INDIAN POINT NUCLEAR GENERATING

PLANT UNIT 3

SAFETY EVALUATION

5/13/73

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11.0 RADIOACTIVE WASTE MANAGEMENT

11.1 Design Objective and Criteria

The radioactive waste management systems are designed to provide for the controlled handling and disposal of radioactive liquid, gaseous and solid wastes. The applicant's design objective for these radwaste systems is to restrict the amount of radioactivity released from normal plant operation to unrestricted areas to within the limits setforth in 10 CFR Part 20. In addition the applicant will be required to maintain and use existing plant equipment to achieve the lowest practicable radioactive releases to the environment in accordance with the requirements of 10 CFR Part 20 and 10 CFR Part 50.

Our evaluation of these waste treatment systems is based on the "as low as practicable" guidelines for radioactive material in effluents discharged to unrestricted areas. To meet these guidelines the following design objectives apply. For liquids the estimated annual quantity of radioactive material releases, excluding tritium, should not exceed 5Ci/yr. For gaseous effluents the annual average radiation dose rate to the whole body or critical organ of an individual at or beyond the site boundary should not exceed 5 mrem/yr. The critical pathway for exposure to individuals from radioiodine in the gaseous effluent is the grass-cow-milk pathway to the thyroid of a two-year old child. For Indian Point Unit 3 this estimated dose is based on the location of the nearest actual cow, approximately 9 miles south of the plant.

In the following sections, we evaluated for Indian Point Unit 3, the equipment capacity and performance for the liquid, gaseous and solid waste systems; the design codes and quality assurance criteria; and the radiation monitoring of the process and inplant areas. Our evaluation also considered radioactive effluent releases for combined operation at the Indian Point site of Units 1, 2, and 3. Each unit will have a separate waste system except for the steam generator blowdown and laundry treatment sytems located at Unit 1 and shared by Unit 1, 2, and 3.

11.2 Liquid Waste

The liquid radioactive wastes will be treated in three principal systems; the reactor coolant treatment, liquid waste disposal and the steam generator blowdown treatment systems. These systems serve only Unit 3. However, when the steam generator blowdown contains radioactivity above a preset value, it will be processed at Unit 1 along with the radioactive blowdown from Unit 1 and 2. The laundry and hot shower wastes are also processed at Unit 1. The collection rates and system capacities are presented in Table 11-1. The liquid effluents will be continuously monitored before discharging through the circulating water duct to the Hudson River. If the radioactivity exceeds a predetermined value, the discharge will be automatically stopped by a valve on the discharge line.

Reactor Coolant Treatment

The reactor coolant treatment system will collect and process deaerated liquids from shim bleed, equipment leaks and excess letdown flows. During normal operation the reactor coolant will be let down continuously and processed to maintain coolant quality at a rate of 75 gpm in the chemical and volume control system (CVCS). This letdown stream will pass through redundant deep-mixed-bed demineralizers and return to the reactor coolant system. Part of this stream, the shim bleed, will be sent to the boron recycle system. The excess letdown and the containment equipment leaks will also be processed through the boron recycle system. These streams will be collected in the reactor coolant drain tank and the CVCS holdup tank. They will be batch processed through redundant cation demineralization, gas stripping, and evaporation equipment. The evaporator condensate goes through a deep-bed anion demineralizer for final purification, and to one of two monitor tanks for sampling and analysis. Condensate that meets specifications will be sent to the primary water tank or released through the liquid effluent monitor to the environment. The condensate can also be sent to the liquid waste disposal system. The boric acid concentrate from the evaporator will be filtered and then flow to the concentrate holding tank for sampling and analysis. The concentrate will be usually sent to the boric acid tanks for reuse, but also may be sent to the solid waste system for disposal. The radioactive gases will be vented from the gas stripper to the gas processing system. The spent resins will be sent to the solid waste system.

