REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8312280502 DOC.DATE: 83/12/16 NOTARIZED: YES DOCKET #
FACIL:50-410 Nine Mile Point Nuclear Station, Unit 2, Niagara Moha 05000410
AUTH.NAME AUTHOR AFFILIATION
MANGAN,C.V. Niagara Mohawk Power Corp.
RECIP.NAME RECIPIENT AFFILIATION
EISENHUT,D.G. Division of Licensing

Revised by PS 1/4/84

SUBJECT: Forwards Amend 7 ato FSAR (filed in PDR Category K) & Suppl 5 to environ rept - OL stage (filed in PDR Category C).

DISTRIBUTION CODE: B001S COPIES RECEIVED:LTR 1 ENCL 60 SIZE: 1 + 1700
TITLE: Licensing Submittal: PSAR/FSAR Amdts & Related Correspondence

NOTES:PNL 1cy FSAR'S & AMDTS ONLY. Amdt 7 to fsar. 05000410

| | RECIPIENT ID CODE/NAME | | COPIES LTTR | COPIES ENCL | RECIPIENT ID CODE/NAME | | COPIES LTTR | COPIES ENCL |
|---|---|---|---|---|---|---|---|---|
| | NRR/DL/ADL | | 1 | 0 | NRR LB2 BC | | 1 | 0 |
| | NRR LB2 LA | | 1 | 0 | HAUGHEY,M | 01 | 1 | 1 |
| INTERNAL: | ELD/HDS3 | | 1 | 0 | IE FILE | | 1 | 1 |
| | IE/DEPER/EPB | 36 | 3 | 3 | IE/DEPER/IRB | 35 | 1 | 1 |
| | IE/DEQA/QAB | 21 | 1 | 1 | NRR/DE/AEAB | | 1 | 0 |
| | NRR/DE/CEB | 11 | 1 | 1 | NRR/DE/EHEB | | 1 | 1 |
| | NRR/DE/EQB | 13 | 2 | 2 | NRR/DE/GB | 28 | 2 | 2 |
| | NRR/DE/MEB | 18 | 1 | 1 | NRR/DE/MTEB | 17 | 1 | 1 |
| | NRR/DE/SAB | 24 | 1 | 1 | NRR/DE/SGEB | 25 | 1 | 1 |
| | NRR/DHFS/HFEB | 40 | 1 | 1 | NRR/DHFS/LQB | 32 | 1 | 1 |
| | NRR/DHFS/PSRB | | 1 | 1 | NRR/DL/SSPB | | 1 | 0 |
| | NRR/DSI/AEB | 26 | 1 | 1 | NRR/DSI/ASB | | 1 | 1 |
| | NRR/DSI/CPB | 10 | 1 | 1 | NRR/DSI/CSB | 09 | 1 | 1 |
| | NRR/DSI/ICSB | 16 | 1 | 1 | NRR/DSI/METB | 12 | 1 | 1 |
| | NRR/DSI/PSB | 19 | 1 | 1 | NRR/DSI/RAB | 22 | 1 | 1 |
| | NRR/DSI/RSB | 23 | 1 | 1 | REG FILE | 04 | 1 | 1 |
| | RGN1 | | 3 | 3 | RM/DDAMI/MIB | | 1 | 0 |
| EXTERNAL: | ACRS | 41 | 6 | 6 | BNL(AMDTS ONLY) | | 1 | 1 |
| | DMB/DSS (AMDTS) | | 1 | 1 | FEMA-REP DIV | 39 | 1 | 1 |
| | LPDR | 03 | 1 | 1 | NRC PDR | 02 | 1 | 1 |
| | NSIC | 05 | 1 | 1 | NTIS | | 1 | 1 |
| NOTES: | | | 1 | 1 | | | | |

TOTAL NUMBER OF COPIES REQUIRED: LTTR 54 ENCL 47

N M NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/300 ERIE BOULEVARD WEST, SYRACUSE, N.Y. 13202/TELEPHONE (315) 474-1511

December 16, 1983
(7820)

Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Eisenhut:

RE: Amendment 7 to Application to Operating License
Nine Mile Point Unit 2
Docket No. 50-410

In accordance with 10CFR50.30 (c) (1), 10CRF51.24 and your March 29, 1983 letter, enclosed are three originals and 60 copies of Amendment 7 to the Final Safety Analysis Report and 41 copies of Supplement 5 to the Environmental Report. These changes incorporate certain responses into the text of the Final Safety Analysis Report as appropriate. Also included are changes which have resulted from our continuing review of these documents.

