50-286

JUN 22 1973

R. C. DeYoung, Assistant Director for Pressurized Water Reactors, L

INPUT TO INDIAN POINT UNIT 3 SER

PLANT NAME: Indian Point Unit 3
LICENSING STAGE: OL
RESPONSIBLE BRANCH: PWR#1
REQUESTED COMPLETION DATE: May 11, 1973
APPLICANTS RESPONSE DATE NECESSARY FOR
NEXT ACTION PLANNED ON PROJECT: N/A
REVIEW STATUS: Accident Analysis Branch - Complete

Attached is our SER input for Indian Point Unit #3. It should be noted that the LOCA analysis is based on the 4% inorganic iodine source term as listed in the report WASH-1233 "Review of Organic Iodide Formation Under Accident Conditions in Water-Cooled Reactors" dated October 1972 and which was approved by the ACRS on May 12, 1973 as a basis for evaluating light water reactor LOCA doses. It should be noted also that the enclosed LOCA analysis is shown for both the initial proposed power level ~~at~~ and stretch power level. Our analysis indicates that the LOCA doses from the IP-3 reactor at the proposed power level (3025 Mwt) fall within the guideline values of 10 CFR Part 100 and therefore reactor operation at this level is acceptable. As indicated in J. Hendrie's memo to A. Giambusso dated May 23, 1973, the 4% methyl fraction will be used for SER inputs now in preparation by the Site Safety group.

The analysis of the Indian Point Unit 3 facility is based on the work of the following individuals. E. Adensam used the USAECAAR computer program to calculate the LOCA and refueling accident doses based on N_aOH spray and internal filter removal factors as provided by R. Zavadoski (co-author of WASH-1233). K. Murphy and K, Campe evaluated the design of the Indian Point Unit 3 control room to determine compliance with Criterion 19. All X/Q values used in our radiological dose calculations are based on E. Markee's (SAB) analysis of the applicant's on-site meteorological data. C. Ferrell, site analyst, completed the review initiated by A. Kenneke, who originally was the responsible site analyst for this plant.

/s/ A. Kenneke

Harold R. Denton, Assistant Director
for Site Safety
Directorate of Licensing

Enclosure:
(As Stated)

OFFICE ▶						Memo
SURNAME ▶	See Page 2 for cc's					
DATE ▶						

JUN 22 1973

cc: w/o enclosure
A. Giambusso
W. McDonald

cc: w/enclosure
S. Hanauer
J. Hendrie
TR:AD's
RP:AD's
SS:BC's
D. Vassallo
H. Spector
C. Ferrell
E. Adensam
R. Zavadoski
K. Murphy
K. Campe

DISTRIBUTION
L - Rdg.
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Docket File

OFFICE ▶	L:AAB	L:AAB	L:AD/SS			
SURNAME ▶	CMFERRELL:MJ	BCRIMES	KRDENTON			
DATE ▶	5/14/73	5/14/73	6/22/73			

Form AEC-318 (Rev. 9-53) AECM 0240 GPO c43—16—81405-1 445-678

2.0 Site Characteristics

2.1 Geography and Demography

There have been no significant changes in the area of the site as described in the February 20, 1969 "Safety Evaluation by the Division of Reactor Licensing in the Matter of Consolidated Edison Company of New York, Inc., Indian Point Nuclear Generating Unit No. 3." In a report prepared by Environmental Analysts, Inc. in June 1972, the population data was updated based on the 1970 census and population projections were made through the year 2010.