In our evaluation we estimated that approximately 15,000 gallons per day of shim bleed, excess letdown and equipment leaks will be collected. These wastes will be processed through the boric acid demineralizers and evaporators and result in an estimated release of 0.035 Ci/yr of radioactivity, excluding tritium. The applicant did not estimate the radioactivity released from this source. The processing capacity will be 43,000 gallons per day when using both evaporators. Our estimate assumed 1-day holdup for decay, nothing going to the waste disposal system and 10% release of the processed effluent to the environment. The holdup tank and processing capacity as shown in Table 11.1 are adequate. The liquid effluent will be continuously monitored during its release to the environment.

Liquid Waste Disposal

The radioactive liquid waste disposal system will collect and batch process aerated wastes from equipment, floor, and chemical drains. The system equipment includes collection and monitoring tanks, a filter, and a 2-gpm evaporator. These wastes are collected in the waste holdup and chemical drain tanks, then filtered, and evaporated. The evaporator condensate will be collected in one of two monitor tanks, sampled and analyzed. The condensate that meets specification will be returned to the reactor water storage tank for reuse or discharged to the Hudson River. Condensate not meeting the required quality will be recycled to the waste holdup tank for further treatment. The evaporator concentrate and spent filters will be sent to the solid waste system. The applicant estimated that approximately 2 Ci/yr of radioactivity, excluding tritium, would be released from this system.

In our evaluation we estimated that approximately 140 gallons per day of equipment drain effluent and 330 gallons per day of floor and chemical drain effluents will be processed by the 2-gpm waste evaporator. Our calculations showed that approximately 2 Ci/yr of radioactivity, excluding tritium will be released. We assumed 1-day holdup for decay, 10% release from equipment drain effluents, and 100% release of the condensate from the floor and chemical drain effluents. As shown in Table 11.1 the holdup volume and processing capacity will be adequate. The releases will be continuously monitored.

Steam Generator Blowdown

The treatment system for the Unit 3 steam generator blowdown stream now installed at Unit 1 will serve Units 1, 2 and 3. The system equipment includes redundant filters and deep-mixed-bed demineralizers, with a total capacity of 132 gpm. An alternate blowdown system located at Unit 3, will be used when the radioactivity in the secondary coolant is less than a preset value. In this system the blowdown stream from Unit 3 will be discharged through the Unit 3 flash tank to the environment without treatment. A composite sample of the blowdown stream will be taken and analyzed daily for isotopic composition. When the radioactivity in the secondary coolant exceeds a preset value, the monitor will activate an alarm and automatically close isolation valves on the blowdown and sampling lines. The operator will manually route the blowdown to the Unit 1 blowdown treatment system. At Unit 1, the blowdown goes to the Unit 1 flash tank. The condensed liquid will flow from the flash tank through a filter, a demineralizer, and through the discharge tunnel to the Hudson River. If the radioactivity in the demineralizer effluent exceeds a preset value, it will activate an alarm alerting the operator to take appropriate action. In addition, a composite sample of the processed blowdown will be taken and analyzed daily for isotopic composition.

We estimate that approximately 10 gpm of blowdown from Unit 3 will be processed in the Unit 1 system, which includes a filter and a mixed bed demineralizer, resulting in an estimated release of 1.7 Ci/yr of radioactive material excluding tritium. With a 50-gpm blowdown rate, the applicant estimated the release rate to be 7.5 Ci/yr. The capacity of the system will be adequate to process 50 gpm blowdown rates from Units 1, 2 and 3. The effluent stream will be continuously monitored.

Liquid Waste Summary

The total radioactivity in the liquid effluent released from Unit 3 to the environment was estimated by the applicant to be 9.6 Ci/yr excluding tritium. His tritium estimate was 610 Ci/yr. Based on our evaluation the radioactivity released to the environment was estimated to be approximately 3.8 Ci/yr excluding tritium and 350 Ci/yr of tritium. The applicant's higher radioactivity release estimate is due to different assumed steam generation blowdown conditions.

