September 23, 1982

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Docket No. 50-245
LS05-82-09-074

LICENSEE: NORTHEAST NUCLEAR ENERGY COMPANY (NNECO)

FACILITY: MILLSTONE UNIT NO. 1

SUBJECT: SUMMARY OF SEPTEMBER 15, 1982 MEETING "POST LOCA COMBUSTIBLE GAS CONTROL - FUEL/CLAD GAP IODINE RELEASE VS. WATER RADIOLYSIS RATES

NRC staff and NNECO - Owners Group representatives (Enclosure 1) met in the NRC, Bethesda, Maryland office on September 15, 1982. The purpose of the meeting was to very quickly review the calculational methodology presented by the licensee in the August 6, 1982 submittal entitled "Combustible Gas Control Evaluation" and the basis for the assumed 12 hours of boiling radiolysis. The NRC evaluation of the NNECO and Owners' Group submittals at this point in time indicated that the methodology used by the licensee for evaluation of oxygen generation by radiolysis is acceptable and the whole issue hinges on the important relationship between the iddine release from the fuel rod into the coolant and the extent of zircaloy/water reaction on the rate of water radiolysis. The amount of water decomposed to hydrogen and oxygen is sensitive to the amount of iodine contaminent in the core cooling water and to the contaiment hydrogen concentration.

A significant amount of iodine in the coolant is tolerable as long as the containment hydrogen concentration (i.e., the extent of metal-water reaction) is also high. The licensee has concluded that Millstone-1 meets all regulatory requirements without the need to purge or vent during post LOCA conditions to prevent a combustible gas mixture within containment or containment pressures greather than one half the design pressure.

The staff's concern focused in two general areas: (1) Does the licensee's analysis conform with all regulatory requirements specifically with regard to the relationship between the extent of metal-water reaction and the release of iodine? That is, can iddine releases be coupled to the extent of metal-water reaction and still meet all regulatory requirements. (2) Assuming the licensee's analysis conforms with all regulatory requirements, is it technically sound.

After considerable discussion in the first area, the question of conformance was tabled for future resolution by the staff. As a result, the rest of the meeting focused on the licensee's analysis used to reach its conclusion, specifically as related to the iodine contaminated water radiolysis rates and the resultant oxygen concentrations compared with combustibility limits during post LOCA conditions.

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The NNECO spokesman, with respect to the 12 hour post LOCA boiling assumption, explained that the 12 hour total core boiling period generously spanned conditions where boiling could exist in the core hottest regions for as much as 30 hours with one low pressure coolant injection and one low pressure core spray system operating. Longer periods of boiling up to 2 or 3 days with the reactor vessel water level at 2/3 core height are beyond this assessment and assume degraded emergency safety features, i.e., no core spray and degraded core cooling; that is failure of redundant emergency core cooling systems, NNECO agreed to provide additional documentation to support the 12 hour boiling period assumed in the NNECO statement.

The NNECO presentation included:

- o Definition of limiting amount of Radiolysis needed to achieve flammability for various metal-water reactions
- o Treatment of gas dissolution effects using gas/liquid partition coefficient
- o Definition of dissolved H_2 gas levels for various levels of radiolysis and metal-water reactions
- o Definition of Radiolytic stability criteria
- o Systematic impurity screening criteria
- o Definition of limiting Iodide concentration vs. extent of metal-water reaction
- o Definition of post-accident Iodide source term

Copies of the visual aids distributed to attendees prior to the oral presentation can be obtained from the undersigned.

Staff comments following the presentation included:

- o Regulatory Guide 1.3 and 1.7 provide the staff's conservative assessment of design basis accidents with respect to fission product release, hydrogen generation and mitigative engineered safety feature design.
- o 10 CFR 50.44(d)(1) requires that the amount of hydrogen contributed by core metal-water reaction as a result of degradation but not total failure of emergency core cooling functioning shall be assumed either to be five times the total amount of hydrogen calculated for compliance with 10 CFR 50.46(b)(3)... This affects the iodine release. Since NNECO desires to demonstrate the adequacy of continuous inerting for conditions differing from R.G.1.7 a spectrum of core accidents should be considered ranging from that characterized by 10 CFR 50 App. K up to the accidents characterized by R.G.1.3-1.7. The staff agreed with NNECO that the large hydrogen concentration resulting from the zircaloy clad oxidation beyond that of 10 CFR 50.44 expected for post LOCA conditions corresponding to accidents on the upper (most severe) end of the spectrum, i.e. those of R.G.1.3 and 1.7, is sufficient to demonstrate an inert containment atmosphere.
- o NUREG/CR-2507 "Background and Derivation of ANS-5.4 Standard Fission Product Release Model" should be considered in assessing the validity of the NNECO calculated iodine release into the coolant.
- o The margins of conservatism in the NNECO calculations should be identified and listed.

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o NNECO should consider confirmatory tests to verify fuel/clad gaps, iodine releases and calculated iodine concentrations during post LOCA conditions.

During the meeting NNECO prepared a table to illustrate the limiting iodine releases for various zircaloy/water reactions (Enclosure 2) that was meant to be a partial response to staff comments. NNRCO noted that the limiting iodine release for the Appendix K LOCA conditions, i.e. 0.19% zircaloy/water reaction, is more than 28 times greater than the calculated release of iodine. (GE estimated that the outer boundary of failed rods is 3.5% - less than 3.5% of the rods would release the fuel gap inventory of 1.7% of total rod iodine inventory.)

NNECO agreed to submit a supplement to the August 6, 1982 NNECO report that is responsive to the expressed staff concerns and to inform the staff by telephone if the additional effort can not be documented by the tentatively agreed upon date, October 4, 1982.

Original signed by Dennis
M. Crutchfield for/

James J. Shea
Operating Reactors Branch #5
Division of Licensing

Enclosures:
As stated

cc w/enclosures:
See next page

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Attachment 1

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Pat Kealey	Bechtel Power Corp.
John H. Bickel	NUSCo/Safety Analysis Branch
JAMES J. Shea	NRC

Attachment 2

Calculation assuming 100% iodine release to coolant

$$[I^-] = \frac{(13.4 \times 10^3 g / 127 \text{ g/mole})}{2.855 \times 10^6 \text{ liters}}$$

$$\boxed{[I^-] = 3.7 \times 10^{-5} \text{ moles/liter}}$$

f_{Zr-H_2O}	limiting $[I^-]$ $\left(\frac{\text{moles}}{\text{liter}}\right)$	limiting fraction of core inventory released
0.0	6.3×10^{-7}	1.7 %
0.0019 (DBA)	6.29×10^{-7}	1.7 %
0.00612	6.1×10^{-7}	1.65%
0.01	7.87×10^{-7}	2.13 %
0.40	2.75×10^{-5}	74.4 %

– assuming 4.0% O_2 initially