Very truly yours,

C V Mangan

C. V. Mangan
Vice President
Nuclear Engineering & Licensing

CVM/JM:rla

Enclosure

Two Rids
B001 Amdt 7 FSAR
1/60
C001 suppl 5 to ER
1/41

NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/300 ERIE BOULEVARD WEST, SYRACUSE, N.Y. 13202/TELEPHONE (315) 474-1511

December 16, 1983
(7820)

Mr. Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Eisenhut:

RE: Amendment 7 to Application to Operating License
Nine Mile Point Unit 2
Docket No. 50-410

In accordance with 10CFR50.30 (c) (1), 10CRF51.24 and your March 29, 1983 letter, enclosed are three originals and 60 copies of Amendment 7 to the Final Safety Analysis Report and 41 copies of Supplement 5 to the Environmental Report. These changes incorporate certain responses into the text of the Final Safety Analysis Report as appropriate. Also included are changes which have resulted from our continuing review of these documents.

Very truly yours,

C V Mangan

C. V. Mangan
Vice President
Nuclear Engineering & Licensing

CVM/JM:rla

Enclosure

Two Rids
B001 Amdt 7 FSAR 1/60
C001 suppl 5 to ER 1/41

50-410 Superseded pages Per Amend 7 to FSAR

w/ ltr 83/12/16
8312280502



Revised by P.S. 1/4/84

TABLE 1.7-1

ELECTRICAL, INSTRUMENTATION, AND CONTROL DRAWINGS

A. General Electric Drawings

| Drawing No. | Title | Rev. | Date |
|---|---|---|---|
| 807E153TY Sh. 1 through 6 | Nuclear Boiler Process Instrumentation System Elementary Diagram | 3 | 7/23/80 |
| 807E155TY Sh. 1 through 15 | Automatic Depressurization System Elementary Diagram | 4 | 7/21/80 |
| 807E156TY Sh. 1, 2 | Jet Pump Instrumentation System Elementary Diagram | 3 | 7/24/80 |
| 807E152TY Sh. 1 through 19 | Nuclear Steam Supply Shutoff System Elementary Diagram | 3 | 7/21/80 |
| 761E791TY Sh. 1 through 30 | Reactor Recirculation System Elementary Diagram | 2 | 7/22/80 |
| 791E406TY Sh. 1 through 34 | Reactor Manual Control System/Rod Control and Information System Elementary Diagram | 7 | 4/14/82 |
| 807E159TY Sh. 1, 2 | Control Rod Drive Hydraulic System Elementary Diagram | 6 | 12/15/81 |
| 807E160TY Sh. 1 through 5 | Feedwater Control System Elementary Diagram | 7 | 5/18/81 |
| 807E161TY Sh. 1 through 4 | Standby Liquid Control System Elementary Diagram | 4 | 7/17/80 |
| 807E164TY Sh. 1 through 5 | Startup Range Detector Drive Control Elementary Diagram | 1 | 7/21/80 |
| 807E162TY Sh. 1 through 11 | Startup Range Neutron Monitor System Elementary Diagram | 2 | 7/24/80 |

1

TABLE 1.7-1 (Cont)

A. General Electric Drawings (Cont)

| Drawing No. | Title | Rev. | Date |
|---|---|---|---|
| 807E163TY Sh. 1 through 49 | Power Range Neutron Monitor System Elementary Diagram | 4 | 7/17/80 |
| 807E166TY Sh. 1 through 18 | Reactor Protection System Elementary Diagram | 3 | 7/16/80 |
| 115D6268TY | Reactor Protection System Motor-Generator Set Control Elementary Diagram | 3 | 6/17/80 |
| 807E179TY Sh. 1 through 3 | Reactor Protection System Interconnection Scheme Elementary Diagram | 0 | 8/22/74 |
| 807E168TY Sh. 1, 2 | Process Radiation Monitoring System Elementary Diagram | 3 | 6/17/80 |
| 807E170TY Sh. 1 through 23 | Residual Heat Removal System Elementary Diagram | 3 | 7/17/80 |
| 807E171TY Sh. 1 through 7 | Low Pressure Core Spray System Elementary Diagram | 3 | 7/16/80 |
| 807E172TY Sh. 1 through 7 | High Pressure Core Spray System Elementary Diagram | 3 | 7/16/80 |
| 807E183TY Sh. 1 through 13 | High Pressure Core Spray Power Supply System Elementary Diagram | 3 | 7/24/80 |
| 807E154TY Sh. 1 through 13 | Leak Detection System Elementary Diagram | 5 | 6/3/81 |
| 807E173TY Sh. 1 through 13 | Reactor Core Isolation Cooling System Elementary Diagram | 3 | 7/21/80 |
| 807E175TY Sh. 1 through 4 | Reactor Water Cleanup System | 3 | 7/23/80 |