In our evaluation we estimated the maximum radiation doses to an individual in unrestricted areas from the aquatic food chain and swimming, would be 0.08 mrem/yr to the whole body and 0.9 mrem to the thyroid. Our radiation dose calculations assumed the combined operations of Units 1, 2 and 3 at the

Indian Point site. All radioactive liquid wastes will be continuously monitored before discharge. Assuming a circulating water flow rate at Unit 1 of 320,000 gpm and at Units 2 and 3 of 870,000 gpm the radioactivity concentration released to the Hudson River will be less than 1% of 10 CFR Part 20.

The liquid waste treatment system has been designed to collect, process, and store waste from operation with up to 1% fission product inventory release to the primary coolant. We conclude that the liquid waste treatment systems will be capable of producing effluents less than 5 Ci/yr which we considered "as low as practicable" and therefore is acceptable.

11.3 Gaseous Wastes

The Unit 3 radioactive waste management systems for gaseous wastes include the gas processing, the condenser air ejector and the steam generator blowdown vent systems along with the containment purge, and the fuel storage, turbine and auxiliary building ventilation systems. These systems for Unit 3 are independent of Units 1 and 2 except for the steam generator blowdown vent. The steam generator blowdown containing radioactivity above a preset level will be processed at Unit 1.

Gas Processing

The gas processing system collects and treats radioactive gases from the reactor coolant treatment system during normal operations. These sources include the shim bleed gas stripper, holdup tanks, cover gases, equipment vents, and gases generated from sampling. The primary source of radioactivity is from degassing the shim bleed in the boron recovery evaporator system. The system includes redundant compressors and four 525 ft^3 and six 40 ft^3 storage tanks. The waste gases will be pumped to one of the four large storage tanks and recycled to the CVCS holdup tanks to meet the cover gas requirements. A second large tank will be available as backup. When 110 psig pressure is reached in the in-service tank, the feed is automatically switched to the backup tank. Prior to cold shutdown of the reactor, the reactor coolant will be degassed and the gas will be distributed in the six small decay tanks.

Some hydrogen is also present in the gas generated from the CVCS system. To prevent hydrogen-oxygen explosions, the process equipment vent system operates at positive pressure so as to minimize inleakage of air. In addition, no air or aerated liquids will be present in equipment that vents to this system. The storage tank gas is automatically sampled and analyzed for hydrogen and oxygen. An alarm will alert the operator when the oxygen concentration exceeds 2%.

The gas in the gas decay tanks will be held for 45 days for radioactivity decay. Before releasing to the environment the gas will be sampled and analyzed. During discharge at a controlled rate through the plant vent, the gas will be continuously monitored. Radioactivity above a preset value will automatically close a valve on the discharge line. Based on a minimum holdup time of 45 days, the applicant estimates releases of 2000 Ci/yr of noble gases.

Based on our evaluation assuming 45 days holdup, our estimated release rate is 1500 Ci/yr of noble gases. Our calculations showed the tank capacity will be adequate to allow approximately 60 days holdup.

Containment Purge

The containment purge system will process radioactive gases that build up in the containment atmosphere as a result of leaks from the primary system. The containment atmosphere will be purged about four times per year. The equipment used for containment purging includes prefilters, HEPA filters and charcoal adsorbers. The filters and the exhaust fan will be shared with the primary auxiliary building ventilation system. Before purging, the air in the containment will be recirculated for 16 hrs. through an internal cleanup system consisting of a HEPA filter and charcoal adsorber. The containment air will then be purged through HEPA filter, charcoal adsorber and the plant vent to the environment. The applicant has estimated the radioactivity released from 4 purges per year to be 88 Ci of noble gases and 0.00014 Ci of iodine-131.

Our evaluation, assuming 4 purges/yr and 16 hr internal recirculation before purging, indicated the same noble gas release as estimated by the applicant and 0.027 Ci/yr of iodine-131. This shared system will be acceptable since during normal operations the exhaust fans provide a negative pressure in the exhaust plenum. This will prevent the cross flow to either the containment or primary auxiliary buildings. If the exhaust fan fails, the associated supply fan will automatically be shutdown to prevent cross ventilation flow between these buildings.

