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A. Schwencer, Chief, PWR No. 4, DRL

INDIAN POINT 3

Attached is a report on the results of our review to date of Indian Point 3.

Note that the LOCA thyroid dose at the exclusion distance is greater than the Part 100 guidelines, principally because a more conservative X/Q, based on Safety Guide meteorology, was used than at the CP stage and a particulate fraction of 5% was assumed in addition to the 10% organic fraction. A new model for spray memoval was also used which gives significantly better removal for inorganic iodides. Only marginal improvement could be achieved by improving the engineered safety features. An increase in distance from the edge of containment to the exclusion boundary of 20 additional meters would result in a calculated dose of 300 rems.

Also note that the radwaste system review is inconclusive at this time. In this respect we suggest that the attached list of additional questions be asked of the applicant. These are supplementary to the questions on this subject already sent to the applicant.

Note that our evaluation was performed at the power level requested by the applicant (3025) and not at the stretch power of the turbine (3216 MWt).

R. P. Grill, Chief
Site Safety Branch, DRL

Enclosures:
1. Rpt. of Indian Pt. 3 Review
2. Additional Questions

cc w/enclosures:
R. DeYoung
C. Hale

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December 22, 1971

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ADDITIONAL QUESTIONS TO APPLICANT

Provide data on the estimated gaseous releases from the air ejectors and those other sources of gaseous releases not normally routed to the vent header. Under what conditions and to what degree can or will these sources be treated or held for decay?

Include in the answers to staff questions 11.1 to 11.6 data on the effectiveness, nuclide-by-nuclide (or by group of chemically similar nuclides), of each component of the waste treatment system and the volume flow rates at each point of the system. Specify the precise location of each release point. In the light of experience at other plants, justify not routing all potentially significant sources of iodine vapor (e.g., from containment purge) through an in-line charcoal filter before release to the plant vent.

S&RS Report on Indian Point 3 as of November 1971

SITE AND ENVIRONMENT

General Description

The Indian Point site is located in upper Westchester County, New York, approximately 24 miles north of the New York City boundary line. Indian Point Unit No. 3 is located adjacent to and south of Unit No. 1. This site has most recently been reviewed by the Committee in connection with the operating license review of Unit No. 2. For this reason, we have presented a summary of the important site related features below and emphasized those areas in which our current review differs from the review of Unit No. 2.

Population and Land Use

The estimated population distribution in the vicinity of the site is presented in Table 2.1. For comparison, the Zion distribution is also presented.

TABLE 2.1

CUMULATIVE POPULATION

	Indian Point		Zion	
Distance (Miles)	1970	1980	1970	1985
1		2,100		2,340
2		20,900		25,600
3		59,520		50,000
4		78,800		75,000
5		108,060		106,000
10		312,640		390,000

The minimum radius of the exclusion area for Unit No. 3 is 350 meters and the nearest corporate boundary of Peekskill, the nearest population center (pop. 19,000) is approximately 900 meters (0.5 mi.) from the unit. Using these figures, a literal interpretation of 10 CFR Part 100, the Commission's site criteria, which states that the population center distance should be at least 1-1/3 times the radius of the low population zone (LPZ), would require the outer boundary of the LPZ to be less than 700 meters from the unit. Nevertheless, Con Ed has chosen 1100 meters as the outer boundary of the low population zone because of the limited population within this distance from the plant. We conclude that this is acceptable (1) because of the limited population (66) within the low population zone and (2) because Peekskill is of a generally industrial nature in the vicinity of the unit so that resident population of that part of Peekskill within the LPZ and out to 1-1/3 times the LPZ distance is low and control of the people would not be difficult.

Meteorology

The meteorology of the Indian Point site is affected by its position in a deep river valley. Consequently, the wind direction generally follows a pronounced diurnal cycle with unstable (lapse) flow in the upriver direction during the daytime and stable flow in the downriver direction at night. We have reviewed in detail the data presented by the applicant in connection with the IP-2 operating license application and conclude that the data are adequate to provide a basis for establishing routine release limits for the site. Further, we conclude that our standard accident meteorological model (Safety Guide No. 4) is adequately conservative for this site.

