



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

MAY 26 1989

MEMORANDUM FOR: Frank J. Miraglia, Associate Director
for Inspection and Technical Assessment, NRR

C. Ernie Rossi, Director
Division of Operational Events Assessment, NRR

Frank J. Congel, Director
Division of Radiation Protection and Emergency
Preparedness, NRR

FROM: Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

SUBJECT: DIFFERING PROFESSIONAL VIEW OF ROBERT B.A. LICCIARDO
CONCERNING CONTAINMENT ISOLATION VALVES AT ZION

Enclosed is a memorandum from Mr. Licciardo to Dr. Murley, dated May 11, 1989 expressing a Differing Professional View. In accordance with NRC Manual Chapter 4125 and NRR Office Letter No. 300 dated March 24, 1989, you are hereby designated as the Panel to review and recommend to the Director, NRR the appropriate disposition of Mr. Licciardo's Differing Professional View. If you deem it necessary, you may solicit input from other NRR technical staff or contractors.

In carrying out your review and formulating your recommendations to me, you should be guided by the Appendix to NRC Manual Chapter 4125 with special emphasis on Sections B.6 and B.7.

A handwritten signature in black ink, appearing to read "T. Murley".

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: J. H. Sniezek
J. Larkins
R. Licciardo

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

May 11, 1989

J. Smyth

MEMORANDUM FOR: Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

FROM: Robert B. A. Licciardo, Reactor Engineer (Nuclear) -
Plant Systems Branch
Division of Engineering and Systems Technology

SUBJECT: DIFFERING PROFESSIONAL VIEW CONCERNING

- a) Issuance of SER to Zion 1/2 allowing full power operation with open 42" containment isolation valves.
- b) Methodology used for calculating related offsite doses.

The writer submits a Differing Professional View (DPV) in accordance with the provisions of NRC Manual Chapter 4125.

This issue has arisen out of the Safety Evaluation Report (SER) undertaken for the Zion Units 1 and 2 as prepared by the writer; see Attachment.

The principal issue is the prudent and conservative calculation of the additions to offsite dose which may result from a LOCA at a facility during the use of open purge supply and exhaust valves at full power.

The licensee for Zion 1/2 has proposed full power operation of the facility with the 42" purge supply and exhaust containment isolation valves open to a limited position of 50°, and capable of isolation within seven (7) seconds of the commencement of a LOCA.

The writer's SER concludes that the 42" valves at Zion should remain closed in Modes 1, 2, 3 and 4 because the consequence of the offsite dose to thyroid (from iodine) during a LOCA is unacceptably high; whole body has not been evaluated. The least value for the additional offsite dose which may be proposed within the licensing basis is 64,000 rem over the first seven (7) seconds of the LOCA. Management staff has disagreed with the writer's methodology and conclusion and plans issuance of a separate SER permitting the operation requested. The writer requests non-issuance of the related SER to the licensee. He also proposes probability of a generic action on other facilities which have been granted such licenses based on the staff's current methodology.

In general, the management staff has adopted a criterion described in SRP BTP CSB 6-4 which is that providing the maximum time for closure of these containment isolation valves does not exceed 5 seconds (and by plant-specific exception, up to 15 seconds), then the valves would be closed before the onset of fuel failure following a LOCA so that the only contribution to offsite dose is from RCS operational levels of fission product directly discharged into containment during this period, and then through the open containment isolation valves before closure.

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In evaluating the consequence for Zion, the writer has used an alternate Criterion in BTP CSB 6-4 which states that:

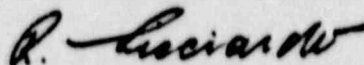
"The following analyses should be performed to justify the containment purge system design:

An analysis of the radiological consequences of a loss-of-coolant accident. The analysis should be done for a spectrum of break sizes, and the instrumentation and setpoints that will actuate the purge valves closed should be identified. The source term used in the radiological calculations should be based on a calculation under the terms of Appendix K to determine the extent of fuel failure and the concomitant release of fission products, and the fission product activity in the primary coolant. A pre-existing iodine spike should be considered in determining primary coolant activity. The volume of containment in which fission products are mixed should be justified, and the fission products from the above sources should be assumed to be released through the open purge valves during the maximum interval required for valve closure. The radiological consequences should be within 10 CFR Part 100 guideline values."

Using these related guidelines for Zion, the fuel performance over the 0-7 seconds is detailed and shows that fuel failure (by infringement of DNBR criteria) occurs within $\frac{1}{2}$ seconds of the commencement of the LOCA, and together with other licensing basis responses including fission product release from the fuel gap and the thermal hydraulic conditions in the core, containment and discharge nozzle, result in a substantive discharge of fission products to the environment of far greater consequence than are calculated by the staff.

The relative consequences of these differing approaches are that whereas the staff methodology gives additions to offsite dose resulting in total doses within 10 CFR Part 100 limits, the alternate approach used by the writer shows a substantially increased offsite dose exceeding 10 CFR Part 100 limits, with completely unacceptable consequences to Public Health and Safety.

The writer requests review of the Differing Professional View in a timely manner in accordance with the provisions of NRC Manual Chapter 4125.



