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

JUL 31 1980

Docket Nos.: 50-247
50-286
50-295
50-304

LICENSEES: Consolidated Edison Company of New York
Power Authority of the State of New York
Commonwealth Edison Company

FACILITIES: Indian Point, Units 2 & 3
Zion, Units 1 & 2

SUBJECT: SUMMARY OF TECHNOLOGY-EXCHANGE MEETING 5 HELD ON JUNE 17, 1980 WITH CONSOLIDATED EDISON COMPANY OF NEW YORK (CON. ED), POWER AUTHORITY OF THE STATE OF NEW YORK (PASNY), AND COMMONWEALTH EDISON COMPANY (CECo) TO DISCUSS CONTAINMENT STRUCTURAL RESPONSE FOR INDIAN POINT UNITS 2 AND 3 AND ZION UNITS 1 & 2

A one-day meeting was held in Bethesda, Maryland to discuss containment structural response to core melt accident sequences for the Zion and Indian Point (Z/IP) nuclear power plants. This was the final technology-exchange meeting of five planned as part of the Z/IP action, described in the letter from Schwencer (NRC) to Peoples (CECo), dated April 10, 1980.

With some minor changes, the announced agenda, Enclosure I, was followed throughout the meeting. An attendance list is included as Enclosure II; Enclosure III is a complete set of meeting viewgraphs.

Meeting Highlights

J. F. Meyer opened the meeting by noting the key items of interest for Meeting #5, namely : Z/IP containment failure pressures, locations, and modes; containment loading characteristics; and vessel failure characteristics. He stated that the results of the containment analyses will be used, in part, as input to (CRAC-Code) consequence analysis specific to the Z/IP plants. The major portion of the agenda was dedicated to utility-contractor and NRC-contractor presentations on the Z/IP containment analyses (Sargent & Lundy for Zion; United Engineers & Contractors for Indian Point; Los Alamos Scientific Laboratory for Zion; and Sandia National Laboratory for Indian Point, respectively). A summary of the Z/IP containment structural analyses is given in Table I. Several key points should be made:

- All the analyses showed failure pressures considerably higher than that initially assumed (e.g., higher than the range assumed in the "Advanced Draft Copy" version of "Report of the Zion/Indian Point Study: Volume I," Sandia, NUREG/CR-1410, namely, a failure range of 75→105 psig for Indian Point)

- For a given plant the analyzed failure pressures were comparable (within 15%).

- Although the failure pressures were comparable, the assessment of failure locations and modes of failure were quite different and thereby disturbing. (For example, what were the cylinder hoop tendon stresses in the NRC analysis for Zion when the liner was calculated to separate at 154 psig?)

- There was general concensus that penetrations are not the containment weak points.

- There was general concensus that the failure modes could be characterized as "ductile" as opposed to "catastrophic."

- The utility-contractors would not speculate in any detail on the characteristics of the containment failure once the failure was initiated. G. Klopp (CECo) referred to this portion of the accident sequence as a "grey area" in need of further attention.

- All the utility analyses were under the assumption of a static or quasistatic pressure loading of the containment. Although the NRC staff considers that assumption appropriate in most cases, the staff believes that dynamic loading of the containment cannot be ruled out due to either hydrogen explosions resulting from pocketing of hydrogen gas or rapid (near sonic) burning of hydrogen.

- There was concensus that temperature loading of the containment was not a problem, in the sense of having an effect on the containment failure characteristics.

The details of the four presentations on containment structural analyses can be found in the Enclosure III viewgraphs. One area that was not addressed was the capability of these containments to withstand a partial vacuum. This is of concern for determining functional requirements and criteria for Filtered-Vented Containment Systems and should be addressed in the continuing NRC programs.

A major uncertainty that was highlighted during technology-exchange meetings #1 and 2 was how the Z/IP vessels will fail under given mechanical and/or thermal loadings. In part "d" of the NRC presentations, R. Alcouffe and C. Anderson of LASL addressed this question in part by reporting on the LASL analysis of the vessel response to in-vessel steam explosions, an analysis first reported in Vol. II of the previously referenced Z/IP study. Their viewgraphs are on pages 113-125 of Enclosure III. Three different work-energy source terms were assumed in order to generate pressure loading histories (head impact pressures) for the vessel structural response analysis. Configuration "b", characterized by large Taylor instabilities, was felt to be most representative. The source terms were consistent with the steam-explosion estimates developed at LASL and SANDIA. The analyses reported indicate that:

- missile generation is unlikely based on "SIMMER" loading histories

- missile generation is more likely if based on "SOLA-VOF" loading histories

. if the head fails, the probability of missile generation is low

. from the loadings considered, lower portions of the vessel may fail before upper (head) portions.

Mr. S. P. Chan (NRC/SEB) reported on very preliminary results from the "Other NRC Containment Analyses" presently in place for ice-condenser steel containments.

Another topic related to vessel failure modes was brought up, namely, the capability to prevent failure of the vessel by flooding the reactor cavity. Mr. Von Riesemann (Sandia) referred to a report which considered this question some years ago. This matter should be reconsidered by NRC.

Following the formal presentations there was a general discussion of the Z/IP action program over the next 6 months, a program which will culminate in a decision for or against mitigation feature requirements by NRC in late fall.