2.1.1 Site Location

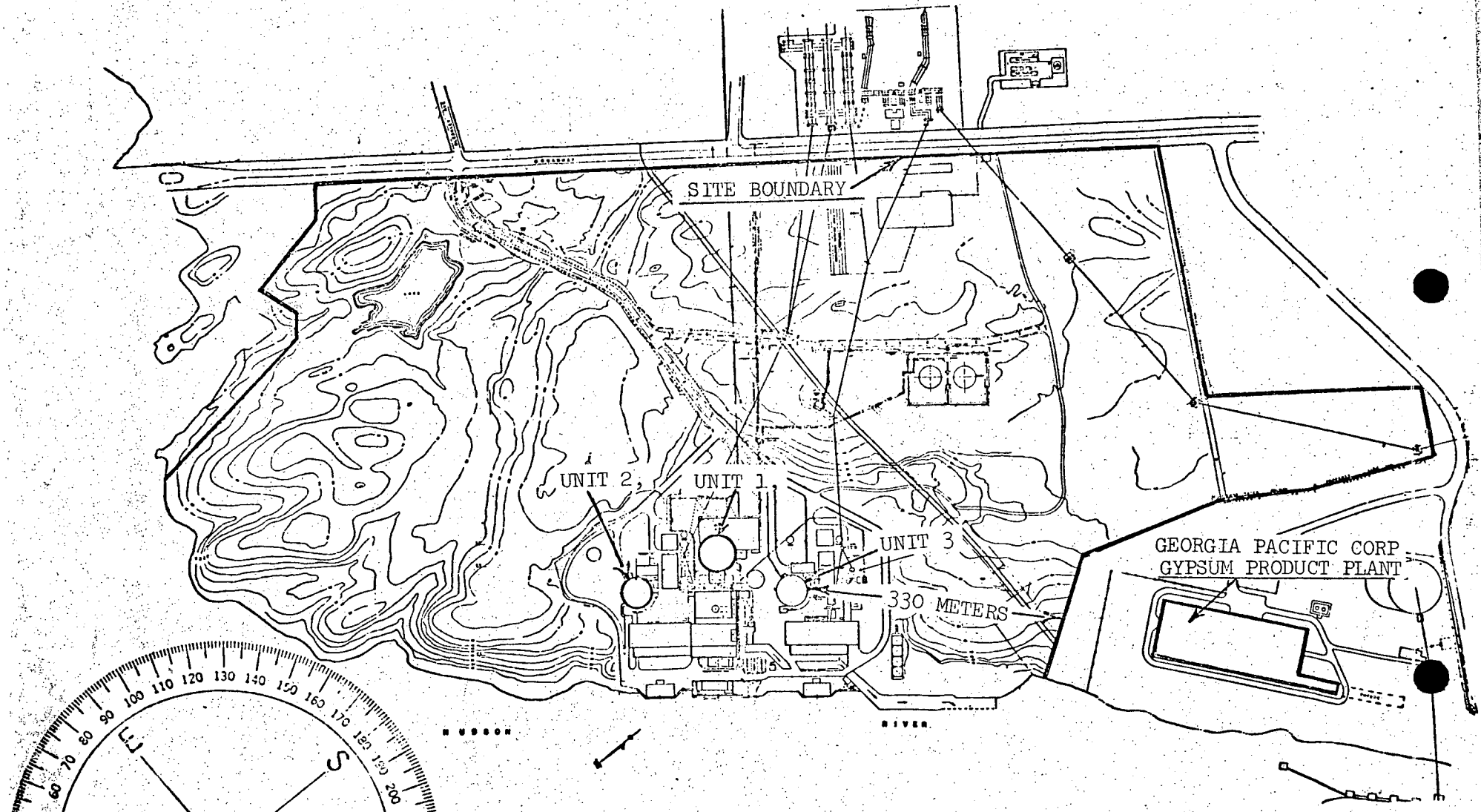
The Indian Point facility is situated on a 239 acre tract of land located in Westchester County, New York on the east bank of the Hudson River. The three unit nuclear facility is located approximately 2 1/2 miles southwest of Peekskill, New York and 24 miles north of the New York City boundary line.

Site Description

The minimum exclusion distance as provided by the applicant for Indian Point Unit 3 is 350 meters from the centerline of the Reactor Building and 330 meters from the outer surface of the Containment Building to the nearest property line. (Shown in Figure Number 1.) The boundaries

of Newburgh and White Plains, the nearest boundaries of densely populated geographic centers containing more than 25,000 persons, are both located approximately 17 miles from the plant site. However, based on projected populations, the outer boundary of the more densely populated area of the City of Peekskill was chosen by the applicant during the Construction Permit stage as the population center distance. The nearest boundary of Peekskill is 0.63 miles to the northeast; however, the nearest residential area of Peekskill is 0.85 miles to the east. The applicant has selected a low population zone having an outer boundary of 0.67 miles (1100 meters). The applicant, with the cooperation of representatives of the state of New York, has developed an acceptable emergency plan for persons residing within the low population zone. On the basis that (1) the population within the proposed low population zone is small (approximately 50 people) and (2) that the area of Peekskill in the area of the nuclear plant is of a general industrial nature, the staff concurred in the applicant's selection.