1

TABLE 1.7-1 (Cont)

A. General Electric Drawings (Cont)

| Drawing No. | Title | Rev. | Date | |
|---|---|---|---|---|
| 731E302AF Sh.1 through 3 | High Pressure Core Spray One Line Diagram | 0 | 6/29/76 | 1 |

TABLE 1.8-1 (Cont)

Regulatory Guide 1.52, Revision 2 (March 1978)

Design, Testing, and Maintenance Criteria for Engineered Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Unit of Light-Water-Cooled Nuclear Power Plants

FSAR Sections 6.5.1 and 9.4.1

Position

The Unit 2 project complies with the Regulatory Position (Paragraph C) of this guide through the alternate approaches described below:

1. Paragraph C.2.a Demisters will be provided only where entrained water droplets could be present.

2. Paragraph C.2.d Filter mounting frames and ducts located outside the containment are not designed to withstand DBA pressure surges.

3. Paragraph C.2.h The following exceptions are taken to the requirement that "all instrumentation and equipment controls should be designed to IEEE-279 1971":

   a. All instruments and equipment controls that sense or process one or more variables and that act to accomplish the protective function are designed in accordance with IEEE-279. These include sensors, signal conditioners, logic, and actuation device control circuitry. (The protective function with which the subject guide is concerned is atmospheric cleanup to mitigate accident doses.)

   b. In addition, a very limited class of analog indicators may be designed in accordance with selected applicable paragraphs of IEEE-279. The basis for selecting specific indicators to be so designed is their significance to safety. All paragraphs of IEEE-279 are applicable, except 4.12, 4.13, 4.15, 4.16, and 4.17. For this limited class of indicators, redundant analog channels are provided, one of

TABLE 1.8-1 (Cont)

Regulatory Guide 1.52, Revision 2 (March 1978) (Cont)

which is recorded. The systems are designed to operate before and after, but not necessarily during, a SSE.

c. Annunciator functions are incorporated into overall system design. Annunciators are not safety-related; therefore, they are not designed in accordance with IEEE-279.

4. Paragraph C.2.j ESF atmosphere cleanup systems are designed to be removed as a minimum number of segmented sections. Individual filter components will be removed prior to cutting the housing into segmented sections.

5. Paragraph C.2.1 Housing leak tests are performed in accordance with the provisions of Section 6 of ANSI N5 10-1975 as recommended in this paragraph. However, ductwork tests are performed using acceptable methods of the Associated Air Balance Council.

6. Paragraph C.3.d All HEPA filters are shipped to an NRC Quality Assurance Station for testing. However, if data confirm that HEPA filters are damaged by the additional transportation, and/or the handling at the NRC facility, the decision to send all HEPA filters for additional testing will be reconsidered.

7. Paragraph C.3.e Filter and adsorber mounting frames are constructed and designed in accordance with the recommendations of Section 4.3 of ERDA 76-21, except for the frame tolerance guidelines in Table 4.2. The tolerances selected for HEPA and adsorber mountings are sufficient to satisfy the bank leak test criteria of Paragraphs C.5.c and C.5.d of Regulatory Guide 1.52, Revision 2.

8. Paragraph C.3.h Exception is taken to the recommendations of Section 4.5.8 of ERDA 76-21 relative to drain sizes and arrangement. Normally open manual valves, in addition to water seals and

TABLE 1.8-1 (Cont)

Regulatory Guide 1.52, Revision 2 (March 1978) (Cont)

traps, will be provided to control the discharge of the fire sprinkler flow.

9. Paragraph C.3.i Exception is taken to the requirement that the absorption unit should be designed for a maximum loading of 2.5 mg of total iodine per gram of activated carbon. Regulatory Guide 1.52, Revision 1, states that "The absorption unit should have the capacity of loading 2.5 mg of total iodine (radioactive plus stable) per gram of activated carbon." The absorption unit provided has a loading capacity of 10.0 mg of total iodine per gram of activated carbon. 4

10. Paragraph C.3.k Exception is taken to the requirement for humidity control to below 70 percent relative humidity for low flow air bleed cooling.

