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Jersey Central Power & Light Company

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MEMBER OF THE General Public Utilities Corporation SYSTEM

December 13, 1973

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Robert J. Schemel, Chief
Operating Reactors Branch #1
Directorate of Licensing
Office of Regulation
United States Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Schemel:

SUBJECT: OYSTER CREEK NUCLEAR GENERATING STATION
RADIOACTIVE WASTE TREATMENT
SYSTEM MODIFICATION

In reply to your letter dated October 10, 1973 in which you requested additional information in connection with our September 20, 1973 submittal entitled "Preliminary Description and Analysis of Proposed Modifications to the Gaseous, Liquid and Solid Radioactive Waste Treatment Systems for the Oyster Creek Nuclear Generating Station", we are enclosing our responses to the questions that were included as Attachment A to your letter.

If you have any questions regarding these responses, we would be pleased to meet with your representatives at your convenience.

Very truly yours,

Ivan R. Finfrock, Jr.
Vice President

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Enclosure

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QUESTION 1

It is proposed to design and construct the liquid waste system and the gaseous waste system to Quality Group D and non seismic classification. In this regard, discuss how the guidelines in Regulatory Guides 1.26 and 1.29 would be met for the accident conditions.

RESPONSE:

A. Classification of Radwaste System as Group D and Seismic Category II

Regulatory Guide 1.26 requires radwaste treatment system components to be classified as Group C unless the failure of any system component would result in a calculated exposure less than 170 mrem whole body dose or its equivalent to parts of the body at the offsite location of highest exposure. The analysis presented herein demonstrates that the liquid and gaseous radwaste system intended for installation at Oyster Creek Nuclear Station, Unit 1, meets the aforementioned guidelines.

Regulatory Guide 1.29, Rev. 1. requires those portions of radwaste treatment systems to be Seismic Category I unless simultaneous failure of these portions result in calculated offsite exposures less than the 500 mrem to the whole body or its equivalent to any part of the body. It is shown herein that simultaneous failure of all components in the Augmented Offgas System and Liquid Radwaste System meet the aforementioned guidelines.

B. Augmented Offgas System Summary

The highest offsite whole body exposure due to the failure of a single component in the Augmented Offgas System is 60 mrem.

The offsite whole body dose due to the failure of all components in the Augmented Offgas System is 110 mrem, which is less than the 500 mrem guideline of Regulatory Guide 1.29.

The highest offsite thyroid exposure from iodine released as a result of the failure of all Augmented Offgas System Components is 342 mrem, assuming 100% of the system iodine inventory escapes. This dose is within the 1500 mrem guidelines.

These conservatively calculated exposures are within the guidelines presented in Regulatory Guides 1.26 and 1.29 and therefore, the systems are Class D and Seismic Category II.

C. Assumptions and Calculational Procedures

Table 11.1.1 of Reference 1 lists the source terms used as a basis for establishing inputs, releases and inventories of each system component. Table 11.3.3A of Reference 1 lists node point activities derived for the system.

Component inventories were determined by activity balances for each component. For parent isotopes, assuming steady state operation, the following relation was utilized:

$$F_{in}C_{j,in} - F_{out}C_{j,out} - \lambda_j N_j = 0 \qquad \text{(Equation 1)}$$

where, in consistent units:

F_{in} = Volumetric flow rate into component.

F_{out} = Volumetric flow rate from component.

$C_{j.in}$ = Specific activity of isotope j entering component.

$C_{j.out}$ = Specific activity of isotope j leaving component.

λ_j = Decay constant for isotope j.

N_j = Total activity of isotope j within component.

For daughter isotopes, again assuming steady state operation, the following relation holds:

$$F_{in}C_{j.in} - F_{out}C_{j.out} + \lambda_{j-1}N_{j-1}B_{j-1} - \lambda_j N_j = 0 \qquad \text{(Equation 2)}$$

where:

λ_{j-1} = decay constant for isotope j-1.

N_{j-1} = total activity of isotope j-1 within component.

B_{j-1} = fraction of isotope j-1 which decays to isotope j.

Equations 1 and 2 were used to calculate component isotopic inventories (N_j). Values for C_j were calculated using a computer code entitled "CORN" which was developed by Burns and Roe, Inc.