The Indian Point nuclear facility is surrounded on all sides by high ground ranging in elevation from 600 to 1,000 feet above sea level. Across the Hudson River, which varies in width between 4500 to 5000 feet in the vicinity of the plant site, the west bank is flanked by steep heavily wooded slopes of the Dunderberg and West mountains to the northwest (elevations 1086 feet and 1257 feet respectively)



INDIAN POINT NUCLEAR
GENERATING STATION

FIGURE 1

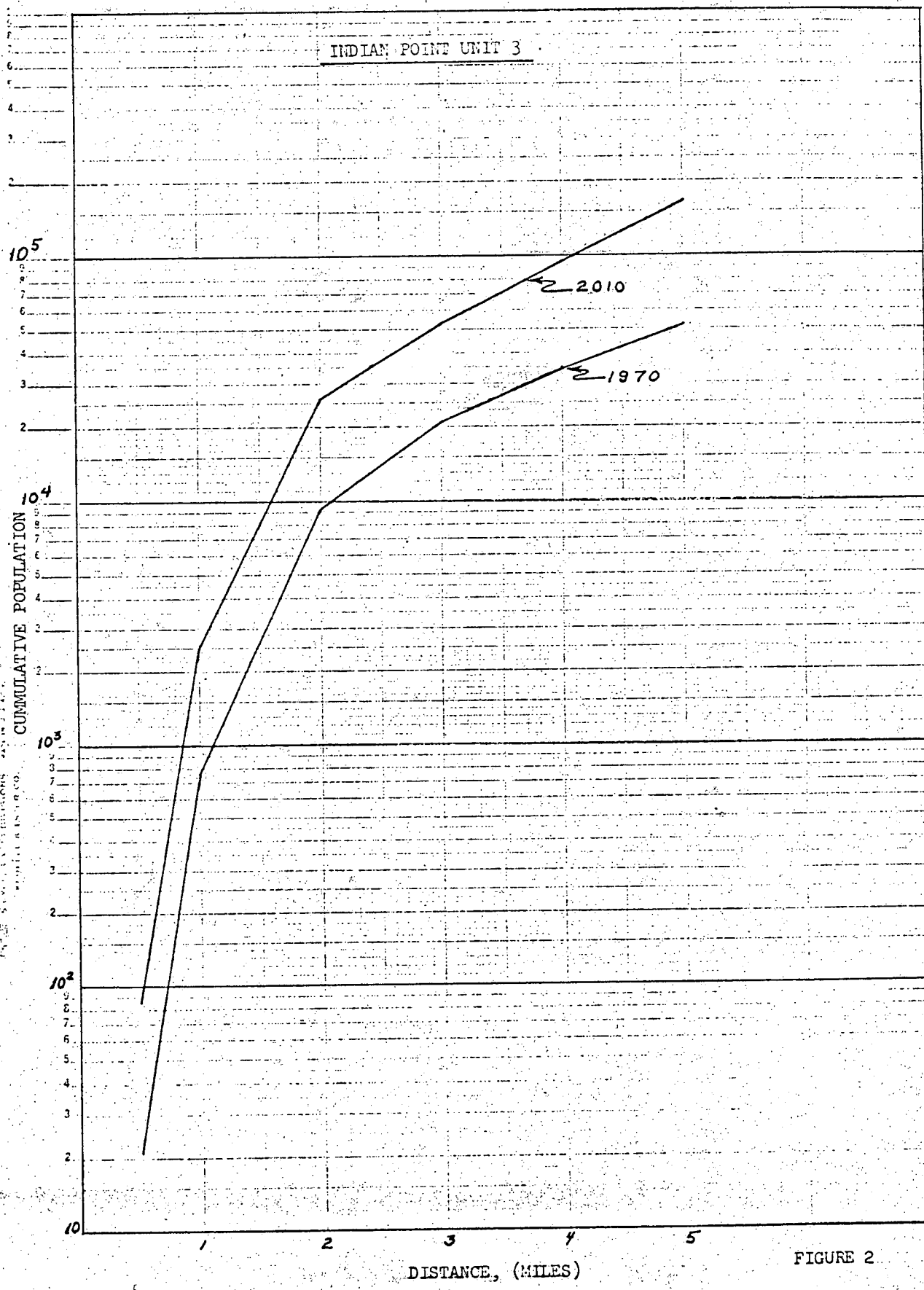

INDIAN POINT UNIT 3
2010
1970
CUMMULATIVE POPULATION
10^5
10^4
10^3
10^2
10
1
2
3
4
5
DISTANCE, (MILES)