11. Paragraph C.3.1 System resistances will be determined in accordance with Section 5.7.1 of ANSI N509-1976 except that fan inlet and outlet losses will not be calculated in accordance with AMCE 201. 4

Exception is taken to Section 5.7.2 of ANSI N509-1976; copies of fan ratings or test reports are not necessary when certified fan performance curves are furnished. Exception is taken to balancing techniques defined in Section 5.7.3 of ANSI N509-1976. Displacement criteria following normal industry practice will be used when maximum vibration velocity method imposes unrealistic requirements at certain operating speeds.

Documentation will not be furnished in accordance with Section 5.7.5 where AMCA certification ratings are submitted.

12. Paragraph C.3.n Exception is taken to Section 5.1u.3.5 of ANSI N509-1976; ductwork, as a structure, will have a resonant frequency above 25 Hz, but this may not be true for the unsupported plate or sheet sections. 4

TABLE 1.8-1 (Cont)

Regulatory Guide 1.52, Revision 2 (March 1978) (Cont)

13. Paragraph C.3.p Exception is taken to the provisions in Section 5.9 of ANSI N509-1976 of designing dampers to ANSI B31.1 and to using butterfly valves. Class B dampers may be designed and tested to meet the verification of strength and leaktightness necessary for use in a contaminated air stream. (NOTE: This exception does not pertain to containment penetrations.) 4

    In addition, exceptions are taken to the following:

    a. Class B leakage rates will be determined for one damper of each type instead of every damper.

    b. Minimum diameter of damper shaft length 24 in and under will be 1/2 in; and 3.4 in for shafts between 25 and 48 in.

14. Paragraph C.4.a Exception is taken to full compliance with Section 2.3.8 of ERDA 76-21; i.e., SWEC does not use any commmunication system, floor drains are as noted in Paragraph C.3.h above, decontamination areas and showers are not "nearby," filters are not used at duct inlets, and duct inspection hatches are not provided. 4

15. Paragraph C.4.d ESF atmosphere cleanup systems are run a minimum of 10 hr/month. However, if field data confirm that it is unnecessary to run the drains 10 hr/month to reduce the amount of moisture present on the filters, this decision will be reconsidered. 4

TABLE 1.8-1 (Cont)

Regulatory Guide 1.75, Revision 2 (September 1978)

Physical Independence of Electric Systems

FSAR Sections 7.1.2, 7.6.2, 8.3.1

Position

The Unit 2 project complies with the Regulatory Position (Paragraph C) of this guide through the alternate approach described below and in Section 7.6.2 and 8.3.1.

Regulatory Position C.9 requires that cable splices in raceways be prohibited. Splicing in electrical penetrations is considered to be exempt from this requirement.

Regulatory Position C.10 requires that the cables be marked at 5-ft intervals. This is a typographical error as confirmed by the NRC Power Systems Branch Assistant Chief, R. G. FitzPatrick, on October 30, 1980. The correct distance is 15 ft, which has been followed in Unit 2.

TABLE 1.8-1 (Cont)

Regulatory Guide 1.118, Revision 2 (June 1978)

Periodic Testing of Electric Power and Protection Systems

FSAR Sections 7.1.2, 8.1, 8.3.1

Position

Will be provided in a future amendment.

TABLE 1.8-1 (Cont)

Regulatory Guide 1.137, Revision 1 (October 1979)

Fuel-Oil Systems for Standby Diesel Generators

FSAR Section 9.5.4

Position

The Unit 2 project complies with the Regulatory Position (Paragraph C) of this guide through the alternate approach described below.

Oxidative stability tests are not performed and pour point is substituted for cloud point.

TABLE 1.8-1 (Cont)

Regulatory Guide 1.140, Revision 1 (October 1979)

Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants

FSAR Section Chapter 16

Position

This regulatory guide applies to the radwaste building exhaust system.

The Unit 2 project complies with the Regulatory Position (Paragraph C) of this guide through the alternate approach described below.

1. Paragraph C.2.b Filter component layouts will normally be no more than three HEPA filters high and 10 HEPA filters wide. If individual filter components with capacities greater than 1,000 cfm are used, the system flow rate may be greater than 30,000 cfm.

2. Paragraph C.2.f Housing leak tests are performed in accordance with the guide, but ductwork leak tests are performed using the methods of the Associated Air Balance Council instead of ANSI N510-1975.