Condenser Air Ejector

Gaseous radioactivity along with noncondensable gases in the secondary coolant will be removed from the turbine condenser by the air ejectors. Leakage in the steam generator from the primary to the secondary system results in some radioactivity in the secondary system coolant. The gases from the condenser will pass through steam jet ejectors and condensers, will be monitored, and then will be released through the plant vent to unrestricted areas. The applicant has calculated that the activity released will be 1300 Ci/yr of noble gases and 0.065 Ci/yr of iodine-131.

Based on our evaluation the radioactivity release will be 580 Ci/yr of noble gases and 0.13 Ci/yr of iodine-131.

Steam Generator Blowdown

The treatment system for the steam generator blowdown will reduce the radioactivity from the secondary coolant before release to unrestricted areas. The treatment system includes flash tanks, redundant filters and demineralizers, and a holdup tank. At Unit 3, the blowdown will go to the Unit 3 flash tank. From the flash tank the vapor will be released without monitoring from a rooftop vent. When the radioactivity in the secondary coolant is above a preset value the blowdown will be automatically stopped and manually diverted to the flash tank at Unit 1. The blowdown system at Unit 1 will also receive the blowdowns from Units 1 and 2. The vent from this flash tank goes to the Unit 1 condenser. The radioactivity released from Unit 1 condenser will be monitored and discharged through the Unit 1 chimney. When the Unit 1 condenser is shut down the vapor will be released from the Unit 1 flash tank through a rooftop vent. The applicant estimated 6 weeks/year for this direct release, and this to contain 0.13 Ci/yr of iodine-131.

Based on the past operating experience of Unit 1, we estimated that the blowdown vapor from Unit 3 would be directly released to the atmosphere for approximately 17 weeks per year. We calculated that this would release 0.16 Ci/yr of iodine-131. The applicant has been advised that capability for continuous treatment should be installed. Monitoring of the blowdown effluent will be required.

Primary Auxiliary Building Ventilation

The atmosphere in the primary auxiliary building will contain radioactivity from equipment leaks. The ventilation system for this building includes a pre-filter, HEPA filter and charcoal adsorber. The filters and exhaust system will be shared with the containment purge system and is acceptable. The ventilation system is designed to sweep air across the building areas and to flow from clean to potentially contaminated areas. The applicant estimated that the radioactivity released will be approximately 1300 Ci/yr of noble gases and less than 0.001 Ci/yr of iodine-131. In our evaluation we estimated 580 Ci/yr of noble gases and 0.05 Ci/yr of iodine-131.

Turbine Building Ventilation

Steam leaks will release some radioactivity into the turbine building atmosphere. This will be discharged without monitoring to the environment through 12 roof-mounted exhaust fans. The applicant has estimated that the radioactivity released will be 0.01 Ci/yr of iodine-131. Based on our evaluation our estimated release is approximately 0.04 Ci/yr of iodine-131. The

Technical Specification for radioiodine release from the station will be reduced to compensate for this unmonitored release path.

Fuel Storage Building Ventilation

The ventilation air for fuel storage building may contain radioactivity from the spent fuel storage pool under accident conditions. The system components include a HEPA filter, charcoal adsorber and fan. Normally exhaust air will pass through a HEPA filter and discharge to unrestricted areas from the monitored plant vent. However, when the radioactivity is above a preset value, the ventilation exhaust air will be automatically diverted through the charcoal adsorber. The applicant did not estimate the radioactivity release in this ventilation system. In our evaluation we determined that the radioactivity released from this building under normal conditions will be negligible.

