NORTHEAST UTILITIES

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 665-5000

November 25, 1985

Docket No. 50-245
B11766

Director of Nuclear Reactor Regulation
Attn: Mr. Christopher I. Grimes, Chief
Systematic Evaluation Program Branch
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

References: (1) J. F. Opeka letter to C. I. Grimes, dated May 17, 1985.

(2) H. L. Thompson letter to J. F. Opeka, dated July 31, 1985.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 1
Integrated Safety Assessment Program

In Reference (1), Northeast Nuclear Energy Company (NNECO) provided a proposed scope for the Integrated Safety Assessment Program (ISAP) review of Millstone Unit No. 1. In Reference (2), the Staff formally issued the results of the ISAP screening review process, establishing the scope of ISAP for Millstone Unit No. 1 and initiating issue-specific evaluations. Reference (1) also indicated that for each issue or topic included in ISAP, NNECO would provide a discussion of the safety objective and an evaluation of the plant design with respect to the issue being addressed to identify specific terms to be considered in the integrated assessment. In accordance with this commitment, the review for the following ISAP topic is attached:

- ISAP Topic I.11 - "Post-Accident Hydrogen Monitor"

With this submittal, NNECO has completed and docketed to the Staff issue-specific evaluations and public safety risk-oriented analyses of all the ISAP topics designated by the Staff in Reference (2). If you have any questions concerning the attached review, please contact us.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

J. F. Opeka
Senior Vice President

cc: J. A. Zwolinski

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ISAP TOPIC NO. 1.11

POST-ACCIDENT HYDROGEN MONITOR

ISAP Topic No. 1.11
Post-Accident Hydrogen Monitor

I. Introduction

Following a postulated design basis accident, limited quantities of hydrogen gas are generated by the reaction of steam with the zircaloy fuel cladding in the core. If adequate quantities of oxygen and hydrogen exist in the containment, there is the potential for combustion or deflagration. To reduce or eliminate the potential for combustion or deflagration, 10 CFR 50.44 requires Mark I BWRs to have inerted containments. Inerting reduces the potential for combustion or deflagration by reducing the oxygen content in the containment atmosphere to the level that it is not capable of reacting with hydrogen produced by an accident. A Combustible Gas Control Evaluation (CGCE) was performed for Millstone Unit No. 1 and has shown that if the initial oxygen concentration in the containment is 4% or less (the Technical Specification limit), there is no potential for combustion or deflagration during or following a DBA. Nevertheless, follow-up actions resulting from the TMI-2 accident have required that the ability to monitor containment hydrogen concentrations be provided (reference NUREG-0737, Item II.F.1.6). The purpose of this topic is to provide the NRC with additional information regarding Millstone Unit No. 1 post-accident hydrogen monitoring capability.

II. Criteria

1. NUREG-0737, Item II.F.1.6
2. Regulatory Guide 1.97, Revision 2

III. Related Topics/Interfaces

ISAP Topic 1.09, Regulatory Guide 1.97 Instrumentation

IV. Evaluation

In response to NUREG-0737, Item II.F.1.6, Northeast Nuclear Energy Company (NNECO) installed a single channel hydrogen monitoring system. Specific details concerning the design and operation of the hydrogen monitor are available in NNECO's Regulatory Guide 1.97 submittal (Reference 1), the NRC Staff's Safety Evaluation Report for Item II.F.1.6 (Reference 2), and two additional NNECO letters (References 3 and 4). In Reference 2, the NRC Staff concluded that the single channel hydrogen monitor already installed at Millstone Unit No. 1 meets all of the "requirements" of NUREG-0737, Item II.F.1.6 with the exception of redundancy.

