK RIDGE, TENNESSEE 37831

October 8, 1984

Mr. L. Frank  
Materials Engineering Branch  
Mail Stop P-328  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Mr. Frank:

Subject: Travel to Bethesda, October 2-3, 1984, to Participate in Meetings Concerning the Review of the Consolidated Edison Report on the Investigation of an Ultrasonic Indication in the Indian Point Unit 2 Reactor Pressure Vessel (Docket 50-247)

I reviewed the information contained in this report in detail at ORNL and discussed my observations with C. Y. Cheng and John Gieske by telephone. Further, John Gieske and I compared notes and observations (on the evening of October 2) dealing with this report and our observations of the mockup demonstration performed by Westinghouse on curved test block IPP-1T on August 17, 1984. We were both in Bethesda (at your request) for the October 3 meeting called by the NRC. Although we discussed many of the details in the Consolidated Edison September 21 report, our main conclusion was that the data presented had not been fully utilized to establish the error bars (i.e., sufficient conservatism had not been used) on the depth and length numbers reported (i.e., the 0.26- by 0.85-in. depth times length of the reactor pressure vessel indication). We discussed the questions that needed answers from the meeting the next day. Questions for which we wanted specific answers were discussed and included the following items:

1. Exact use of Table 1-C statistics.
2. Interpretation of the preceding peak time statement for the delta-measured tip and root signal on the reactor pressure vessel indication (to confirm that the peak times were 131 and 132.8  $\mu$ s).
3. A real possibility of a buttress notch being in the vessel.
4. Origin of the 0.26-in. depth number.
5. Had an attempt been made to use the 30- $\mu$ s delayed satellite pulse observed with the reactor pressure vessel indication?

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On Wednesday morning, October 3, we met with C. Y. Cheng, Jack Durr, and Harry Kerch on the third floor of the Phillips Building. Jack and Harry are NRC Region I personnel. Around 9:00 a.m., we were joined by Warren Hazelton, Martin Hum, Bill Clayton, and Wayne Flach. We discussed the data presented by O'Toole and agreed that the 1.2- by 1.96-in. size of the reactor pressure vessel indication (measured by code) probably bounded the indication. We also agreed that the reduced size measured by augmented techniques was probably not conservative enough due to measurement variations that were evident in the report.

W. Johnston held a meeting prior to the official review in his office with all who attended the morning session, along with S. Varga, B. Elliot, and possibly one or two more NRC people. Varga and Johnston outlined the approach to be taken in the afternoon session based on Cheng's summary of the morning activities and appropriate discussions that ensued.

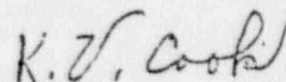
Shortly after 1:00 p.m., the official review of the Indian Point Unit 2 report was convened on the fourth floor of the Phillips Building (Room P422). Prime participants in this meeting were S. Varga, D. Johnston, J. O'Toole, Don Adamonis, Warren Beamford, and John Fox. However, many people asked questions and the information presented was very informative. After hearing comments and discussion from Consolidated Edison, Westinghouse, and Combustion Engineering personnel and receiving answers from them on a number of questions, we caucused in a separate meeting room on the fourth floor. We discussed the way the statistics had been generated (in particular, that the 0.26-in. depth amplitude number was based on four points, with one of these a questionable data point) and the possible errors in the calculated number (the depth is subject to a plus-or-minus measurement error as noted by the large standard deviation). We discussed the two delta methods used and observed that, according to a statement in their report, the 0.18-in.-deep measurement was subject to a  $\pm 0.15$ -in. variation and that the 0.24-in.-deep measurement was subject to a  $\pm 0.2$ -in. variation. Thus, we concluded that the reported 0.26-in. depth was not conservative since all three methods provide values that may exceed 0.3-in. We discussed the reported length (0.85 in.) and concluded again that it was not conservative because ideal reflectors (those with very high ultrasonic reflectivity) with nonflaw shapes (square notches with abrupt full depth steps on each end, as opposed to the gradual depth increase and decrease predicted at the ends of a natural or code-type indication) would be expected to size different with ultrasonic amplitude measurements. We also discussed the fact that they could not substantiate the existence of a buttress notch and had not used the satellite pulse. The NRC decided to ask for three pieces of information: (1) documented fracture mechanics and probability results, (2) delta information detail, and (3) a sketch documenting the physical location of the reactor pressure vessel indication based on the latest data.

Around 4:30 p.m., we returned to P422, where S. Varga asked for these three pieces of information (O'Toole agreed to supply them) and informed O'Toole that startup could begin, based on the flaw being bounded by the



1.2- by 1.96-in. size and the successful conclusion of the NRC fracture analysis (i.e., agreement with Westinghouse). Vargas also informed O'Toole of the probable requirement for augmented inspections (more than one in ten years). Consolidated Edison asked for permission to perform some tests at elevated temperature with a pressurized vessel. Vargas asked for a written request and promised full speed ahead on this request as well as the fracture mechanics analysis so that startup could be as soon as possible. Adjournment was around 4:45 p.m.

