2.0 Site Characteristics

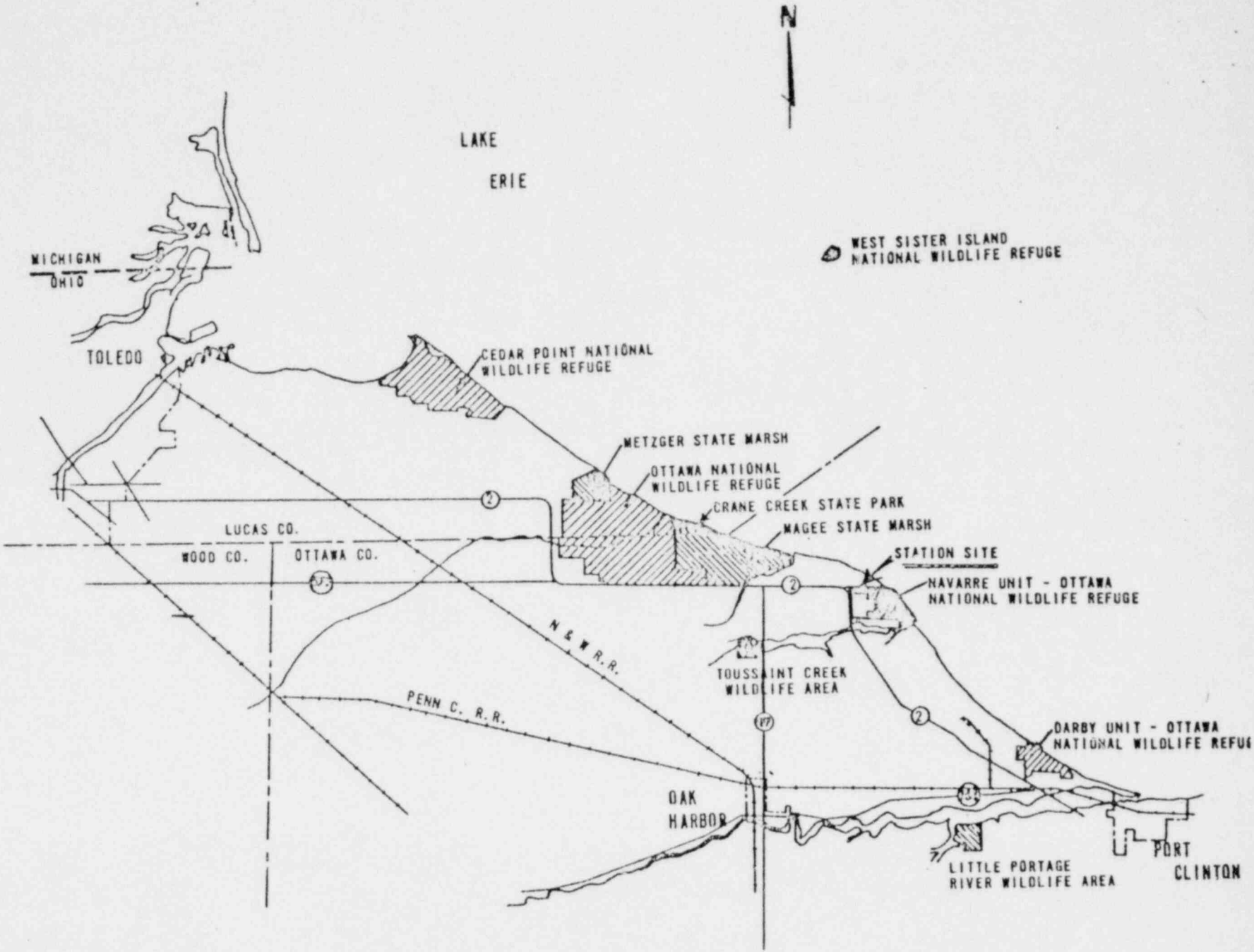
2.1 Geography and Demography

The Davis-Besse site is a 954 acre tract of land located on the southwestern shore of Lake Erie in Ottawa County, Ohio. The site is approximately 20 miles east-southeast from Toledo, Ohio (population 383,818) and 20 miles west-northwest from Sandusky, Ohio (population 32,674) (Figure 2.1).

The applicants have specified a minimum exclusion area distance of 732 meters (2400 feet) for the Davis-Besse reactor. The applicants have specified a low population zone (LPZ) with a radius of 3,218 meters (2 miles) Figures 2.2 and 2.2a show the exclusion area for the site.