Criterion 2 in Appendix B to NUREG-0737 states in part:

> No single failure within either the accident-monitoring instrumentation, its auxiliary supporting features or its power sources concurrent with the failures that are a condition or result of a specific accident should prevent the operator from being presented the information necessary for him to determine the safety status of the

plant and to bring the plant to a safe condition and maintain it in a safe condition following that accident. Where failure of one accident monitoring channel results in ambiguity (that is, the redundant displays disagree) which could lead the operator to defeat or fail to accomplish a required safety function, additional information should be provided to allow the operator to deduce the actual conditions in the plant.

In References 5 and 6, NNECO demonstrated that a combustible mixture cannot exist following a postulated design basis accident at Millstone Unit No. 1 if the containment is pre-inerted. This position was accepted by the NRC Staff in References 7 and 8. Because of this, no operator actions at Millstone Unit No. 1 are currently predicated on the containment atmosphere hydrogen concentration when the drywell is pre-inerted. NNECO relies on the control of oxygen, rather than hydrogen, to prevent the containment atmosphere from reaching flammable concentrations. Thus, while the drywell is inerted, no single failure in, or any amount of erroneous information generated by, the containment hydrogen monitor system could prevent the operator from determining the safety status of the plant or from bringing it to or keeping it in a safe condition. Therefore, NNECO concludes that Millstone Unit No. 1 meets the above criterion for design basis accidents.

Although the hydrogen monitor is only single channel, Millstone Unit No. 1 has the capability to determine both hydrogen and oxygen concentrations through the use of the Post-Accident Sampling System (PASS) installed in response to NUREG-0737, Item II.B.3. This system does not provide continuous indication, but rather is based on grab sample analysis. However, it provides a backup to the on-line hydrogen monitor system. As part of its review of our Regulatory Guide 1.97 report submitted in Reference 1, the NRC Staff indicated in Reference 9 that NNECO should show that the sampling and analysis frequency of the PASS is sufficient to respond to any rapid changes in hydrogen or oxygen concentration before a single channel analyzer can be considered acceptable. We intend to provide by January 31, 1986 additional information or reference previously submitted information regarding the capabilities of the PASS.

On October 25, 1985, NNECO received an SER regarding conversion of the Millstone Unit No. 1 Provisional Operating License to a Full-Term Operating License. The SER identified the need for additional information on the four (4) items discussed below:

(1) Beyond DBA Hydrogen Monitoring Capability

The Combustible Gas Control Evaluation (CGCE) was prepared and submitted to the NRC to show compliance with 10 CFR 50.44 in its entirety. Note that 10 CFR 50.44, and accordingly the CGCE, addresses DBAs only. The CGCE was accepted by the NRC in References 7 and 8.

The CGCE concluded that an inerted containment at Millstone Unit No. 1 is sufficient by itself to preclude the formation of a flammable gas mixture for an indefinite period of time following a postulated DBA LOCA. As long as the oxygen concentration is below about

5 percent, there is no possibility of combustion or deflagration. The oxygen concentration in the Millstone Unit No. 1 containment is maintained, in accordance with the Technical Specifications, below 4% by volume during plant operation. In reality, oxygen concentration is maintained much less than required. After an accident, the oxygen concentration in containment is diluted by the production of hydrogen by the metal-water reaction. Radiolysis was identified to be self-limiting in nature and in equilibrium will not contribute enough oxygen to the containment to produce a flammable mixture.

For most beyond DBA events, the additional hydrogen generated acts as a further diluent for the oxygen and, in fact, tends to lower the oxygen concentration and the potential for a combustible gas mixture inside containment. This situation is addressed in detail in Reference 5. A non-mechanistic beyond-DBA event was postulated by the NRC Staff during its review of our CGCE whereby insufficient amounts of hydrogen were generated in conjunction with high iodine releases from the fuel to produce an equilibrium condition prior to reaching a combustible gas mixture. This low probability event was addressed and adequately resolved by the NRC Staff in SECY-83-292, "Applicability of Recombiner Capability Requirements of Revised 10CFR50.44 to BWR Licensees with Mark I Containments," dated July 19, 1983. The NRC Staff found that use of such "conservatively non-mechanistic assumptions" was not warranted in this instance.