Robert B. A. Licciardo
Registered Professional Engineer California
Nuclear Engineering License No. NU 001056
Mechanical Engineering License No. M 015380

cc: J. Sniezek
D. Muller
S. Varga
C. Patel
F. Miraglia
L. Shao
A. Thadani
J. Wermiel
J. Kudrick



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

May 11, 1989

Attachment

Docket Nos. 50-295
and 50-304

MEMORANDUM FOR: Daniel Muller, Director
Project Directorate III-2
Division of Reactor Projects III, IV, V
and Special Projects

FROM: Jared S. Wermiel, Acting Chief
Plant Systems Branch
Division of Engineering and Systems Technology

SUBJECT: OFFSITE RADIOLOGICAL CONSEQUENCES OF LOCA DURING
CONTAINMENT PURGE PROPOSED IN TS CHANGES FOR ZION 1 AND 2

Reference: Letter to H. R. Denton (NRC) From P. C. Leonard dated
February 2, 1986, Subject: Zion Nuclear Power Station,
Units 1 and 2 Proposed Amendment to Facility Operating
License No. DPR-39 and DPR-48

Plant Name: Zion Nuclear Power Station, Units 1 and 2
Licensee: Commonwealth Edison Company
TAC Nos.: 55417 and 55418
Review Status: Complete

Zion Units 1 and 2 (CECo) has responded to an NRC request to propose TS to primarily constrain operation of the large (42") containment purge supply and exhaust valves on these units; see reference 1.

The former Plant Systems Branch, Section A, of the Division of PWR Licensing A, requested Section B of the same branch to review the offsite radiological consequences of this proposal.

The enclosed Safety Evaluation Report has been prepared by the technical reviewer initially assigned to this task, namely Robert B. A. Licciardo.

The licensee's proposal is to allow full power operation of the facility with the 42" purge supply and exhaust containment isolation valves open to a limited position of 50", and capable of isolation within seven (7) seconds of the commencement of a LOCA.

The review concludes that the 42" valves at Zion should remain closed in modes 1, 2, 3 and 4 because the consequence of the offsite dose to thyroid (from iodine) during a LOCA is unacceptable high; whole body dose has not been evaluated: The least value for the additional offsite dose which may be proposed within the licensing basis is 64,000 rem over the first seven (7) seconds.

The conventional treatment of BTP CSB 6-4 which assumes that fuel failure does not occur over the first 5-15 seconds after a LOCA and thereby that only RCS operating inventory of fission products is released to the containment, and then to the environment, cannot in general be sustained against thermal hydraulic analyses for containment response, and licensing basis requirements (including criteria) for the calculation for, and the occurrence of, fuel damage and the quantification and treatment of resulting source terms.

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Daniel Muller

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Our SALP input is provided in Enclosure 2. We consider our efforts on TAC Nos. 55417 and 55418 to be complete.

Jared S. Wermiel, Acting Chief
Plant Systems Branch
Division of Engineering and Systems Technology

Enclosures:
As stated

cc w/enclosures:
C. Patel

CONTACT: R. Licciardo
X20876

Daniel Muller

-2-

Our SALP input is provided in Enclosure 2. We consider our efforts on TA Nos. 55417 and 55418 to be complete.

Jared S. Wermiel, Acting Chief
Plant Systems Branch
Division of Engineering and Systems Technology

Enclosures:
As stated

cc w/enclosures:
C. Patel

CONTACT: R. Licciardo
X10876

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5520 NAME: Zion TACs 55417/8 Licciardo



UNITED STATES
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WASHINGTON, D. C. 20555

Enclosure 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
PLANT SYSTEMS BRANCH
OFFSITE RADIOLOGICAL CONSEQUENCE OF LOCA DURING
CONTAINMENT PURGE
ZION NUCLEAR POWER STATION, UNITS 1 AND 2
DOCKET NOS. 50-295 and 50-304

1.0 INTRODUCTION

Zion Units 1 and 2 (CECo) has responded to an NRC request to propose TS to primarily constrain operation of the large (42") containment purge supply and exhaust valves on these units.

The former Plant Systems Branch, Section A, of the Division of PWR Licensing A, requested Section B of the same branch to review the offsite radiological consequences of this proposal.

2.0 EVALUATION

Background review shows that the facility was evaluated on the basis of normally closed purge valves so that these consequences were never included in the Zion SER. Further, that a letter from Westinghouse (W) to Commonwealth Edison Company dated October 22, 1976 on the subject of "Offsite Doses During LOCA and Containment Purge" (Ref. 2) has never been evaluated by the NRC. Subsequent to the TMI-2 event, the operability and automatic control of these valves was evaluated leading to the request for the required TS, but the Radiological Assessment was left as a "long(er) term issue" (Ref. 3) which was intended to be resolved in a subsequent probabilistic risk assessment which definitively excluded it from consideration without any justification (Ref. 4).