Sincerely yours,



Kenneth Von Cook  
Nondestructive Testing Group  
Metals and Ceramics Division

KVC:jlb

cc: C. Y. Cheng, NRC ✓  
R. W. McClung  
G. M. Slaughter  
J. H. Smith  
K. V. Cook/File

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October 26, 1984

Dr. C. Y. Cheng  
Nuclear Regulatory Commission  
Mail Stop P328  
Washington, D.C. 20555

Dear Dr. Cheng:

Previously presented reports document the observations and conclusions of the Southwest Research Institute (SwRI) consultants regarding the initial meeting on the Indian Point vessel flaw and the meeting at Westinghouse to review the additional work performed to demonstrate the basis for the reduced flaw size estimate. We wish to present in this letter our observations and conclusions regarding our review of the Consolidated Edison (Con Ed) submittal of September 21, 1984 and the meeting of October 3, 1984, on the same subject.

Based on our review of the Con Ed submittal and with consideration of our observations of the Westinghouse demonstrations, we believe that the flaw size estimates of 0.26 inches deep by 0.85 inches long are not conservative. The statement that flaw length was exaggerated by a constant of 1.109 inches is not entirely credible because it includes the exaggeration observed on notches of greatly different ultrasonic response. If the notch which is closest to the postulated flaw size, and, which produces ultrasonic response similar to the vessel flaw, is independently considered a length exaggeration of 0.789 inches is noted. Applying this correction to the Code derived flaw size, one derives a corrected flaw length of 1.1 inch. We cannot be certain that the true length is precisely 1.1 inches, but we believe that 1.1 inch is a more qualified estimate and closer to the true length.

Similarly we believe that the flaw depth estimate of 0.26 inch is not conservative. When one considers that the 60 degree data of the 0.3 inch and 0.5 inch deep notches using Code sizing techniques exaggerates the depth by a factor 2x to 3x, the exaggeration factor of 6x applied to the vessel flaw to obtain the depth estimate of 0.26 inches appears inappropriate. Additionally, the 1.5 inch deep notch was exaggerated only by a factor of 1x to 1.5x. These data points independently suggest that the flaw could be approximately .5 inches deep.



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SAN ANTONIO, TEXAS  
WITH OFFICES IN HOUSTON, TEXAS, AND WASHINGTON, D.C.

Mr. C. Y. Cheng  
October 26, 1984  
Page Two

The pitch catch data does not clearly demonstrate that the flaw is only 0.26 inches deep. In fact this data does not conclusively prove that the flaw is necessarily much less than 1.0 inch in depth. This is not to suggest that the flaw is 1.0 inch deep, but to show that this data does not support the flaw depth estimate of 0.26 inches.

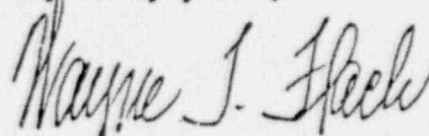
We agree that the time of flight data suggests a flaw depth of 0.3 inches but this is a single data point and there is a distinct possibility that the observed tip signal is emanating from a portion of the flaw other than the deepest point. The demonstration of this technique on a notch verifies a well established ultrasonic principal, but the flaw likely does not have the same type of uniform edge as the machined notch and, therefore, there is no assurance that this examination is detecting the deepest point of the flaw.

During the October 3, 1984 meeting, essentially the same data as contained in the written submittal was presented and discussed. While some points were clarified, no additional data was presented to change the conclusions delineated above. Therefore, it is our opinion that estimated flaw size of 0.85 inches long by 0.26 inches deep is not conservative and that the flaw is likely to be somewhat larger. We are confident that the flaw is smaller than the 2 inches long by 1.2 inches deep estimates originally presented.

There are several other nondestructive examination techniques which could be applied to this flaw to give more accurate measurements of its true size. Some of the available techniques are not routinely utilized in a power plant environment and some require special adaptation to a particular examination problem. However, given appropriate consideration and early planning, a flaw such as this can be characterized and sized with much more accuracy than has been accomplished so far. We suggest you consider the potential benefits to be derived from requiring reexamination of this flaw utilizing advanced techniques.

It has been a pleasure working with you on this problem. If we can be of any further assistance, please call at any time.

Very truly yours,



Wayne T. Flach  
Director

CF

DISTRIBUTION LIST FOR BOARD NOTIFICATION

Indian Point, Units 2&3  
Docket Nos. 50-247/286

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