Environmental Monitoring

The radioactivity levels in the vicinity of the Indian Point site have been measured by Consolidated Edison since 1958. The operational environmental radiation monitoring program for the Indian Point Unit No. 3 facility will be a continuation of this long-standing program. The following samples will be taken: fallout, air particulate, airborne iodine, water from various surface drinking water supplies, Hudson River water, water from lakes near the site, well water, lake aquatic vegetation, Hudson River vegetation, river bottom sediment, river aquatic biota, terrestrial vegetation, soil, and direct gamma.

We conclude that the applicant's program will provide an adequate basis for evaluating the radiological effects of reactor operations on the environs.

Iodine Removal Systems

Sodium hydroxide additive is used in the spray system to remove elemental iodine from the post-accident containment atmosphere. The performance evaluation of the additive spray is based on the assumed operation of only one of two systems.

An iodine impregnated charcoal filter system has been provided to remove organic as well as elemental iodine from the post-LOCA containment atmosphere.

The filter system consists of five units, three of which are assumed to be operational in the evaluation of post-accident doses. The charcoal beds are preceded by moisture separators and HEPA filters. The latter remove iodine particulates. We have evaluated these three iodine removal systems in terms of combined functions, crediting the spray system solely with the capability of reducing the concentration of elemental and other inorganic forms of iodine, the charcoal adsorber system with the capability of removing both inorganic and organic iodides, and the HEPA filters with the capability to remove particulate iodines.

We have evaluated the iodine reduction capability of the alkaline spray solutions using a more conservative model than that applied by the applicant. The removal constant for elemental iodine for the spray system, as derived by the staff, is 9.24 hr^{-1}, based on the minimum performance characteristics of the system, with parameters as follows: fall height, 118.5 feet (130 feet were used at the CP stage); spray flow rate, 90% of 2600 gpm, or 2340 gpm; mass transfer velocity, 4.74 cm/sec; containment free volume, 2.6×10^6 cubic feet; average droplet size, 1500 microns; droplet terminal velocity, 480 cm/sec. No arbitrary factor of conservatism is applied as the droplet size assumed incorporates adequate conservatism (1.5 times the measured value).

For the removal efficiencies for organic iodide by impregnated charcoal adsorbers we have made the conservative assumption of 10% per pass, and the calculated removal constant for organic iodides by the charcoal filters is .05 hr^{-1}.

In addition, the charcoal filters are assumed to remove elemental iodines with an efficiency of 90% per pass, giving a calculated elemental removal rate constant of 0.45 hr^{-1} by filtration.

The HEPA and charcoal filters are assumed to remove particulates with a 98% per pass efficiency. The calculated removal rate constant for particulate iodines in the HEPA and charcoal filters is .49 hr^{-1}. Sprays are assumed to have a removal rate constant of 0.35 hr^{-1} for particulate (this assumes a technical specification of less than 0.5% bypass flow and single pass removal efficiency of greater than 99.8% for specified test conditions). Thus the total removal rate constant for particulates is .94 hr^{-1}.

RADIOACTIVE WASTE MANAGEMENT

Liquid Waste

The Chemical and Volume Control System (CVCS) forms part of the radwaste management system. In normal operation, a portion of the reactor primary coolant is let down continuously. This portion normally passes through a mixed bed demineralizer, a cation demineralizer (intermittently for cesium removal), a filter (for large particle removal) and into the volume control tank, from which it can be fed back to the primary coolant.

If the boron concentration must be changed, primary coolant is let down to the CVCS holdup tanks which normally go to two parallel systems each of which includes two ion exchangers in series, a filter, a gas stripper and a boric acid evaporator. The boric acid evaporator concentrates are normally sent through a filter to a concentrate holding tank and then to the boric acid storage tank for re-use. Alternatively, the bottoms can be fed to the waste disposal system evaporator (described later) for processing.

The two evaporator condensate streams are joined, pass through a demineralizer and filter, and flow into monitor tanks. If the radioactivity concentration in the CVCS monitor tanks is sufficiently low, it may discharge through two normally closed valves, with continuous monitoring and automatic valve closure and control room alarm. The monitor tank effluent, if sufficiently pure, may also go to the primary water storage tank. If the effluent is not acceptable radiologically or chemically, it may be recycled through the condensate demineralizers or go back to the CVCS holdup tanks for complete reprocessing.