(2) Hydrogen Monitoring System Reliability and Operability Requirements

The hydrogen monitor was declared operational on December 31, 1984. Since then, typical problems associated with the operation of a new instrument have occurred. The overall reliability of the instrument is still being evaluated, and additional information on this subject will be provided by January 31, 1986.

The monitor is used during normal operation to determine the hydrogen and oxygen concentration in the drywell and is continuously operated. Technical Specification 4.7.A.6 addresses maximum allowable oxygen concentration and minimum permissible oxygen sampling frequency. The operability requirement for hydrogen monitoring parallels that specified for oxygen monitoring. Existing plant surveillance practices provide greater than 95% availability during plant conditions when the monitor would be necessary, based on typical time required to perform system linearity checks (as detailed in References 3 and 4). The monitor could be returned to service, if required, following performance of these linearity checks within 30 - 60 minutes of establishing the need to return the monitor to service. The 30 - 60 minutes reflects the time period from realignment of the monitor to the "SAMPLE" mode until monitor output has stablized. Since this monitor is continuously operating, operability of this monitor is essentially assured following an accident.

(3) Emergency Procedure Guidelines Relating to the Hydrogen Monitoring System

Revision 4 to the BWROG Emergency Procedure Guidelines (EPGs) has recently been developed and pertains, in part, to the hydrogen and oxygen concentrations in the drywell and suppression chamber. This revision has not yet been implemented and is currently being evaluated to determine the extent of applicability to Millstone Unit No. 1. Further information regarding the applicability of those portions of Revision 4 to the EPGs related to hydrogen and oxygen control will be provided by January 31, 1986.

(4) Hydrogen Generation Risk Considering Deinerting and Reinerting Periods

The probability of a large-break LOCA for Millstone Unit No. 1 is roughly 10^{-4} per year. Although there is no maximum cumulative time limit for deinerting periods, it is an infrequent occurrence and a conservative estimate of the number of deinerted hours per year while conforming to limiting Technical Specification action statements is 96. The probability of these two events occurring simultaneously is conservatively estimated at approximately 10^{-6} per year, and the probability of these events occurring with a simultaneous failure of the hydrogen monitor is even lower. NNECO concludes that the expense of installing a redundant hydrogen monitor solely for the deinerted periods cannot be justified.

V. Conclusions

Millstone Unit No. 1 has a single channel hydrogen monitor which meets all NRC criteria except redundancy, and a Post-Accident Sampling System that can also provide information on containment atmosphere hydrogen concentration. Since a combustible gas mixture will not exist following a postulated design basis accident at Millstone Unit No. 1 and NNECO relies on the control of oxygen rather than hydrogen to prevent a combustible mixture, no operator actions are currently predicated on the ability to monitor the containment hydrogen concentration while the drywell is inerted. The NRC Staff interprets current criteria to require a two-channel containment hydrogen monitoring system. However, NNECO concludes that, based on the above information as supported by previous NNECO and NRC correspondence, there is no need to install a redundant containment hydrogen monitor at Millstone Unit No. 1. Additional information supporting this conclusion will be provided by January 31, 1986.

VI. References

1. W. G. Counsil letter to D. M. Crutchfield, dated April 9, 1984.

2. W. A. Paulson letter to W. G. Counsil, dated July 30, 1984.

3. W. G. Counsil letter to W. A. Paulson, dated October 24, 1984.

4. J. F. Opeka letter to J. A. Zwolinski, dated July 5, 1985.

5. W. G. Counsil letter to W. J. Dircks, dated August 6, 1982.

6. W. G. Counsil letter to W. J. Dircks, dated November 5, 1982.

7. D. G. Eisenhut letter to All Licensees of Operating Reactors, dated May 8, 1984.

8. J. A. Zwolinski letter to W. G. Counsil, dated November 1, 1984.

9. J. A. Zwolinski letter to W. G. Counsil, dated March 11, 1985.