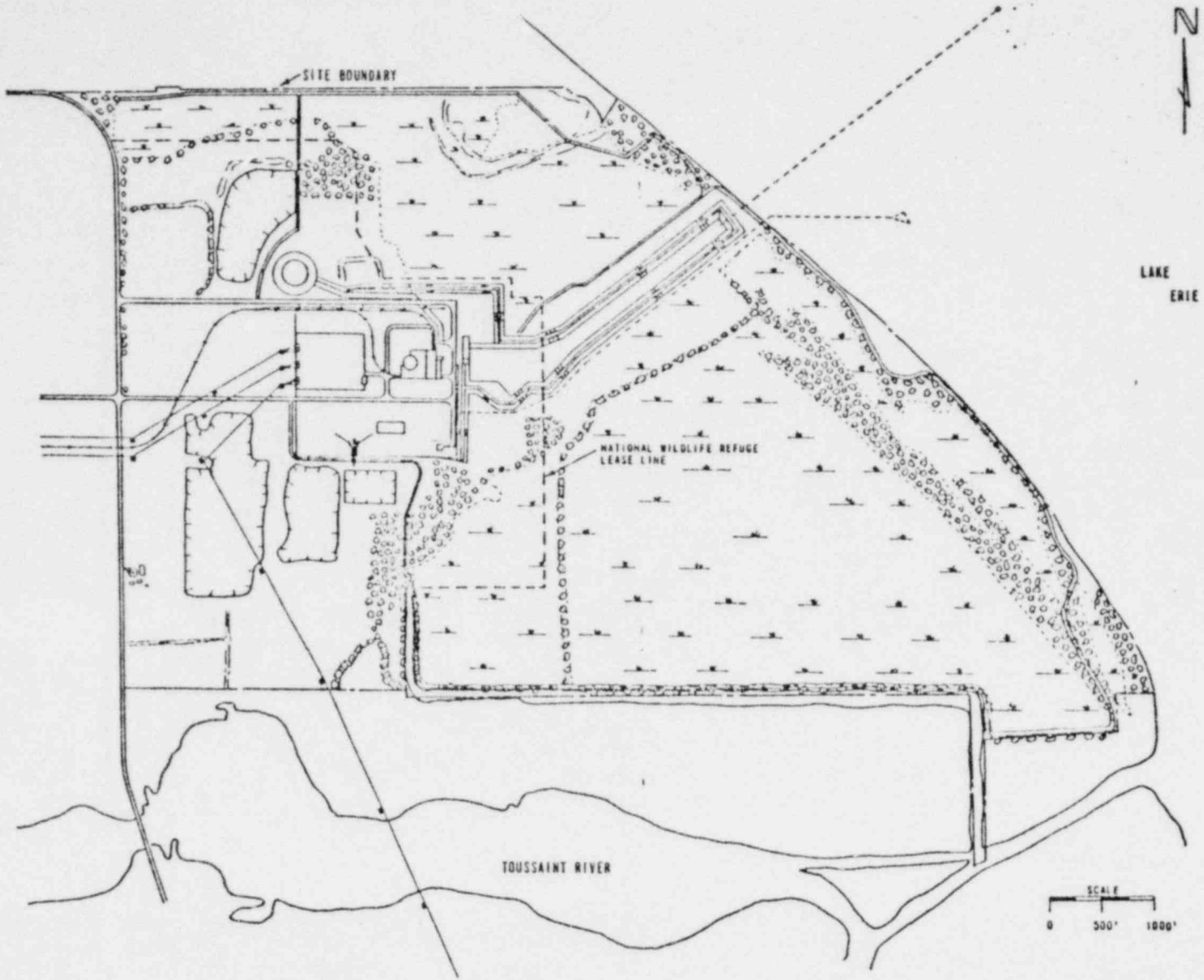
The topography of the Davis-Besse site consists of approximately 354 acres of flat shoreline and 600 acres of marshland, the latter leased to the U. S. Government as a national wildlife refuge. Figure 2.3 shows the present and projected year 2010 populations surrounding the Davis-Besse site. The population within the LPZ is about 1,958 using the 1970 census. The nearest population centers (as defined in 10 CFR Part 100) with a present population exceeding 25,000 are Toledo, Ohio (1970 population 383,818) and Sandusky, Ohio (1970 population 32,674) which are both located approximately 20 miles from the nuclear facility. The applicants have specified a low population zone of 2 miles. Because the population center distance is over one and one-third times the LPZ distance of 2 miles, the applicant's selection of the low population zone is in compliance with 10 CFR Part 100. At the present time, the land surrounding the site is of a rural nature. Wildlife refuges cover a large section of the shoreline on both sides of the plant site. The closest industrial areas are four miles southeast of the site. Water sport activities in the area include pleasure boating, sport fishing, duck hunting and swimming. Lake Erie is used also for commercial fishing and shipping. The nearest Lake Erie potable water supply user is the Erie industrial park, located 3.6 miles from the Davis-Besse station discharge line.