The atmospheric dispersion coefficient (X/Q) for ground release was determined using site wind direction data and site plan data. The X/Q was evaluated to be 2.26×10^{-3} seconds per cubic meter using equations 3.141 and 3.142 from Reference 2, a wind speed of 1 meter per second and Pasquill Type F conditions.

Dose conversion factors, used to evaluate the whole body exposure and iodine exposures were obtained from Reference 3. The doses were calculated using the methods described in Section 7-5.2 of Reference 2 for the dose from a finite cloud.

Release factors for Xe and Kr gases from the charcoal adsorbers for a charcoal upset failure are based on the assumption that the charcoal bed temperature instantaneously increases from 40°F, its operating temperature, to 100°F, the highest expected ambient temperature.

The difference between the equilibrium isotopic inventories for bed temperatures of 40°F and 100°F is the conservatively assumed basis for establishing released activity. This approach leads to released fractions of 0.5 to 0.67 of the 40°F bed inventory depending on the isotope and the source of the dynamic adsorption coefficients (K_D).

If concentration gradients and comparative gradients were infinite, the .5 to .67 fraction would be instantaneously released. Since these gradients are not infinite, it would be realistic to choose a much smaller fraction than these for estimating releases during the first two hours following the postulated failure. However, in the interest of conservatism, the exposure calculation is based on a released fraction of 0.5.

The whole body dose due to releases from the first carbon bed adsorber is calculated to be 60 mrem. This was the highest dose calculated in the single component failure analysis. The dose due to the failure of all components in the Augmented Offgas System is 110 mrem.

The whole body exposure due to the release of activity from the end of the delay pipe at the anticipated operational occurrence activity release rate of 260,000 microcuries per second was calculated to be 15 mrem, if the reactor is postulated to operate for 20 minutes after the accident.

If 100% of the Augmented Offgas System iodine inventory is assumed to be released, the resultant thyroid exposure was calculated to be 342 mrem. This calculation is very conservative, since a very small fraction of the iodine will actually be released.

D. Liquid Radwaste System

The noble gas inventory in the liquid radwaste system is several orders of magnitude less than that of the Augmented Offgas System. The resultant whole body exposure due to the release of the entire noble gas inventory will thus be negligible with respect to the guidelines of Regulatory Guides 1.26 and 1.29.

The lower floor of the Liquid Radwaste Building will be watertight with retaining walls sufficiently high to contain the entire liquid inventory of the building. The Lower floor and the portion of the surrounding wall that is required to retain the building's liquid inventory will be designed to Seismic Category I requirements. Therefore, all liquid wastes within the

Liquid Radwaste Building will be contained following a postulated SSE.* In addition, the new tanks located outside of this building will be Seismic Category I to ensure containment of radioactive liquids.

*Safe Shutdown Earthquake.

REFERENCES

Reference 1 - "Preliminary Description and Analysis of Proposed Modifications to the Gaseous Liquid and Solid Radioactive Waste Treatment Systems for Oyster Creek Nuclear Generating Station." submitted 9/20/73.

Reference 2 - "Meteorology and Atomic Energy 1969" by D. H. Slade.

Reference 3 - "Final Environmental Statement - ALAP - LWR Effluents, Volume 1 - The Statement," July 1973.

QUESTION 2

Provide the weight of charcoal in each adsorber bed of the proposed gaseous waste system, the operating pressure of the beds, and the dynamic adsorption coefficient for the operating conditions of the beds.

RESPONSE:

The total estimated weight of the charcoal in adsorber beds of the proposed gaseous waste system is approximately 20 tons as computed from the following formula for the proposed operating conditions listed below:

$t = \frac{K_D M}{F}$ where t = residence time (minutes).

K_D = Dynamic Adsorption Coefficient. (cubic centimeters/gram)

M = Mass of Charcoal (grams)

F = Volumetric Flow. (cubic centimeters/minute)

Charcoal Bed Temperature	= 40°F
Minimum Bed Operating Pressure	= 1 Atm. (14.7 psia)
Xenon delay (residence time)	= 20 days (28,800 minutes)
Total volumetric flow rate	= 20 SCFM* (566,400 cubic centimeters/minute)
Relative humidity of entering gas	= 30%

The dynamic adsorption coefficient at the above referenced conditions for xenon is approximately 850 cc/gm. The weight of charcoal is therefore:

$$M = \frac{tF}{K_D} = \frac{(28,800 \text{ minutes})\ (566,400 \text{ cc/min})}{850 \text{ cc/gm}}$$

$$= 19.19 \times 10^6 \text{ gms} = 21.2 \text{ tons}$$

*Reference conditions are 60°F and 14.7 psia.