FIGURE 2

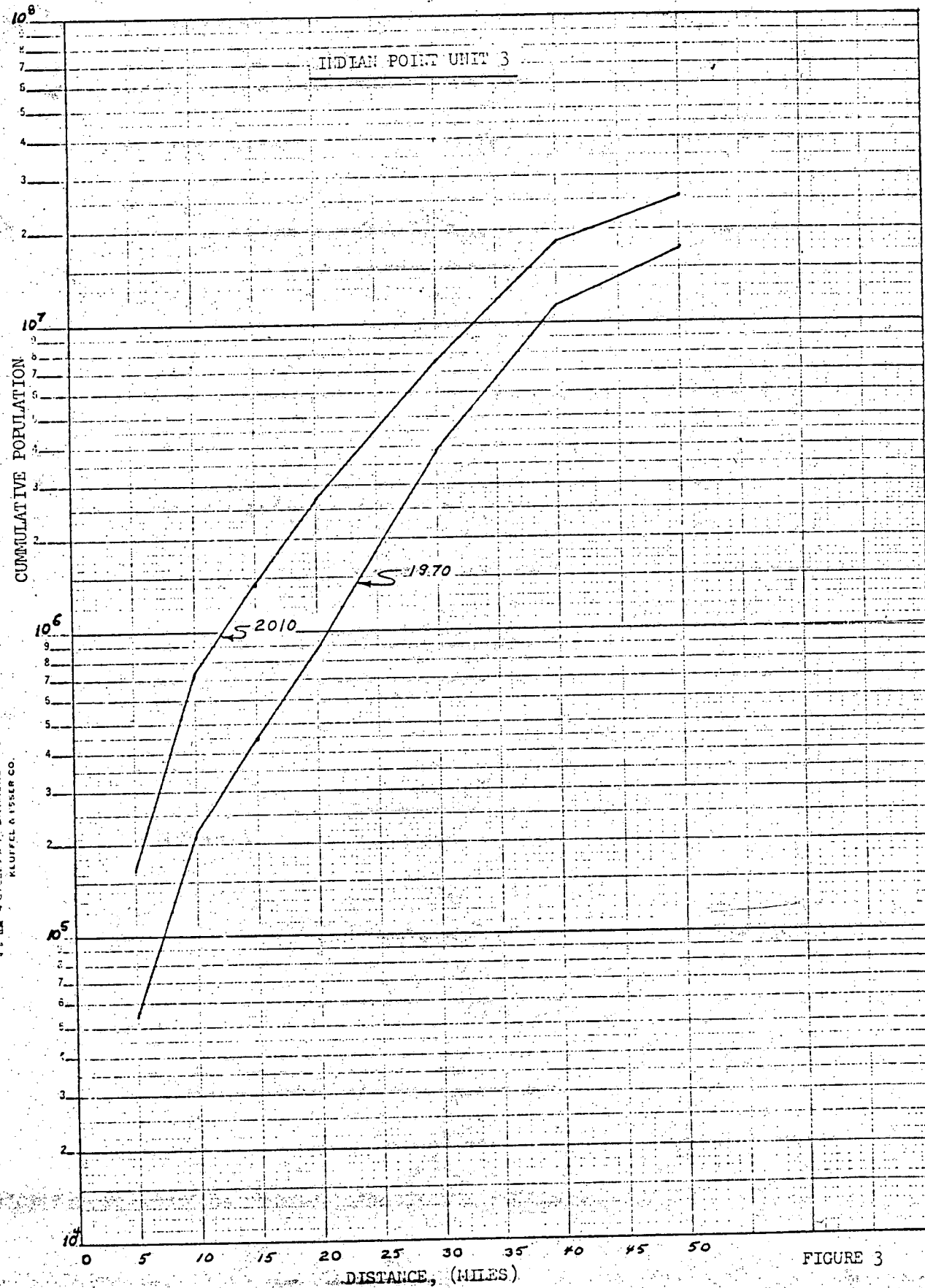

INDIAN POINT UNIT 3
CUMULATIVE POPULATION
10^8
10^7
10^6
10^5
1970
2010
0
5
10
15
20
25
30
35
40
45
50
DISTANCE, (MILES)

FIGURE 3

and the Buckberg Mountains to the west-southwest (elevation 793 feet MSL).