The Waste Disposal System (WDS) handles the other sources of liquid wastes. Accumulator drains, drains for equipment inside the containment, and leakage from reactor coolant pump seal leakage, reactor flanges and valves are fed to the reactor coolant drain tank and then to the CVCS holdup tanks or, if desired, to the waste holdup tank (WHT). Liquids from the spent resin storage tank and from floor drain sumps and other equipment drains are collected in a sump tank and then go to the WHT. Laboratory drains go first to the chemical drain tank and then to the WHT. All other sources, such as the containment sump go directly to the WHT.

If acceptable for release, the WHT liquids go to the waste condensate tanks; otherwise they pass through the waste filter to the waste evaporator. Evaporator bottoms are drummed. The condensate goes to the waste condensate tanks and is sampled prior to discharge, which is monitored with automatic valve closure and alarm. If the condensate tank liquid is not acceptable for release, it is returned to the WHT for reprocessing.

Steam generator blowdown normally drains to the discharge canal, but may be diverted to the WDS. A high radiation signal closes the blowdown lines automatically.

Gaseous Waste

Gases removed by the CVCS gas stripper and displaced by liquid accumulation from the CVCS Volume Control tank, CVCS holdup tanks, reactor coolant drain tank and spent resin storage tank go through the vent header to one of two waste gas compressors and are compressed into one of four large gas decay tanks. The decay tank gases (principally nitrogen) can be returned to act as cover gases in the CVCS holdup tanks, or released, if acceptable after sampling, through the monitored plant vent to the atmosphere. The CVCS filters and monitor tanks and WDS waste condensate tanks are vented directly to the compartment atmosphere and drawn into the primary auxiliary building ventilation system flow to the monitored plant vent.

The WDS chemical drain, sump and waste holdup tanks are also vented to the building exhaust. During reactor coolant degassing, the gases are compressed into six smaller gas decay tanks for ultimate release to the plant vent. Containment purge gases go untreated to the plant vent, as do the gases released by the pressure relief system.

The air ejector gases normally go to the atmosphere through the monitored air ejector discharge but are diverted to the containment in the event the air ejector exhaust monitor gives a high activity signal. The blowdown tank is released to the atmosphere through a separate monitored vent.

Solid Wastes

The evaporator bottoms and spent resins are solidified in drums. A baler is used to compress other solid materials. The packaged solids are shipped to an authorized disposal site.

COMMENTARY ON RADWASTE MANAGEMENT

Based on operating experience at other plants and the design at this plant, it is reasonably certain that Part 20 limits will not be exceeded on an annual average basis nor, for most operations, even instantaneously. However, in the light of the requirements of Parts 20 and 50 and the proposed numerical criteria of Appendix I of Part 50, there is insufficient information to make a judgment that releases will be "as low as practicable" (ALAP). Furthermore, based on operating experience at other PWR's it is not certain that instanteous releases of iodine from containment purging will be less than 1/700 of the Part 20 Appendix B values.

With respect to the ALAP requirement, the applicant has not provided estimates of liquid and gaseous releases from steam generator blowdown, containment purging and pressure relief. (This information has been requested from the applicant.) Similarly, estimates have not been provided for gaseous releases from the air ejectors and those other sources of gases which do not enter the vent header to be compressed in the gas decay tanks. (This should be requested.) Although the applicant has estimated liquid and gaseous releases by nuclide, he has assumed for the most part that the individual components of the removal systems are effective for all nuclides equally. This is surely not the case for, e.g., iodine in the evaporators. (The nuclide-by-nuclide analysis should be provided for each component of all waste streams.)

The applicant, in the basis for his proposed Technical Specification 3.9, states that liquids are expected to be less than 10% of Part 20, as contrasted to the estimated liquid releases given in Table 11.1-5 (25 mCi/yr), which would be about 0.01% of Part 20. However, he does not include certain sources (as indicated above) and has not accounted for differences in nuclide removal by system components (also indicated above). Furthermore, based on operating experience at other plants, it is not certain that the waste evaporator capacity of 2 gpm will be adequate (although a factor that may make this capacity adequate is the diversion of the Unit 3 laundry waste to the Unit 1 system).

