**NORTHEAST UTILITIES**

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Docket No. 50-245
B11684

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

Gentlemen:

Millstone Nuclear Power Station, Unit No. 1
Integrated Safety Assessment Program
Summaries of Public Safety Impact Model Project Analyses

In a letter dated July 31, 1985,(1) Northeast Nuclear Energy Company was requested to provide the Staff with summaries of the public safety risk oriented analyses of a selected number of projects we are evaluating in the Integrated Safety Assessment Program (ISAP).

In response to this request, and in accordance with our understanding of the ISAP process, we are providing the Staff with a summary of the following project we have evaluated for public safety impacts:

1) ISAP Topic No. 1.12 - "Control Room Habitability"

It is noted that since we have not completed our analyses of the entire set of ISAP projects, the public safety impact scores are to be considered preliminary at this time. Upon completion of our analyses of the entire ISAP project set, including all five attributes, we will review our analyses and revise our public safety impact results, if necessary, to assure consistency in the ranking of the ISAP projects.

As further public safety impact analyses are completed, we will promptly forward summaries to the Staff for review.



(1) H. L. Thompson letter to J. F. Opeka, "Integrated Safety Assessment Program," July 31, 1985.

If you have any questions on this material, please feel free to contact my staff.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

J. F. Opeka
Senior Vice President

cc: J. A. Zwolinski

## ISAP #1.12 Control Room Habitability

### Safety Issue

There are three areas in which control room habitability can have an impact on safety, and these are:

- o Assuring the ability of control room operators to function during the course of an accident which results in a radioactivity release.
- o Assuring the ability of control room operators to function following a chlorine gas release.
- o Providing a working environment which is not likely to induce operator errors due to high temperature, humidity, or lack of sufficient fresh air.

Each of these is further discussed below.

The Millstone Unit 1 control room Heating, Ventilating and Air Conditioning (HVAC) system automatically isolates the control room if high airborne radioactive contamination is detected. Following such an isolation, the control room operators may have to use Scott air-packs for breathing should air samples indicate such a need. This requires wearing a full face mask which impedes the operator's sensory inputs (both visual and auditory) and hampers communication with other operators. This would tend to result in an increased chance of an operator error while shutting the reactor down or in mitigating an accident.

Millstone Unit 1 currently uses a chlorine gas injection system to control biofouling growth in certain plant cooling water systems that use seawater for cooling. At present, the source of the chlorine is a railroad tank car which holds 55 tons of chlorine gas in liquid form under pressure. The current HVAC system does not automatically isolate following chlorine gas release. The Millstone Unit 2 control room, which is adjacent to the Unit 1 control room, has a high chlorine level alarm. Following the unlikely event of a major chlorine gas release, the Unit 2 control room operators would inform the Unit 1 operators to take protective actions (isolating of the control room and/or wearing of Scott air-Packs). In the hypothetical worst case scenario, the concern is that if the release is large enough and the wind direction is within

certain limits, the control room operators may become incapacitated before the protective actions are completed. If the operators are incapacitated, a transient occurs (e.g. reactor trip), and the automatic systems (e.g. feedwater, Isolation Condenser) fail, the transient will not be mitigated leading to a severe core damage.

Loss of the control room HVAC during normal operation causes the room temperature to increase. In the past 13 years of operation, the control room HVAC has failed 3 times. Loss of HVAC has not initiated any transient (due to possible equipment malfunction at high temperature). However, with high temperature and the control room environment being uncomfortable, there is an increased chance of operator error while performing routine duty which could result in initiating a transient.

**Proposed Project**

The HVAC for the control room is proposed to be upgraded to provide the following capabilities:

- Under normal operation - provides air conditioning to the control room, utilizing recirculation and outside air make-up.

- Upon detection of high radiation or high chlorine gas levels initiate automatic isolation of air intake.

- Filtration without makeup - during a radiation or chlorine gas release, provide 100% recirculated air (3,000 cfm is filtered) to the control room ensuring a habitable environment.

- Filtration with makeup - post accident purge made to reduce the $CO_2$/radiation content of the control room.

The proposed system will use charcoal filters capable of removing iodine.

**Analysis of Public Safety Impact**

The public safety impact of this proposed changed was assessed using Methods A

and B. Method A was utilized to analyze the conditions following release of high radiation and chlorine gas. Method B was utilized in assessing loss of the control room HVAC during normal operation with its effect on operator actions. The effect of chlorine gas release on Millstone Unit 1 control room personel and indirectly causing a core melt accident is also discussed in ISAP Topic #2.07, "Sodium Hypochlorite System" (Reference 1).