2.1.3 Population and Population Distribution

The closest cities with populations exceeding 25,000 are Newburgh, New York (1970 population of 26,219, a decrease of 15% since 1960) and White Plains, New York, (1970 population of 50,220 a 0.5% decrease since 1960) both located approximately 17 miles from the Indian Point site. The area within 5 miles of the site has a population of 18,130 based on the year 1970 census data. The projected population for the year 2010 is approximately 74,000 persons. The closest schools are located about 1 mile to the south and east of the site. Figures 2 and 3 show the 1970 and predicted year 2010 cumulative population data relevant to the Indian Point nuclear facility.

2.1.4 Uses of Adjacent Lands and Waters

At the present time the land surrounding the Indian Point site is residential with large areas devoted to parklands and a military reservation. A gypsum plant is adjacent southwest border of the Indian Point site. Northeast of the site just within the 1100 meter low population zone radius is a second industrial area on the shoreline of Lents Cove. The closest commercial airport is at White Plains, New York, 17 miles south of the station. Minor seaplane activity occurs at Greens Cove about 1.5 miles south of the plant.

The Hudson River in the area of the site is used for commercial ship and barge traffic and for pleasure boating. For recreation, there are several sections of the Palisades Interstate Park on the west bank and fishermen's landings, parks and beaches on the east bank of the Hudson River. Section 2.4.1 describes the industrial use of Hudson River water.

2.1.1 Conclusions

Based on the 10 CFR Part 100 definitions of the population center distance, the exclusion area and low population zone distances (for which adequate emergency plans have been developed), on our analysis of the onsite meteorological data from which dilution factors were calculated for various time periods (Section 2.3 of this report), and on the calculated potential radiological dose consequences of design basis accidents (Section 15.0 of this report), we conclude that the exclusion area radius is acceptable from the standpoint of computed exposure doses from all of the design basis accidents analyzed when the reactor is operated at the proposed initial power level of3025 MWt.

2.2 Nearby Industrial, Transportation and Military Facilities

2.2.1 Location and Routes

The Indian Point site is accessible by New York State Route 9 which passes through Peekskill and Buchanan on the East Bank and by Route 9W and the Palisades Interstate Parkway on the West Bank of the Hudson River. The Penn Central railway passes within 0.85 miles of the Unit 3 structure on the east bank of the Hudson and on the west bank, another line of the Penn Central tracks pass approximately one mile from the Indian Point site.

The commercial barge and ship traffic on the Hudson River varies from 600 to 800 per year past the Indian Point site. The cargo consists of petroleum products, dry goods, and molasses. The applicant has indicated that no river traffic shipment of toxic materials or explosives currently pass the site. The mothballed fleet shown in the earlier aerial photographs of the Indian Point site, submitted by the applicant in the Final Safety Analysis Report, have been removed from the Hudson River. There are no new environmental hazards which have been identified since the construction permit review for this unit.

There are no commercial airports within 15 miles of the site. The staff has reviewed the question of airport proximity to nuclear power plants in various licensing cases. On the basis of these studies, we conclude that the Indian Point site is sufficiently far from an

airport of significant size that the probability of a crash at the site is essentially that associated with general overflights and that the Indian Point facility need not be designed or operated with special provisions to protect the facility against the effects of an aircraft crash.

The military installations in the area include the New York State Military Reservation (Camp Smith) and the West Point Military Reservation.

2.2.2 Description of Industry

The closest industry to the Indian Point site is the Georgia Pacific gypsum plant located approximately 0.3 mile southwest of the Unit 3 containment building. Oil, gasoline, and molasses storage facilities are located outside of the 1100 meter low population zone for this facility. We have concluded that these facilities will not affect the safe operation of the Indian Point Nuclear Station.