Agriculture is a major source of income in the vicinity of the Davis-Besse site. Major crops include peaches, grapes, apples, corn, wheat, soy beans, oats, hay, tomatoes, pumpkins, and sugar beets. According to the applicants, the Crane Creek State Park, located 3 miles from the site has an average daily summertime attendance of 2,500 and a peak attendance of 5,000. The Magee Marsh Wildlife Area located 2-1/2 miles from the site had an annual attendance of 48,000 with a peak daily attendance of 1,500.



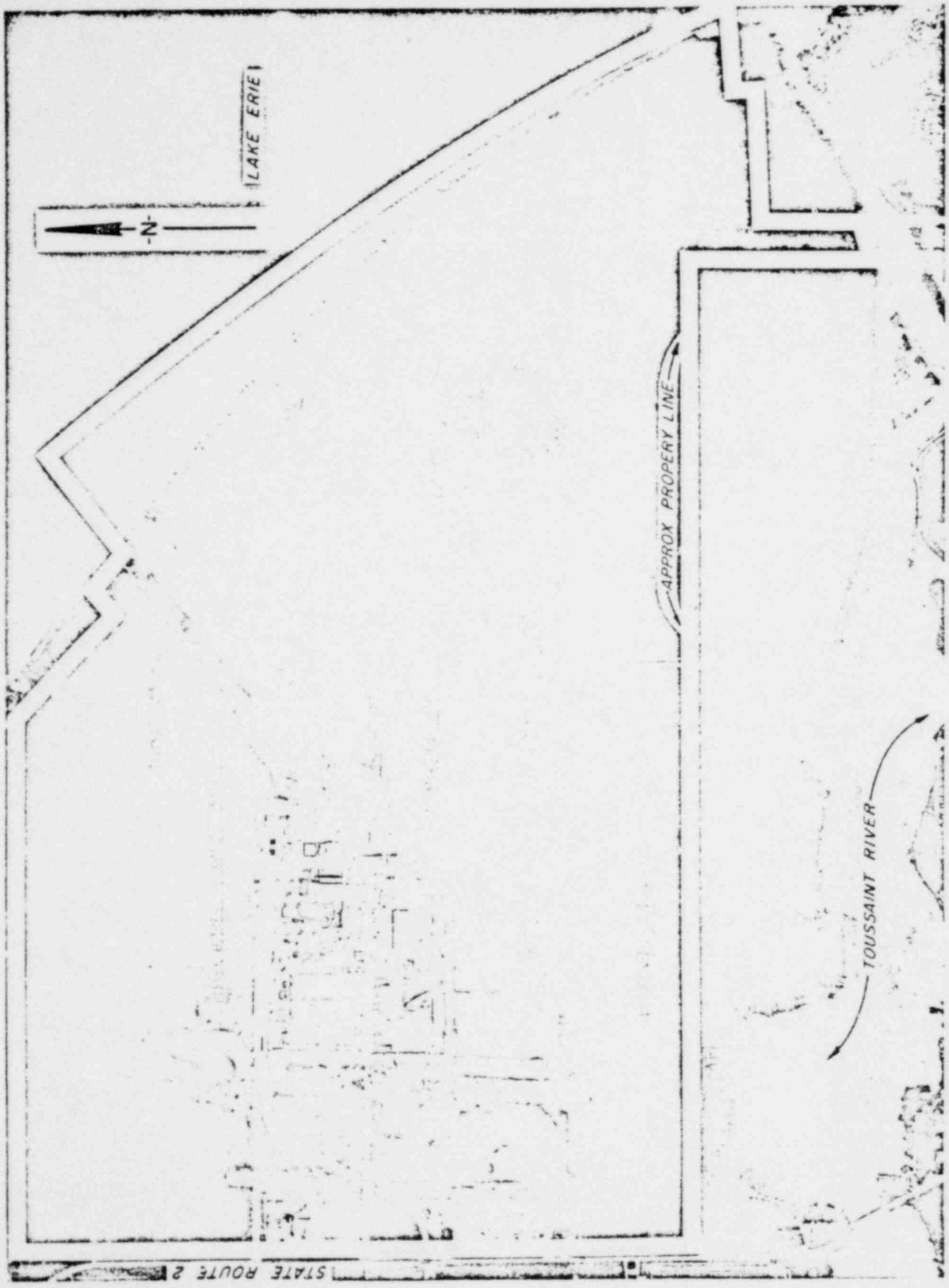
DAVIS-BESSE NUCLEAR POWER STATION
UNITS NO. 1, 2, & 3