The W analyses undertaken under Commonwealth Edison instruction, uses an RCS operational inventory of 50 uc/gm equivalent I 131 at the time of the accident with a resulting site boundary thyroid dose due to iodine (during closure of the valves), of 52 rem, and which added to the containment leakage dose of 123 rem gives a total 175 rem which is within the 10 CFR 100 limit of 300 rem. The total iodine inventory of the RCS is assumed to be released into containment on initiation of the LOCA; a 50% plate out is assumed leaving the residual 50% as part of containment inventory for discharge out through both fully open containment purge lines for a total of seven (7 seconds).

However, when reviewed against the BTP CSB 6-4, Item B.5.a requires that:

"The source term used in the radiological calculations should be based on a calculation under the terms of Appendix K to determine the extent of fuel failure and the concomitant release of fission products, and the fission product activity in the primary coolant."

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Further: SRP 4.2 identifies fuel failure with infringement of DNBR criteria, with the related requirement that gap activity be considered as part of the source term, and Regulatory Guide 1.77 recommends that under similar circumstances, gap activity should be assumed at 10% of core activity. Fuel damage criteria also includes the occurrence of center line melting with measures of additional activity release also guided by Regulatory Guide 1.77, but the Zion SAR shows this does not occur.

Revising the source term to Appendix K calculations [in which all fuel goes to DNBR in $\frac{1}{2}$ second] with related release of all gap activity into containment, with limited blowdown to offsite during the related 7 seconds closure time and absent a 50% plate out of iodine as can be interpreted from the above referenced item B.5.a, increases offsite dose due to containment purge above by a factor of 3400 to 176,000 rem and would thereby be completely unacceptable. Limiting the purge line valves to an opening of 50° could reduce offsite dose to 64,000 rem and represents the least value which may be proposed within the licensing basis.

Note: The BTP CSB G-4 proposing that valve closure within 5 seconds will ensure purge valves are closed before the onset of fuel failures has since been extended by the staff on a plant-specific basis to 15 seconds. Further, the writer cannot find any safety evaluation report supporting these positions. These positions cannot be sustained for Zion since a) DNBR infringement (from Appendix K calculations) and hence fuel failure and gap activity release [Ref. SRP 4.2) of 10% of core inventory (Ref. Regulatory Guide 1.77) occur within $\frac{1}{2}$ second of the initiation of the LOCA, b) related maximum clad temperatures of 1750°F occur immediately and never reduce below 1400°F, c) RCS pressure in the region of the core rapidly reduces from 2250 psia to 900 psia in 7 seconds increasing potential pressure drop across the cladding for release of gap activity to the RCS inventory, d) the massive bulk boiling and blowdown surrounding the failed fuel ultimately discharges 270,000 lbs of RCS inventory into the containment at 7 seconds into the event increasing containment pressure from 0.3 psig to 23.8 psig (in these 7 seconds), and e) causes 15,000 lbs of the resulting containment inventory to be discharged to the environment through 2x42" fully open lines, or 5400 lbs for the same lines with valve closed to 50°.

3.0 CONCLUSION

The 42" valves at Zion should remain closed in Modes 1, 2, 3, and 4 because the consequences of the offsite dose to thyroid (from iodine) during a LOCA is unacceptably high; whole body dose has not been evaluated. The least value for offsite dose to the thyroid which may be proposed within the existing licensing basis is 64,000 rem.

The conventional treatment of BTP CSB 6-4 which assumes that fuel failure does not occur over the first 5-15 seconds after a LOCA and thereby that only RCS operating inventory of fission products is released to the containment, and then to the environment, cannot in general be sustained against thermal hydraulic analyses for containment response, and licensing basis requirements (including criteria) for the calculation for, and the occurrence of, fuel damage and the quantification and treatment of the resulting source terms.

References

1. Letter from P. C. Blond (CECo) to H. R. Denton (NRC); Subject: Zion, Units 1 and 2, Proposed Amendment to Facility Operating License Nos. DPR-39 and DPR-48 dated February 21, 1986.
2. Letter from R. L. Kelley (W) to C. Reed (CECo); Subject: Offsite Dose During LOCA and Containment Purge, dated October 22, 1986.
3. Letter to L. O. DelGeorge (CECo) from S.A. Varga (NRC); Subject: Generic Concerns of Purging and Venting Containments, dated September 9, 1981.
4. Memo for F. H. Robinson from R. W. Houston, Subject: "Evaluation of the Risk at Zion," dated August 14, 1985.

SPLB SALP INPUT

Plant Name: Zion Nuclear Generating Stations, Units 1 and 2
SER Subject: Containment Purge and Vent Valve Operation
TAC Nos.: 55417/8

Summary of Review/Inspection Activities

The licensee provided an evaluation of offsite doses undertaken in 1976. This was undertaken with a methodology and source term chosen by the licensee. The licensee did not present results from alternative more detailed methodologies which could be considered enforceable under existing regulatory positions and the related circumstances.

Narrative Discussion of Licensee Performance - Functional Area

The single only methodology used by the licensee is not an acceptable approach for estimating doses under the proposed circumstances and especially since alternate detailed evaluations required by the SRP give greatly increased values beyond 10 CFR Part 100 limits. A prudent approach would have recognized the deficiencies and risks in the single methodology adopted with resulting substantively different recommendations to ensure public health and safety.

Author: Robert B. A. Licciardo

Date: May 11, 1989