4.4 Iodine Removal Equipment

4.4.1 Spray

An internal recirculation containment spray system is provided to remove heat from the containment atmosphere and to remove iodine which may be present in the containment following a loss-of-coolant accident. Initially, the two containment spray pumps take suction on the refueling water storage tank and deliver water to spray nozzles inside containment. Each pump has a design capacity of 2600 gpm. Concentrated sodium hydroxide solution is added at the suction of the spray pumps in quantities sufficient to maintain a pH of at least 9.3 in the water in the containment spray. Sodium hydroxide in the containment spray water will scavenge elemental radioiodine from the containment atmosphere. When the refueling water storage tank is exhausted, a portion of the recirculation flow provided for continued core cooling is diverted to the containment spray headers.

To calculate the total iodine removal constant for the proposed system we made conservative assumptions regarding liquid film mass resistance and drop coalescence. Consistent with conclusions of WASH 1233 we assumed that 4 % of the iodine in the containment atmosphere is in the form of organic iodides and 5% in a particulate form. Because experiments have shown that sodium hydroxide

spray solutions are not efficient in the removal of organic iodides, we assumed no reduction of the organic iodides by the containment spray.

We calculated an elemental iodine removal constant of 9.85 hr^{-1}. A two-hour reduction factor for the iodine accident dose at the exclusion area boundary of 5.2 and a thirty-day reduction factor for the iodine accident dose at the outer boundary of the low population zone of 8.8 was calculated as a result of iodine removal by the chemical additive sprays. The impact of these reduction factors on computed accident consequences is discussed in Section 5.0.

4.4.2 Charcoal Filters

The air handling system (1) will remove heat from the containment in the post-accident environment and (2) will reduce the iodine concentration in the containment atmosphere by the use of charcoal filters. Five air handling units are provided. In each unit, a fan draws air through a moisture separator, cooling coils, roughing filters, and high efficiency particulate air (HEPA) filters at a flow rate of approximately 24,000 cfm under post-accident conditions. Charcoal filters are located at the fan discharge header. They are isolated by butterfly valves. Under accident conditions, these valves are automatically opened by the high containment pressure signal and a flow rate of 8,000 cfm is diverted through these filters. Three of the five air handling units will operate even if normal offsite power is lost. This was assumed in our analyses of the Design Basis Accident

in Section 5.3. Under this circumstance, approximately 150% of the free volume of the containment is processed through the charcoal filters each hour.

Research performed to date using impregnated charcoals of various manufacture, indicates that at 100% relative humidity the removal efficiency decreases to about 70% for methyl iodide and to about 99% for elemental and particulate iodine. The staff assumes a value of 30% for methyl iodide and 90% for elemental and particulate iodine in accident assessment for the purposes of site and engineered safety feature evaluation. Together, the spray and filters reduce the overall two-hour iodine accident dose at the exclusion area boundary by a factor of 6.4 and the thirty day overall iodine accident dose at the outer boundary of the LPZ by a factor of 20.

15.0 Accident Analysis

15.1 Radiological Consequences of Postulated Accidents

The postulated design basis accidents analyzed by the applicant and by us for offsite radiological consequences are the same as those analyzed for previously licensed PWR plants of similar design, including a loss-of-coolant accident, a fuel handling accident, and rupture of a radioactive gas storage tank in the gaseous waste system. The offsite doses calculated by us for these accidents are presented in Table 15.0 and the assumptions used are listed in Appendix F of this report. All doses are within 10 CFR Part 100 guideline values. Technical specifications are set on primary coolant total activity to limit potential steam generator tube rupture dose and on secondary coolant iodine - 131 activity to limit potential steam line break dose at the site boundary to limits well within the guideline values of 10 CFR Part 100.

TABLE 15.C

POTENTIAL OFFSITE DOSES CALCULATED BY STAFF FOR DESIGN BASIS ACCIDENTS AT 3025 MWT OPERATION*

ACCIDENT	EXCLUSION BOUNDARY TWO HOUR (330 METERS)		LOW POPULATION ZONE COURSE OF ACCIDENT (1100 METERS)	
	Thyroid (Rem)	Whole Body (Rem)	Thyroid (Rem)	Whole Body (Rem)
Loss of Coolant**	288	22	119	15
Refueling	67	8	19	2
Gas Decay Tank*** Rupture	Negligible	8	Negligible	2

* Our calculated potential doses to control room personnel following a LOCA are within the guidelines of Criterion 19.