FIGURE 2.1



DAVIS-BESSE NUCLEAR POWER STATION
SITE ARRANGEMENT

FIGURE 2.2



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SCALE (APPROX)

AERIAL PHOTOGRAPH SHOWING
PHYSIOGRAPHIC FEATURES OF THE SITE AREA

FIGURE 2.2a

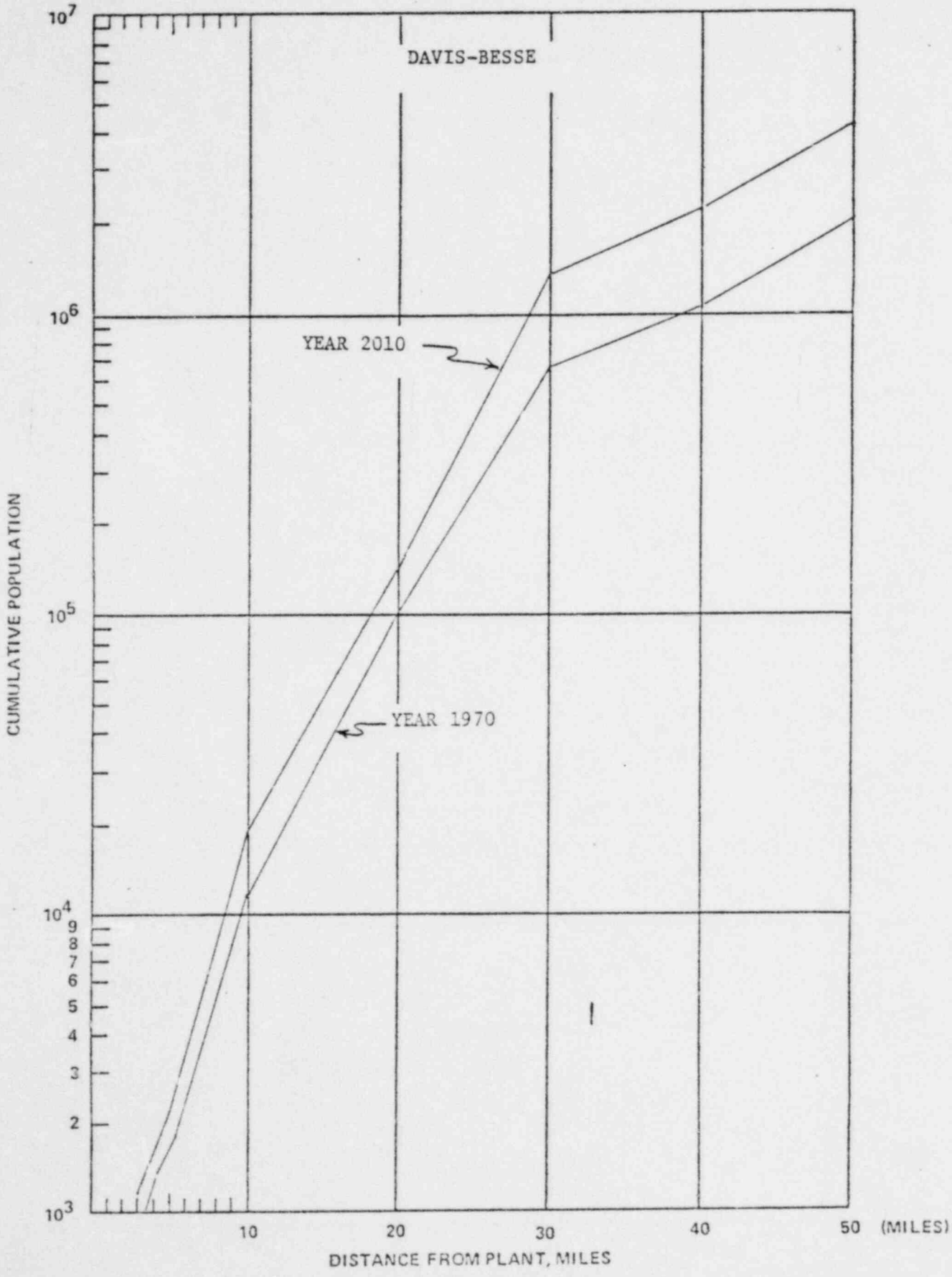


FIGURE 2.3 CUMULATIVE POPULATION DISTRIBUTION

We have concluded that the adjacent land uses have been adequately considered and are not critical with respect to the safety of the plant.