Design basis calculations indicate the need to protect the operators during design basis accid ts where subsequent operator actions are still assumed. However, such design basis calculations use grossly conservative estimates of the iodine source term. Realistically, severe core damage and significant containment failure or bypass is required to reach a situation where the control room operators would require protection. If the source of such releases is Millstone Unit 1, subsequent Unit 1 operator actions will have no significant impact on public risk. However, if the source of the release is Millstone Unit 2, protecting the Unit 1 operators from high radiation could improve the probability of a safe shutdown of Unit 1.

The presence of a high radiation alarm in the Millstone Unit 1 control room may lead to donning of protective breathing apparatus (Scott air-Packs) and further investigation of the situation. A decision would be made to either continue operation or initiate a manual shutdown. If a decision to continue operation is made it would require an additional transient event occurring in addition to the radiation release from Millstone Unit 2 to initiate core melt. (This represents a highly unlikely coincidence.) An alternate path investigated using bounding type analysis involves the following:

- operators initiate a controlled manual shutdown using the recirculation flow control system and eventually trip the reactor from low power levels (this prevents the closure of M.S.I.V.s).

- shortly after this, the operators are forced to evacuate due to the radiation

- feedwater fails to continue to run after reactor trip

- failure of either the Isolation Condenser or IC makeup system

Such a sequence would result in a TE1 Plant Damage State as defined in the Millstone Unit 1 Probabilistic Safety Study. The overall frequency of this sequence is calculated as:

$$\lambda = \lambda_{CM2} Q_{RT} Q_{FW/RT} (Q_{IC} + Q_{ICMUP})$$

-where: $_{CM2}$ is the frequency of major radiation release from the Unit 2

$Q_{RT}$ = 1.0, given manual scram

$Q_{FW/RT} = 1.031 \times 10^{-2}$, unavailability of feedwater given reactor trip (Table 2A-8 Millstone Unit 1 PSS)

$Q_{IC} = 2.19 \times 10^{-2}$, unavailability of automatic isolation condenser (Table 2A-5 Millstone Unit 1 PSS)

$Q_{ICMUP} = 2.78 \times 10^{-2}$, unavailability of automatic isolation condenser makeup (Table 2A-6 Millstone Unit 1 PSS)

In truth, the probability is much less in that the above does not consider items such as the probability of the plume blowing towards the control room or the probability that iodine will be limited.

Combining the above values yields the frequency of Millstone Unit 2 radiological releases resulting in core melt events at Millstone Unit 1.

$$\lambda = \lambda_{CM2} (5.124 \times 10^{-4})$$

Although not calculated, the frequency of a severe core damage event which results in a significant release at Millstone Unit 2 ( $\lambda_{CM2}$) is expected to be less than $5 \times 10^{-4}$/year. Thus, the resultant frequency of a core melt event at Millstone Unit 1 resulting from a radiological release from Millstone Unit 2 is about $2.5 \times 10^{-7}$/year.

In addressing the final area, the current control room HVAC is a single train system. The proposed upgrade to the system will have two 100% air filteration units and air conditioning units. Therefore, the upgraded system is expected to be more reliable. This would tend to reduce the likelihood of future losses of control room HVAC, and hence the probability of operator errors.

**Results**

As calculated in ISAP Topic #2.07, "Sodium Hypochlorite System", the frequency of core melt accident initiated by chlorine release is $9.2 \times 10^{-7}$/year. This sequence results in TE1 Plant Damage State as defined in the Millstone Unit 1 P.S.S. The equivalent public risk is 34.5 Man-Rems (excluding the direct effect of chlorine on offsite population).

The frequency of core melt accident at the Unit 1 initiated by high radiation level due to a release from the Unit 2 is $2.5 \times 10^{-7}$/year. This sequence also results in TE1 Plant Damage State. The equivalent public risk is 10 Man-Rems.

The effect of loss of HVAC and subsequent higher control room air temperature will place additional environmental stresses on the operators. However, the increased probability of the operator making an error and initiating a transient due to environmental stresses cannot be easily quantified. The upgraded system will not completely eliminate this risk. Since the proposed system is expected to be more reliable, this risk will be somewhat reduced. The total benefit of the proposed HVAC upgrading is about 45 Man-Rems for the cases of chlorine gas and radiation release. Based on reduction of 45 Man-Rems and engineering judgment (for lower probability of loss of HVAC during normal operation), this project is assigned a score of 0.5 out of 10.

References

J.F. Opeka letter to C.I. Grimes dated August 7, 1985.