** The 2 Hour site boundary dose using the stretch power level of 3216 Mwt is 302 rem thyroid.

*** The technical specifications for Unit #3 will be set to reduce the inventory of noble gases stored in a single gas decay tank so that any single failure such as lifting and sticking of a pressure relief valve will not produce a whole body dose in excess of 0.5 rem at the site boundary.

3.1.9 Conclusions

On the basis of our evaluation of the important site characteristics, and taking into consideration the design of the facility including the engineered safety features and the design of the systems that will be provided for the control of radiological effluents from the postulated design basis accidents, we have concluded that the site is acceptable.

APPENDIX F

ASSUMPTIONS USED BY AEC REGULATORY STAFF IN CALCULATIONS OF OFFSITE DOSES FROM DESIGN BASIS ACCIDENTS

F-1 Loss-of-Coolant Accident Assumptions

Power Level	3025 Mwt
Operating Time	3 Years
Primary Containment Leak Rage	0.1%/day $\leq$ 24 Hours
	0.05%/day >24 Hours
Initial Iodine Form Distribution	91% Elemental
	4% Organic
	5% Particulate
Spray Filter Data:	
Filter Flow Rate	24,000 cfm
Filter Efficiencies	
Organic Iodine	30%
Particulate Iodine	90%
Elemental Iodine	90%
Primary Containment Volume	2.61×10^6 ft^3
Spray Fall Height	118 feet
Spray Flow Rate	2500 gpm
Elemental Mass Transfer Velocity	4.74 cm/sec
Spray Drop Diameter	1500 μ
Spray Terminal Velocity	480 cm/sec
Factor of Conservatism	1.11
X/Q Data, sec/m^3	
Exclusion Boundary (330 meters)	
0-2 Hours (Equivalent to Pasquill "F", $\bar{\mu}$ = 0.7 m/sec)	1.8×10^{-3}
Low Population Zone Boundary (1100 meters)	
0-8 Hours (Equivalent to Pasquill"F", $\bar{\mu}$ = 0.7 m/sec)	4.7×10^{-4}
8-24 Hours	1.4×10^{-4}
24-96 Hours	6.5×10^{-5}
96-720 Hours	2.2×10^{-5}

F-2 Refueling Accident Assumptions

1. Rupture of 204 fuel rods (one assembly).
2. All gap activity in the rods, assumed to be 10% of the noble gases and 10% of the iodine (with a peaking factor of 1.7), is released.
3. The accident occurs 100 hours after shutdown.
4. 99% of the iodine is retained in the pool water.
5. Iodine filter efficiencies of 70% and 90% for organic and elemental forms respectively.
6. On-site data used to determine X/Q values for ground release meteorology, and dose conversion factor.

F-3 Gas Decay Tank Rupture Assumptions

1. Gas decay tank contains all the primary coolant loop inventory of noble gases resulting from operation with 1% failed fuel (100,000 curies equivalent of Xe^{133}).
2. X/Q values based on on-site meteorological data.

F-4 Control Room Dose Assumptions

The applicant proposes to meet General Design Criterion No. 19, Control Room, of Appendix A to 10 CFR Part 50, by use of adequate concrete shielding and by filtering inlet air to the control room in case of an emergency. Under emergency conditions redundant 2000 cfm clean-up trains consisting of HEPA filters and two inch deep charcoal beds, filter the recirculated air inside the control room. Approximately 200 cfm, or less, make-up air is added upstream of the filter train to assure control room pressurization. The units are automatically activated upon accident or high radiation signals. We have calculated the potential radiation doses to control room personnel following a LOCA. The resulting doses are within the guidelines of criterion 19.

REMOVAL RATES AND REDUCTION LIMITS FOR EACH FORM OF IODINE

Time Period, Hours	Iodine Removal Rates, $Hrs.^{-1}$		
	Elemental	Particulate	Organic
0-0.448	10.3	0.897	0.149
0.448-5.13	0.447	0.897	0.149
5.13-10.28	0.447	0.447	0.149
10.28-10.75	0.447	0	0.149
10.75-46.36	0	0	0.149
46.36-720	0	0	0
	Reduction Limits		
Sprays	100	100	1
Filters	10,000	1,000	1,000

DOSE REDUCTION FACTORS DUE TO USE OF SPRAYS + INTERNAL FILTERS

Time	Thyroid	Whole Body
0 - 2 Hours	6.4	1.4
0 - 30 Days	20	1.5