On the basis of the applicant's specified population center distance, minimum exclusion area and low population zone, our analysis of the onsite meteorological data from which atmospheric dilution factors were calculated (see Section 2.3 of this report), and the calculated potential radiological dose consequences of design basis accidents discussed in Section 15.0 of this report, we have concluded that the exclusion area, low population zone, and population center distance meet the guidelines of 10 CFR Part 100, and that the Davis-Besse site is acceptable.

2.2 Nearby Industrial, Transportation and Military Facilities

There are areas of Lake Erie adjacent to the Davis-Besse Nuclear Power Station site which are established as Restricted Areas for use by segments of the Armed Forces in performing training missions using ground weapons. Historically, these areas were primarily used by the Erie Ordnance Depot for proof firing of artillery.

When the Erie Ordnance Depot was deactivated in 1967 and reverted to private ownership for development as the Erie Industrial Park, the main need for these Restricted Areas was removed but they have been maintained, with several major reductions, for limited use of certain other agencies. These include Camp Perry, an Ohio National Guard installation and, until recently, the Naval Air Facility in Michigan and the Lockbourne Air Force Base in Ohio. In addition to these governmental agencies, the Cadillac Gage Company, located at the Erie Industrial Park, uses the offshore restricted areas under an arrangement with the Adjutant General, State of Ohio, for test firing of ordnance.

The uses of these restricted areas were known and evaluated to determine the probable effect on the Davis-Besse Station at the time of the construction permit review.

The Restricted Lake Areas as shown in Figure 2.4 (Areas I and II), with their closest boundary offshore from the station site and 1-1/2 miles from the station structures, are limited to use as impact areas for small arms, artillery, and antiaircraft artillery.

Use of an area lying approximately ten miles north of the station (Area III), which, at the time of the construction permit review, was established for use by aircraft as an impact area for aerial gunnery, rocket firing, and bombing, has been discontinued and the designation of this area as a restricted danger zone area has been removed by the U. S. Corps of Engineers.

Camp Perry is used for both small arms and 40 mm antiaircraft (equipped with a self-destroying fuse) firing with the nearest boundary of impact at 1.5 miles from the Davis-Besse facility. Test firing at the Cadillac Gage Company includes mortars, cannons and automatic weapons. The nearest boundary of impact is 1.5 miles from the Davis-Besse site. A maximum of 10,000 pounds of high explosive equivalent is stored in approved bunkers in this area.

On the basis of our review of the present use of these facilities, we conclude that the present activities at these ranges have not changed, since the construction permit review, in a way that would increase the hazard to the plant, and we conclude that these activities will not endanger the Davis-Besse Nuclear Power Station.

There are no oil or gas pipelines within 5 miles of the Davis-Besse site. The closest airport with a paved runway is at Port Clinton, 13 miles from the site. Because of the shallowness of Lake Erie in the area of the site, the nearest shipping lanes are 20 miles from the site. The nearest railroad is the Penn Central which runs in an east-west direction 5 miles south of the site.

A spur line owned by the applicant which connects to the Norfolk & Western Railroad 7-1/2 miles southwest of the site has been constructed to serve the Davis-Besse Station.