Hence, the weight of charcoal adsorbers to be installed at Oyster Creek Nuclear Station will be on the order of 20 tons. The number of beds provided is dependent on the vendor selected and is not known at this time.

QUESTION 3

It is proposed to install the recombiners downstream of the delay line. State the reasons for the proposed installation location since it appears that installation of the recombiners ahead of the delay line may be advantageous because it would provide for longer delay of the noble gases and eliminate the possibility of hydrogen explosions in the delay line.

RESPONSE:

Installation of the recombiner subsystem ahead of the delay pipe would holdup Xenon and Krypton isotopes approximately 5 hours longer than if installed downstream of the delay pipe assuming a design basis air in leakage rate of 20 SCFM. This additional delay, however, has a negligible effect on the decontamination factor achieved by the proposed system.

The consequences of a hydrogen explosion in the delay line will not be increased due to the installation of the recombiner after the delay line. Since the delay line is designed to withstand the effects of a hydrogen explosion, installation of the recombiner upstream to eliminate the possibility of a hydrogen explosion is not required. Furthermore, recombiners operating at Tsuruga and KRB for several years have not initiated any hydrogen explosion.

The reasons for installing the recombiner subsystem downstream of the delay line are as follows:

1. Reduce the number of interconnections with the existing system.

   If the recombiner subsystem were located in front of the existing delay line and charcoal subsystem downstream of the delay line, two tie-ins to the existing system would be required. With the proposed arrangement only one tie-in is required. Reducing the number of tie-ins will reduce the interconnection time and will reduce the radiation exposures to the personnel making the tie-ins.

2. Reduced shielding requirements

The existing delay line holds noble gases up to one hour. Locating the recombiner subsystem downstream of the delay line will reduce the shielding requirement for the recombiner subsystem.

3. Simplification of Preoperational Testing

By installing the recombiner subsystem downstream of the delay pipe, it may be tested as a unit with the charcoal adsorber subsystem prior to startup.

4. Economic and Space Considerations

Locating the recombiner in front of the delay line would require two new buildings, one with the recombiner subsystem and the other with the charcoal subsystem. The proposed arrangement requires only one new building.

There is a minimal amount of available space within the Turbine Building. A recombiner subsystem with adequate redundancy could not be installed in the Turbine Building without moving existing equipment and changing the flow scheme of the air ejectors. Further, there is no convenient location adjacent to the Turbine Building in the vicinity of the SJAE room on which a building can be erected to house the recombiner subsystem.

QUESTION 4

The Detergent and Laundry Waste Subsystem will utilize a detergent evaporator. For this evaporator, provide the capacity, design temperature and design pressure.

RESPONSE:

It is anticipated that the detergent waste evaporator to be installed at Oyster Creek will be of a nominal 4320 GPD capacity.

The "normal operation" and "anticipated operational occurrence" flow rates assigned to detergent waste in the source term calculation was 4,000 GPD. This is a conservative estimate and was used only to establish a prudent level of conservatism in the annual activity release estimate. To date, the production of detergent and laundry waste at Oyster Creek has averaged 800 GPD.

The schedule for the redesign of the liquid radwaste system requires that the new high purity and chemical/floor drain waste subsystem be constructed and operational before the detergent and laundry waste subsystem can be installed. Detailed design of this subsystem has not progressed to the point where it is possible to specify the design pressure and temperature of the detergent waste evaporator at this time. However, from the preliminary design information which is available at present, it can be assumed that the steam side of the evaporator will operate at a pressure ≤ 75 psig and the saturated steam temperature associated with that pressure (320°F). The process fluid side will operate at atmospheric or sub-atmospheric pressure and a temperature of 212°F or less. This is based entirely on preliminary estimates and is subject to modification as the design progresses. Changes made in the limiting conditions specified will be promptly reported.