Gaseous Waste Summary

The applicant has estimated the radioactivity in the gaseous effluents released from Unit 3 will be 5500 Ci/yr of noble gases and 0.34 Ci/yr of iodine-131. For the combined operations of Unit 1, 2, and 3 his estimated releases are 11,000 Ci/yr of noble gases and 0.68 Ci/yr of iodine-131. He also estimated that radiation doses at the site boundary from the combined operation will be 2.4 mrem/yr for the whole body and 1.4 mrem/yr for the thyroid from inhalation.

Based on our evaluation of the gaseous waste systems we calculated that the radioactivity released from Unit 3 during normal operation will be 2700 Ci/yr of noble gases and 0.41 Ci/yr of iodine-131. For the combined operation of Units 1, 2, and 3 we calculated the radioactivity release will be 6600 Ci/yr of noble gases and 0.88 Ci/yr of iodine-131. Based on the combined operation of Units 1, 2, and 3 we calculated the radiation doses at the site boundary to be 2.7 mrem/yr to the whole body and 5.6 mrem/yr to the thyroid from inhalation. We calculated the radiation dose to a child's thyroid to be 5.8 mrem/yr based on the grass-cow-milk pathway for iodine-131 at the nearest actual cow, 9 miles south of the plant site. We conclude that the release of radioiodine in the gaseous effluents from the modified system can not be considered "as low as practicable" due to radioiodine released from the intermittant treatment of the steam generator blowdown. The applicant has been informed that he will be required to have the capability to provide continuous treatment of the blowdown gases and to implement a monitoring program to assure that the actual dose would not exceed our "as low as practicable" guidelines.

11.4 Solid Wastes

The sources of solid radioactive wastes will be spent demineralizer resins, evaporator concentrates, filters, and miscellaneous items such as contaminated clothing, gloves, shoe covers, glassware and paper. The solid waste disposal system is designed to package all solid wastes in 55-gallon drums. A six-drum station will be provided for loading spent resin and evaporator concentrates. A hydraulic baler will be used for the miscellaneous wastes. The filled drums will be stored in a shielded area of the drumming room. The spent demineralizer resins after approximately 6 months storage will be slurried into shielded filter units within 55-gallon drums. The filtrate will be returned to the waste holdup tank. The evaporator concentrates will be pumped into 55-gallon drums containing vermiculite and cement for solidification. The miscellaneous solid waste, clothing, paper and glassware will be compressed in 55-gallon drums. The applicant has estimated that approximately 150 drums of waste will be packaged and shipped each year. Based on the experience of operating reactors we estimate that approximately 4900 Ci of radioactivity in 1000 55-gallon drums will be shipped each year. The proposed system is similar to those previously reviewed. We conclude that the solid waste system will have adequate capacity and is acceptable.

11.5 Design

The radioactive waste treatment systems will be designed and fabricated in accordance with acceptable codes and standards. The reactor coolant drain tank, the spent resin storage tanks and the gas decay tanks will be designed to ASME III, Class C. The piping code will be USAS-B 31.1. This equipment will be located in a Class I (seismic) structure. We have concluded that the equipment and piping designs of the radwaste system are acceptable.

11.6 Process and Area Radiation Monitoring Systems

The process radiation monitoring systems will be designed to provide information regarding radioactivity levels in effluents released to the environment. In addition, these systems will automatically stop releases to unrestricted areas when the radioactivity in the effluents exceed preset values.

The liquid effluents in the discharge line from the waste condensate tanks will be monitored continuously. The monitor will automatically stop the discharge if the radioactivity concentration exceeds preset values. A similar system will monitor the secondary coolant activity in the steam generators that will automatically stop the blowdown when the activity exceeds a preset value. The component cooling loop of the auxiliary coolant system will monitor any primary coolant leakage into that cooling water system. The circulating water discharge will be continuously sampled and analyzed weekly.