3. Paragraph C.3.c For HEPA filters and adsorber mountings, the requirements of ANSI N509-1976 Section 5.6.3 will be complied with, except for the tolerance requirements. The tolerances for HEPA filters and adsorber mounting frames will be sufficient to pass the bank leak tests of Paragraphs 5.c and 5.d of the guide.

4. Paragraph C.3.g The dwell time for a charcoal adsorber unit with minimum 2-in bed depth will be 0.25 sec. For bed depths greater than 2 in, where the dwell time is less than 0.25 sec/2 in, bed depth, experimental verification of filter efficiency will be provided.

TABLE 1.8-1 (Cont)

Regulatory Guide 1.140, Revision 1 (October 1979) (Cont)

5. Paragraph C.3.h Exception is taken to Section 5.2.2.4 of ANSI N509-1976 which calls for a means of compaction to uniform density. Where uniform compaction can be demonstrated, compacting means shall not be required.

6. Paragraph C.3.i

   a. System resistances will be determined in accordance with Section 5.7.1 of ANSI N509-1976 except that fan inlet and outlet losses will not be calculated in accordance with AMCA 201.

   b. Exception is taken to Section 5.7.2 of ANSI N509-1976. Copies of fan ratings or test reports are not necessary when certified fan performance curves are furnished.

   c. Exception is taken to Section 5.7.3 of ANSI N509-1976. Balancing techniques specified need not be followed. Maximum permissible vibration velocity level method need not be complied with.

   d. Exception is taken to Section 5.7.5 of ANSI N509-1976. Where AMCA certification ratings are submitted, documentation will not be furnished.

7. Paragraph C.3.k The air flow distribution will be within ±20 percent of the average air flow as tested in accordance with ANSI N510-1975. Turning vanes will be provided only where a uniform air distribution cannot be achieved.

8. Paragraph C.3.1 Exception is taken to Section 5.9 of ANSI N509-1976:

   a. Dampers will not be designed to the specifications of ANSI B31.1.

   b. Butterfly valves will not be used.

TABLE 1.8-1 (Cont)

Regulatory Guide 1.140, Revision 1 (October 1979) (Cont)

c. Class B leakage rates will be determined for one damper of each type instead of every damper.

d. Dampers with shaft lengths ≤24 in will have a minimum shaft diameter of 1/2 in. Dampers with shaft lengths >24 in and ≤48 in will have a minimum shaft diameter of 3/4 in.

TABLE 1.9-1

STANDARD REVIEW PLAN CONFORMANCE TO ACCEPTANCE CRITERIA

| SRP Number | Title | Revision | Conformance | Difference |
|---|---|---|---|---|
| CHAPTER 1: INTRODUCTION AND GENERAL DESCRIPTION OF PLANT | | | | |
| 1.8 | Interfaces for Standard Design | 1 | NA | NA |
| CHAPTER 2: SITE CHARACTERISTICS | | | | |
| 2.1.1 | Site Location and Description | 2 | X | |
| 2.1.2 | Exclusion Area Authority and Control | 2 | X | |
| 2.1.3 | Population Distribution | 2 | | Attachment 1.9-1 |
| 2.2.1-2.2.2 | Identification of Potential Hazards in Site Vicinity | 2 | X | |
| 2.2.3 | Evaluation of Potential Accidents | 2 | X | |
| 2.3.1 | Regional Climatology | 2 | X | |
| 2.3.2 | Local Meteorology | 2 | | Attachment 1.9-2 |
| 2.3.3 | Onsite Meteorological Measurements Programs | 2 | | Attachment 1.9-3 |
| 2.3.4 | Short-Term Diffusion Estimates for Accidental Atmospheric Releases | 1 | X | |
| 2.3.5 | Long-Term Diffusion Estimates | 2 | X | |
| 2.4.1 | Hydrologic Description | 2 | X | |
| | Appendix A | 2 | X | |
| 2.4.2 | Floods | 2 | X | |
| 2.4.3 | Probable Maximum Flood (PMF) on Streams and Rivers | 2 | NA | NA |
| 2.4.4 | Potential Dam Failures | 2 | NA | NA |
| 2.4.5 | Probable Maximum Surge and Seiche Flooding | 2 | X | |
| 2.4.6 | Probable Maximum Tsunami Flooding | 2 | NA | NA |
| 2.4.7 | Ice Effects | 2 | X | |
| 2.4.8 | Cooling Water Canals and Reservoirs | 2 | NA | NA |
| 2.4.9 | Channel Diversions | 2 | NA | NA |
| 2.4.10 | Flood Protection Requirements | 2 | X | |
| 2.4.11 | Cooling Water Supply | 2 | X | |
| 2.4.12 | Groundwater | 2 | | Attachment 1.9-4 |
| | BTP HMB/GSB 1 | 1 | NA | NA |
| | BTP HGEB 1 | 2 | NA | NA |
| 2.4.13 | Accidental Releases of Liquid Effluents in Ground and Surface Waters | 2 | | Attachment 1.9-5 |
| 2.4.14 | Technical Specifications and Emergency Operation Requirements | 2 | NA | NA |
| 2.5.1 | Basic Geologic and Seismic Information | 2 | X | |
| 2.5.2 | Vibratory Ground Motion | 1 | X | |
| 2.5.3 | Surface Faulting | 2 | X | |