If the applicant's estimates are justified, then they should be expected to meet annual activity releases more restrictive than those implied by his proposed Technical Specification 3.9. If the revised estimates indicate that the sources presently unaccounted for and normally released without treatment are significant, (in particular, blowdown liquids and gases and containment purge iodines), then he will have to ascertain under what conditions and to what degree they will be treated. For example, all gaseous lines (e.g., containment purge) might be routed to the same plant vent and a charcoal filter installed in the vent line.

Additional review will be needed on the radwaste system when the requested information becomes available.

ACCIDENT ANALYSIS

General

We have evaluated the potential offsite radiological consequences for two postulated accidents. The calculated offsite doses for these accidents are presented in Table 9.1-1. The assumptions used in calculating the offsite dose for each case are provided in subsequent sections.

TABLE 9.1-1

CALCULATED OFFSITE DOSES

@ 3025 MW(t)

Accident	2 Hour Dose at Site Boundary (Rem)		Course of Accident Dose at LPZ (Rem)	
	Thyroid	Whole Body	Thyroid	Whole Body
LOCA	322	16	228	11
Refueling	49	5	13	1

LOCA

The assumptions used to calculate doses from the LOCA were:

1. Power level of 3025 MW(t) (not the stretch power of 3216 MW(t).)
2. Fraction of core inventory released from the fuel: noble gases 100; iodines 50%.
3. Fraction of released iodines not plated out: 50%
4. Initial composition of airborne iodine following plateout: 85% elemental, 10% organic, 5% particulate.

5. Iodine removal constants

A) Elemental:

1. Spray: 9.24 hr^{-1}

2. Charcoal: 0.45 hr^{-1}

3. HEPA: Zero

4. Total: 9.69

B) Organic:

1. Spray: Zero

2. Charcoal: .05 hr^{-1}

3. HEPA: Zero

4. Total: .05 hr^{-1}

C) Particulate:

1. Spray: .45 hr^{-1}

2. HEPA and Charcoal: .49 hr^{-1}

3. Total: .94 hr^{-1}

6. Meteorological diffusion based on Safety Guide No. 4, including Type F stability and 1 meter/second wind speed and building wake credit (A = 2000 m^2) for the 0-8 hour period gives a χ/Q value of 1.36×10^{-3} sec/m^3 at 330 meters and 3.52×10^{-4} sec/m^3 at 1100 meters.

REFUELING ACCIDENT

The assumptions used to calculate the refueling accident were:

1. Long term operation at 3025 MW(t).
2. Shutdown for 100 hours.
3. A total of 204 rods (one assembly) are opened.
4. This assembly has operated at 1.65 times the average power density.
5. The rods release 10% of their noble gas inventory and 10% of the iodines to the water.
6. The initial composition of iodine is taken as 99.75% elemental and 0.25% organic.
7. The fraction of elemental which escapes from the pool water is 0.75% and for organics, 100%, giving an effective overall reduction of 100.
8. The fraction of elemental iodine which is removed by the charcoal filters is 90% and for organics, 70%, giving an overall efficency of 85%.
9. The release is complete within two hours.
10. Meteorological assumptions are the same as for the LOCA.

OTHER EVENTS INVOLVING RELEASE OF ACTIVITY TO THE ATMOSPHERE

Technical Specifications will be placed on the primary and secondary coolant activities and gas decay tank contents such that conceivable releases resulting from a steam generator tube rupture or a steamline break will not exceed a whole body dose of 0.5 rem or 1.5 rems to the thyroid.

Using the same bases described in Sections 3.1 and 3.4 of the Indian Point 2 Technical Specifications, and accounting for the shorter distance to the Indian Point 3 Site boundary, the Indian Point 3 Technical Specification for the primary coolant total activity would be $33/\overline{E}$ μCi/cc, and for the secondary coolant, total iodine activity, 0.1 μCi/cc (based on 210 m^3 volume from 4 steam generators.) The Technical Specification limit for the gas decay tanks is 8,000 Ci.