The gaseous effluent in the plant vent will be monitored for gross (β,γ) continuously and particulates. However, no method is planned for monitoring of the radioiodine released through the plant vent. The plant vent provides the discharge path for the gas decay tanks, the containment purge, the condenser air ejector and the ventilation systems for the primary auxiliary building and the fuel storage building. Radiation levels above a preset value will auotmatically stop the discharge from the gas decay tanks and activate the auxiliary dilution air supply to the plant vent. A similar monitoring system will serve the containment to control the purge and entry operations. Radiation levels in the containment above a preset value will automatically stop the purge.

A continuous monitor will measure the radioactivity in the effluent from the turbine condenser air ejector. Radioactivity in the gas decay tanks will be measured periodically during the filling operation, and will alarm when the inventory limit is reached.

The air exhausted from the turbine building will not be monitored for radioactivity since it is exhausted from many places.

The area radiation monitoring system will be designed to provide information on radiation fields in the various areas of the plant for personnel protection. Monitor locations will include the control room, containment, in-core instrumentation area spent fuel building, sampling room, changing pump room and drumming station. If the radiation level rise above the setpoint an alarm will be sounded locally and in the control room.

Monitoring systems will detect, indicate, annunciate and/or record the levels of activity to verify compliance with existing regulations to keep radiation levels within the plant and in unrestricted areas "as low as practicable." We conclude that the process monitoring equipment will not satisfy the guidelines of Safety Guide 21 and the General Design Criterion 64, as regards effluent discharge paths and, therefore, is not acceptable. The applicant has been informed that a radioiodine monitoring system will be required for the plant vent before the operating license is issued.

11.7 Personnel Protection

The personnel protection systems are established to maintain exposure to plant personnel to levels as low as practicable. The applicant's design objective for radiation shielding for normal operation is to maintain whole body dose rates for all controlled access areas of the plant to less than 1.24 rem per calendar year, assuming continuous occupancy and 1% fission product release. The plant is zoned into six radiation areas for personnel occupancy control. These range from continuous access at less than 0.1 mrem/hr maximum radiation to controlled access at greater than 15 mrem/hr. The reactor operator must approve entry into areas with radiation greater than 200 mrem/hr.

Personnel monitoring equipment shall be provided for all personnel at the plant. Records showing radiation exposures of all personnel at the plant will be maintained by the applicant. The records will contain at least a monthly tabulation of readings from beta-gamma-neutron film badges or their equivalent. Protective clothing and respiratory protective equipment will be available for the protection of personnel, when required.

We conclude that the personnel protection systems satisfy the requirements of existing regulations as pertains to exposure of individuals to radiation, and are acceptable.

11.8 Conclusions

Based on our evaluation, we have concluded that the proposed radioactive waste systems as described by the applicant for limiting the discharge of radioactivity to unrestricted areas will not satisfy the "as low as practicable" guidelines of 10 CFR Part 50. This is primarily due to the release of radioiodine from intermittant treatment of the steam generator blowdown. The applicant has been informed that capability for continuous treatment of the steam generator blowdown will be required.

In addition the capability for monitoring radioiodine in the plant vent according to Safety Guide 21 is not planned. The applicant has been informed that the radioiodine monitoring capability will be required before the operating license is issued.

We conclude, however, that the remainder of the radioactive waste treatment system will satisfy the "as low as practicable" guidelines of 10 CFR Part 50; that the system will be designed in accordance with acceptable codes and standards; that the area monitoring will be similar to other systems previously accepted; and that the process monitoring system will measure radioactivity in the effluents released from the plant in accordance with Safety Guide 21 and the General Design Criteria 64.

TABLE 11-1

INDIAN POINT NUCLEAR GENERATING UNIT 3
COLLECTION RATE FOR AND CAPACITY OF RADIOACTIVE
LIQUID WASTE TREATMENT SYSTEM

	Collection		Process	Monitor Tank
	Rate (gpd)	Capacity (gal)	Capacity (gpd)	Capacity (gal)
Reactor Coolant Treatment	15,000	200,000	43,000	20,000
Liquid Waste Process	470	26.000	2,900	2,000
Steam Generator Blowdown Treatment	43,000 to 220,000	----	400,000	----