ATTACHMENT 1.9-1

STANDARD REVIEW PLAN 2.1.3, REVISION 2
POPULATION DISTRIBUTION

Difference

The population data presented in FSAR Section 2.1.3 are not in the format suggested by the SRP which incorporates the specifics of Regulatory Guide 1.70, Revision 3.

Discussion FSAR Section 2.1.3 was compiled in conformance with NUREG-0555 in order to maintain consistency with ER-OLS Section 2.5. For this reason, population distributions in the FSAR are not presented in the format outlined in Regulatory Guide 1.70, Revision 3. To resolve this difference, population distributions consistent with Regulatory Guide 1.70, Revision 3, are presented in ER-OLS Appendix 7A. 1

(f) RCS/RWCU (primary only).
(g) Containment atmosphere monitoring.
(h) Hydrogen recombiner system.

(2) In addition to radiation shine from system piping and components, the primary containment was assumed to leak at technical specification limits resulting in an airborne source term that was included in the radiation zoning. As provided by NUREG-0737, no additional leakage was assumed.

2. <u>Pipe Break in Reactor Building</u> As specified in NUREG-0737, reactor building airborne time history dose and dose rates were established for this event using the following fission products uniformly mixed in the primary coolant system:

| | |
|---|---|
| Noble gases | 10% |
| Iodine | 10% |
| Others | 0% |
| Kr-85 | 30% |

## II.B.3 POST-ACCIDENT SAMPLING

FSAR Cross Reference

Section 9.3.2

NUREG-0737 Position

A design and operational review of the reactor coolant and containment atmosphere sampling line systems shall be performed to determine the capability of personnel to promptly obtain (in less than 1 hr) a sample under accident conditions without incurring a radiation exposure to any individual in excess of 3 and 18 3/4 Rem to the whole body or extremities, respectively. Accident conditions should assume a Regulatory Guide 1.3 or 1.4 release of fission products. If the review indicates that personnel could not promptly and safely obtain the samples, additional design features or shielding should be provided to meet the criteria.

A design and operational review of the radiological spectrum analysis facilities shall be performed to determine the capability to promptly quantify (in less than 2 hr) certain radionuclides that are indicators of the degree of core damage. Such radionuclides are noble gases (which indicate cladding failure), iodines and cesiums (which indicate high fuel temperatures), and nonvolatile isotopes (which indicate fuel melting). The initial reactor coolant spectrum should correspond to a Regulatory Guide 1.3 or 1.4 release. The review should also consider the effects of direct radiation from piping and components in the auxiliary building and possible contamination and direct radiation from airborne effluents. If the review indicates that the analyses required cannot be performed in a prompt manner with existing equipment, then design modifications or equipment procurement shall be undertaken to meet the criteria.

In addition to the radiological analyses, certain chemical analyses are necessary for monitoring reactor conditions. Procedures shall be provided to perform boron and chloride chemical analyses assuming a highly radioactive initial sample (Regulatory Guide 1.3 or 1.4 source term). Both analyses shall be capable of being completed promptly (i.e., the boron sample analysis within an hour and the chloride sample analysis within a shift).

The licensee shall have the capability to promptly obtain reactor coolant samples and containment atmosphere samples. The combined time allotted for sampling and analysis should

be 3 hr or less from the time a decision is made to take a sample.

The licensee shall establish an onsite radiological and chemical analysis capability to provide, within the 3-hr time frame established above, quantification of the following:

1. Certain radionuclides in the reactor coolant and containment atmosphere that may be indicators of the degree of core damage (e.g., noble gases, iodines and cesiums, and nonvolatile isotopes):

2. Hydrogen levels in the containment atmosphere.

3. Dissolved gases (e.g., $H_2$), chloride (time allotted for analysis subject to discussion below), and boron concentration of liquids.