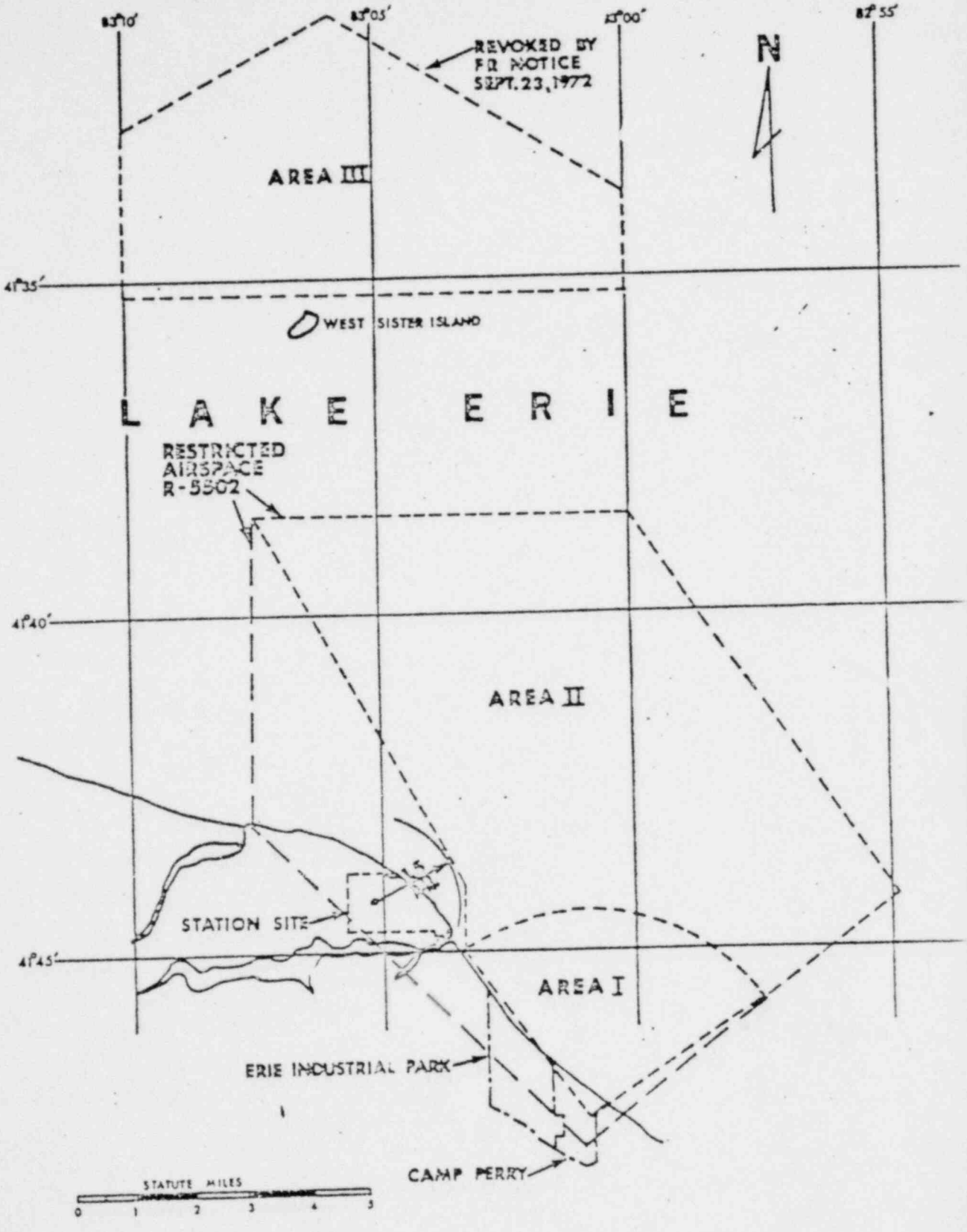
The closest highway is State Highway Route 2 located approximately 2,600 feet from the station structures.

In view of the distances to major transportation routes, we conclude that transportation accidents involving hazardous materials will not affect the safety of the nuclear facility.

3.5 Turbine Missiles

The applicant has arranged the Unit 1 turbine generators in a non-peninsular orientation with respect to the containment. The applicant has performed an analysis to estimate turbine missile damage probabilities and has concluded on the basis of the results of the analysis that the safety related systems are protected by adequate structural barriers.

We are currently performing a generic study and are formulating a Regulatory Guide on the matter of turbine missiles. When the results of our study are available, we will evaluate the significance of potential turbine missiles on this facility and determine



DAVIS-BESSE NUCLEAR POWER STATIC
RESTRICTED AREA BOUNDARIES
NOVEMBER 1972

FIGURE 2.4

if additional protection is required beyond that already offered by the presently proposed plant design.

6.2.3 Containment Atmosphere Cleanup Systems

In addition to the heat removal function, the containment spray system also functions to remove iodine. However, no iodine scrubbing additives to the containment spray have been proposed by the applicant. Consequently the iodine removal effectiveness of the containment spray system is not very pronounced. We estimate iodine removal coefficients of 0.06 hrs^{-1} and 0.2 hrs^{-1} for the elemental and particulate forms of iodine, respectively. These values are used in the accident calculations described in Chapter 15.