James F. Meyer
Reactor Systems Branch
Division of Systems Integration
Office of Nuclear Reactor Regulation

Enclosures:
As stated

Enclosure - I

AGENDA FOR TECHNOLOGY-EXCHANGE MEETING #5
"CONTAINMENT STRUCTURAL RESPONSE"
JUNE 17, 1980

8:30AM	I.	Introductory Comments - NRC Utilities
9:00AM	II.	Utility Presentations
		a. Zion 1. Containment Description 2. Bases for Analyses 3. Method of Analyses 4. Failure Criteria 5. Results
10:00AM		b. Indian Point 1. Containment Description 2. Bases for Analyses 3. Method of Analyses 4. Failure Criteria 5. Results
11:00AM	Break	
11:15AM	III.	NRC Presentations
		a. Zion Containment Building Evaluation
11:45AM		b. Indian Point Containment Building Evaluation
12:15PM		c. Other NRC Containment Analyses
12:45PM		d. Vessel Failure Analyses
1:00PM	Lunch	
2:00PM	Review of Meetings, summaries, discussion	
3:30PM	Adjourn	

ENCLOSURE II

Attendance List

Mel Silberberg	NRC-RSR
Nancy B. Willowby	Bechtel
Jim Meyer	NRC/NRR
John Olshinski	NRC/NRR
John Long	NRC?NRR
R. Philip Hammond	R & D Associates
Er-Ping Chen	SANDIA
Walter A. Von Riesemann	SANDIA
James Leas	UCS
Bill Bennett	Con Edison
W. Sayed	Power Authority of State of N.Y.
James F. Davis	Power Authortiy of State of N.Y.
H. F. Conrad	NRR
D. L. Peoples	Commonwealth Edison
Hatum Radwan	Sargent & Lundy
Bryan Erler	Sargent & Lundy
Joe Uccifierro	UE & C
David C. Jeng	NRC/NRR/SEB
D. E. Bessette	NRC/ACRS
Jan S. Teraszkiewicz	Power Authority of State of N.Y.
G. T. Klopp	Commonwealth Edison
F. Schauer	NRC
P. T. Kuo	NRC
Charles A. Anderson	LASL
Goutam Bagchi	NRC/RES
Richard Perry	United Engineers & Const. Phila.
Y. W. Chang	ANL
R. W. Seidensticker	ANL
J. B. Van Erp	ANL
Victor Gonnella	Con Edison
Raymond Alcouffe	LASL
Peter Cybulskis	Battelle Columbus
Charles Tinkler	NRC
D. H. Cho	ANL
W. A. Wogsland	Commonwealth Edison
Profull Kakkad	Bechtel Power Corp.
Reimar Duerr	United Engineers & Const. Phila.
R. W. Barton	United Engineers & Const. Phila.
B. W. Washburn	DOE,
Richard Toland	United Engineers
Joel Bennett	Los Alamos
Elton Endebrock	LASL
Gary Quittschreiber	NRC/ACRS
Gary Boyd	SANDIA
J. C. LaVallee	Sargent & Lundy
Martin Oper	Westinghouse
Don Paddleford	W
E. E. Schmidt	NUS
Gary H. Rush	Philadelphia Electric Co.
R. E. Henry	Fauske & Assoc. Inc.
D. C. Bley	Westinghouse Elec. Corp

Robert E. Kelly	Westinghouse Elec. Corp
garry R. Thomas	NSAC
Rick Sherry	NRC/RES
Ray DiSalvo	NRC/RES
L. S. Rubenstein	NRC
M. C. Leverett	NSAC (EPRI)
R. D. Gasser	Brookhaven Natl. Lab.
P. M. Williams	NRC/NRR/DST/RSCB
T. J. Walker	NRC/RES/AESR
R. S. Orr	W Offshore power Systems
Charles Kelber	NRC
W. H. Layman	NSAC/EPRI
R. P. Remshaw	Con Edison
Martin J. Scott	Con Edison
Jay D. Dunkleberger	NYS Energy Office
John Yerick	DOE
Taft Broome	NRC/RES
Joanne Dann	Mcgraw-Hill
Calin A. Laldwell	B & W
R. J. Pacc	LACO
John S. Ma	SEB/NRC
Shankar Meon	Studsvik, Sweden
M. S. Medeiros, Jr.	NRC/SD
Robert Sugarman	IEEE Spectrum Magazine
Leonard Olshan	NRC/ORB-1
Ed. Reeves	NRC/ORB-1
Michael W. Dobbs	ANCO Engineers, Inc.
Ed. Fenstermacher	NRC/NRR/RSB
J. L. Carter	NRC/RSB
Fritz Sturz	EPS/ORP

TABLE 1 - SUMMARY OF Z/IP CONTAINMENT STRUCTURAL ANALYSES

Analysis of → / REACTOR ↓	FAILURE-PRESSURE/ DESIGN-PRESSURE, PSIG	FAILURE LOCATION	FAILURE MODE	CONTAINMENT LOADING CHARACTERISTICS
ZION (UTILITY ANAL.)	134/47 (with liner)	1/2 way up cylinder	Hoop Tendon yielding	Quasistatic
ZION (NRC ANAL.)	154/47	near spring line on cylinder	Liner Separates (concrete already cracked) - non-catastrophic	Quasistatic (also analyzed dynamic loadings)
INDIAN PT. (UTILITY ANAL.)	126/47	high on cylinder away from discontinuities	Hoop, ductile	Quasistatic
INDIAN PT. (NRC ANAL.)	110/47	just below spring line or at cyl. basemat intersection	Bending Failure, ductile	Quasistatic (also analyzed dynamic loadings)
REFERENCE WASH-1400 PWR	85/39	Top of Containment	Cracking of concrete followed by liner failure; rapid depressurization	Quasistatic

ENCLOSURE III

VIEWGRAPHS FROM JUNE 17, 1980

TECHNOLOGY EXCHANGE MEETING #5

"CONTAINMENT STRUCTURAL RESPONSE"