4. Alternatively, have inline monitoring capabilities to perform all or part of the above analyses.

Reactor coolant and containment atmosphere sampling during post-accident conditions shall not require an isolated auxiliary system (e.g., the letdown system, reactor water cleanup system) to be placed in operation in order to use the sampling system.

Pressurized reactor coolant samples are not required if the licensee can quantify the amount of dissolved gases with unpressurized reactor coolant samples. The measurement of either total dissolved gases or $H_2$ gas in reactor coolant samples is considered adequate. Measuring the $O_2$ concentration is recommended, but is not mandatory.

The time for a chloride analysis to be performed is dependent upon two factors: 1) if the plant's coolant water is seawater or brackish water, and 2) if there is only a single barrier between primary containment systems and the cooling water. Under both of these conditions the licensee shall provide for a chloride analysis within 24 hr of the sample being taken. For all other cases, the licensee shall provide the analysis to be completed within 4 days. The chloride analysis does not have to be done onsite.

The design basis for plant equipment for reactor coolant and containment atmosphere sampling and analysis must assume that it is possible to obtain and analyze a sample without radiation exposures to any individual exceeding the criteria of GDC 19 (Appendix A, 10CFR50) (i.e., 5 Rem whole body,

75 Rem extremities). (Note that the design and operational review criterion was changed from the operational limits of 10CFR20 NUREG-0578 to the GDC 19 criterion October 30, 1979 letter from H. R. Denton to all licensees.)

The analysis of primary coolant samples for boron is required for PWRs. (Note that Revision 2 of Regulatory Guide 1.97, when issued, will likely specify the need for primary coolant boron analysis capability at BWR plants.)

If inline monitoring is used for any sampling and analytical capability specified herein, the licensee shall provide backup sampling through grab samples, and shall demonstrate the capability of analyzing the samples. Established planning for analysis at offsite facilities is acceptable. Equipment provided for backup sampling shall be capable of providing at least one sample per day for 7 days following onset of the accident and at least one sample per week until the accident condition no longer exists.

The licensee's radiological and chemical sample analysis capability shall include provisions to:

1. Identify and quantify the isotopes of the nuclide categories discussed above to levels corresponding to the source terms given in Regulatory Guides 1.3 or 1.4 and 1.7. Where necessary and practicable, the ability to dilute samples to provide capability for measurement and reduction of personnel exposure should be provided. Sensitivity of onsite liquid sample analysis capability should permit measurement of nuclide concentration in the range from approximately 1 uCi/g to 10 Ci/g.

2. Restrict background levels of radiation in the radiological and chemical analysis facility from sources such that the sample analysis will provide results with an acceptably small error (approximately a factor of 2). This can be accomplished through the use of sufficient shielding around samples and outside sources, and by the use of ventilation system design which will control the presence of airborne radioactivity.

Accuracy, range, and sensitivity shall be adequate to provide pertinent data to the operator to describe radiological and chemical status of the reactor coolant systems.

In the design of the post-accident sampling and analysis capability, consideration should be given to the following items:

1. Provisions for purging sample lines, for reducing plateout in sample lines, for minimizing sample loss or distortion, for preventing blockage of sample lines by loose material in the RCS or containment, for appropriate disposal of the samples, and for flow restrictions to limit reactor coolant loss from a rupture of the sample line. The post-accident reactor coolant and containment atmosphere samples should be representative of the reactor coolant in the core area and the containment atmosphere following a transient or accident. The sample lines should be as short as possible to minimize the volume of fluid to be taken from containment. The residues of sample collection should be returned to containment or to a closed system.

2. The ventilation exhaust from the sampling station should be filtered with charcoal adsorbers and high-efficiency particulate air (HEPA) filters.

3. Guidelines for analytical or instrumentation range are given in the table with Task II.B.3.

Nine Mile Point Unit 2 Position

Unit 2 uses a system dedicated to post-accident sampling. This system (PASS) has the capability to obtain reactor coolant and containment atmosphere samples under accident conditions to permit the necessary radiological and chemical analysis to be performed within the time frame and sensitivities stipulated in NUREG-0737.

The samples can be obtained without incurring a radiation exposure to any individual in excess of 3 and 18 3/4 Rem to whole body or extremities, respectively.