6.4 Habitability Systems

The emergency protective provisions of the control room related to the accidental release of radioactivity or toxic gases are evaluated in this section. Relevant portions of the control room ventilation system are described here but are described and evaluated more fully in Section 9.4.

6.4.1 Radiation Protection Provisions

The applicant proposes to meet General Design Criterion 19, Control Room, of Appendix A to 10 CFR Part 50, by use of concrete shielding and a 3300 cfm charcoal filter to control radiation levels within the control room.

In the event of high radioactivity after a LOCA, the normal control room air-conditioning system is shut down automatically and the emergency ventilation system is started manually. All outside air dampers are closed to minimize the dose to operating personnel. For the first four days following the accident, the emergency system will be operated in a fully recirculating mode where 3300 cfm of air is processed through the charcoal filter. On the fourth day, the system will be manually switched to admit 200 cfm of filtered outside air to the control room with 3100 cfm being recirculated through the filter.

We have calculated the potential doses to the operator after a design basis LOCA. We find that the present system adequately protects the operator against whole body gamma and beta skin exposure. However we calculate a 68 rem thyroid dose which is in excess of the 30 rem guideline. The following parameters were used in calculating the dose:

1. Design basis LOCA source term per Regulatory Guide 1.4 and the staffs' evaluation of plant safety features.

2. Atmospheric dilution factors (X/Q) from plant vent to isolated control room as given below:

Time after LOCA	X/Q, sec/m^3
0 - 8 hours	3.16×10^{-3}
8 - 24 hours	1.90×10^{-3}
1 - 4 days	4.70×10^{-4}
4 - 30 days	1.04×10^{-4}

3. A filter efficiency of 95% for all iodine species, a filter flow rate of 3300 cfm and an unfiltered inleakage of 25 cfm.

4. After four days, it was assumed that 200 cfm of filtered make-up air is admitted to the control room with 3100 cfm of control room air being recirculated through the filter and an unfiltered inleakage of 5 cfm.

5. The resultant doses are presented below:

Time after LOCA	Operator Thyroid Dose (Rem)*
0 - 8 hours	29
8 - 24 hours	25
1 - 4 days	10
4 - 30 days	4
Total	68

*Based on ICRP2 methods and a breathing rate of 3.47×10^{-4} m^3/sec.

In addition to the non-compliance with the Criterion No. 19 dose guidelines, the following deficiencies are noted:

1. The emergency filter units are not automatically activated upon a high radiation signal from air intake radiation monitors. Also it has not been verified that control room isiolation is accomplished automatically in the event of high radiation at the intake.

2. The applicant has indicated that the control room is of low leakage design but has not committed to a periodic verification test. Periodic testing should be performed to verify that 200 cfm of make-up air will pressurize the control room to at least +1/8 inch water gauge differential with respect to all adjacent zones. He should also describe the seal design to be

used for t.. doors leading into the control room and provide manufacturer's leakage data to show that the seal system provides adequate protection.

We conclude that the present system does not comply fully with our acceptance criteria as noted above.

6.4.2 Toxic Gas Protection Provisions

Control room habitability following a postulated toxic gas release is required to insure that operators can continue to operate the . nt. Chlorine (30-ton railroad car) has been identified to be the on.. material that, if released, would pose a potential operator hazard.

The applicant was requested to provide protection against such a release. He has partially complied with this request by supplying quick acting chlorine detectors, automatic control room isolation, and breathing apparatus. We have requested in our Q-2 positions that the applicant supply additional detectors at the chlorine storage location and that he provide additional breathing air for the respirators as per Regulatory Position C.4.c. of Regulatory Guide 1.95. Once the applicant commits to these additional items, then the plant's toxic gas protection will be acceptable.

15.4.6 Radiological Consequences of a Postulated Loss-of-Coolant Accident at Davis-Besse Unit 1: Containment Leakage Contribution

The radiological consequences of a loss-of-coolant accident as a result of leakage from the containment were evaluated. The analysis of the containment leakage doses following a postulated design basis loss-of-coolant accident included the influence of fission product removal and holdup systems and the containment leakage routes on the estimated radiological consequences as well as appropriate conservative assumptions relating to fission product releases and transport. This analysis of the proposed design results in calculated radiological consequences which do not conform to the Commission's regulations. Therefore, the applicant will be required to take some positive measure, such as reducing the containment design leak rate to 0.3%/day or less, to assure that the conservatively computed doses from a loss of coolant accident are within the exposure guidelines of 10 CFR Part 100.

Estimates of the radiological consequences have been made using a containment leak rate of 0.3%/day. Table I lists the assumptions used by the staff in determining these dose estimates, and Table II presents the results.

TABLE I

ASSUMPTIONS USED TO ESTIMATE RADIOLOGICAL CONSEQUENCES DUE TO A POSTULATED LOSS OF COOLANT ACCIDENT AT DAVIS BESSE UNIT 1

Power level, Mwt	2772
Operating time, years	3
Primary Containment Leak Rate,* %/day	0.3 to 24 hours 0.15 > 24 hours
Fraction of Core Inventory Available for Leakage from Containment:	
Noble Gases	100%
Iodine	25%
Bypass Leakage Fraction, % of Primary Containment Leak Rate	
0 - 2 minutes	100.
2 minutes to 30 days	3.
Primary Containment Free Volume, ft^3	2.834×10^6
Iodine Form Fractions, %	
Elemental	91
Particulate	5
Organic	4
Filter Efficiencies for Iodine Forms, %	
Elemental	95
Particulate	90
Organic	95
Spray Removal Rates, per hour	
Elemental (Effective to 1.1 hours)	0.06
Particulate	0.2
X/Q Values, sec/m^3	
0 - 2 hours @ 732 meters	5.4×10^{-4}
0 - 8 hours @ 3200 meters	1.8×10^{-5}
8 - 24 hours @ 3200 meters	1.3×10^{-5}
24 - 96 hours @ 3200 meters	5.8×10^{-6}
96 -720 hours @ 3200 meters	1.9×10^{-6}

TABLE II

ESTIMATED CONSEQUENCES FROM A
POSTULATED LOCA AT
DAVIS BESSE UNIT 1

	Doses, rem	
	Thyroid	Whole Body
Exclusion Area Boundary (732 meters)		
0 - 2 hours	200	17
LPZ Boundary (3200 meters)		
0 - 8 hours	21	1
8 - 24 hours	11	0.4
24 - 96 hours	10	0.2
96 -720 hours	9	0.1
0 - 30 days	50	2

15.4.7 Radiological Consequences of a Postulated Fuel Handling Accident at Davis-Besse Unit 1

The staff has evaluated the radiological consequences of a postulated fuel handling accident to any individual located at the nearest exclusion area boundary or at the outer boundary of the low population zone (LPZ). The staff concludes that the estimated consequences are well within the guideline values of 10 CFR Part 100. Table III presents the assumptions made and the estimated consequences calculated for the fuel handling accident.

TABLE III

ASSUMPTIONS FOR AND CONSEQUENCES OF A
POSTULATED FUEL HANDLING ACCIDENT
DAVIS BESSE UNIT 1

Power level	2772 Mwt
Power Peaking Factor	1.7
Operating time	3 years
Number of rods failed	208
Number of rods in core	38,816
Fraction of Inventory in gap:	
Noble Gases	10%
Iodines	10%
Effective Iodine Decontamination Factor in Pool	100
Filter Efficiencies:	
Elemental Iodine	90%
Organic Iodine	70%
Iodine Fractions Leaving Pool	
Elemental	75%
Organic	25%
Shutdown Time	72 hours
X/Q Values	
0 - 2 hours @ 732 meters	5.4×10^{-4} sec/m^3
0 - 2 hours @ 3200 meters	3.7×10^{-5} sec/m^3

Estimated Consequences:

	Dose, rem	
	Thyroid	Whole Body
Exclusion Area Boundary (732 meters)	22	2
LPZ Boundary (3200 meters)	2	<1

TABLE IV

ASSUMPTIONS FOR AND CONSEQUENCES OF
A POSTULATED GAS DECAY TANK ACCIDENT
DAVIS-BESSE UNIT 1

Gas Decay Tank Rupture

The assumptions used to calculate the offsite doses from a gas decay tank rupture were:

(1) Gas decay tank contains one complete primary coolant loop inventory of noble gases resulting from operation with 1% failed fuel (94,000 curies of noble gases).

(2) The release is complete within 2 hours.

(3) Meteorological assumptions are the same as for the LOCA.

Estimated Consequences:	Dose, Rem	
	Thyroid	Whole Body
Exclusion Area Boundary (752 meters)	Negligible	3
LPZ (3200 meters)	Negligible	<1