The ability to obtain these samples does not rely on the use of any isolated auxiliary system. Onsite radiological and chemical analysis is provided to quantify radionuclides in the reactor coolant and containment atmosphere in accordance with Regulatory Guides 1.3 and 1.4. PASS can identify and quantify the following radionuclides: noble gases (indicative of cladding failure), iodines and cesiums (indicative of high fuel temperatures) and nonvolatile isotopes (indicative of fuel melting). These radionuclides

would indicate the degree of core damage after an accident. Analysis capability is available for hydrogen levels in the containment and suppression pool atmosphere, and the quantification of dissolved gases, chloride, and boron concentration in liquids. PASS has the ability to dilute samples to provide the capability for the measurement and reduction of personnel exposure if necessary. The sensitivity of onsite liquid sample analysis will permit the measurement of nuclide concentration from approximately 1 uCi/g to 10 Ci/g. Background radiation levels in the onsite laboratory are such that an acceptably small error, less than a factor of two, will result during sample analysis. For each one of the sample lines, a purge line of demineralized water or nitrogen gas will be provided for purging before and after taking samples. This reduces the chance of system pluggings, reduces the radiation exposure by minimizing plateout, and enhances the capability of obtaining representative samples.

Two return lines are provided, one for gas and one for liquid. These lines provide a closed loop and return any unused liquids or gases to the suppression pool. Total dissolved gas composition and concentration are determined by the analysis of the gas phase over any liquid volume and by application of Henry's Law together with the measurement of the applied pressure. The analytical detection limit for dissolved gas is the solubility limit at greater than ambient temperature and 1 atmosphere. Hydrogen determination can be performed by gas chromatography to ±1 percent mole fraction.

## II.D.1 RELIEF AND SAFETY VALVE TEST REQUIREMENTS

FSAR Cross Reference

Sections 5.2, 5.4

NUREG-0737 Position

BWR licensees and applicants shall conduct testing to qualify the reactor coolant system relief and safety valves under expected operating conditions for design basis transients and accidents.

Nine Mile Point Unit 2 Position

The NRC has identified a total of 20 scenarios that could possibly lead to high pressure two-phase or liquid flow through the SRV.

The Unit 2 project will provide the following means to resolve the NRC concerns:

1. Redundant Level 8 trip for RCIC (Events 4 and 9)

2. Redundant Level 8 trip for HPCS (Events 5 and 10)

3. Redundant nonsafety Level 8 trip to close the three feedwater control valves and two HPLF valves (Event 1)

## II.D.3 SRV POSITION INDICATION

<u>FSAR Cross Reference</u>

Sections 5.4, 7.6, 7.3.2

<u>NUREG-0737 Position</u>

The reactor coolant system relief and safety valves shall be provided with a positive indication in the control room derived from a reliable valve position detection device or a reliable indication of flow in the discharge pipe.

The basic requirement is to provide the operator with unambiguous indication of valve position (open or closed) so that appropriate operator actions can be taken. The valve position should be indicated in the control room. An alarm should be provided in conjunction with this indication. The valve position indication may be safety grade. If the position indication is not safety grade, a reliable single channel direct indication powered from a vital instrument bus may be provided if backup methods of determining valve position are available and are discussed in the emergency procedures as an aid to operator diagnosis and action.

The valve position indication should be seismically qualified consistent with the component or system to which it is attached. The position indication should be qualified for its appropriate environment (any transient or accident that would cause the relief or safety valve to lift).

<u>Nine Mile Point Unit 2 Position</u>

Unit 2 has two means of SRV position indication. The primary means is an acoustic monitoring system that monitors SRV tailpipe noise. This system is IE and is qualified for in-containment use. Valve position is indicated in the control room and is entered into the Emergency Response Facility (ERF) computer. The secondary means of valve lift monitoring is non-IE thermocouples on the SRV tailpipe. This monitoring means is only a backup/verification of valve lift and is displayed on a temperature recorder as described in Section 7.3.2.

## LICENSING ISSUE: 12 - ATWS

### Issue

Applicants have been requested to implement plant modifications on a scheduled basis to conform with the NRC's final resolution of ATWS.

### Position

The Nine Mile Point Unit 2 ATWS modifications are described in FSAR Section 15.8 and include scram discharge volume modifications, reactor coolant recirculation pump trip, and manual standby liquid control system operation. Emergency procedures will be established and operators will be trained to recognize ATWS events and take necessary mitigating actions. A review of the Unit 2 design will be performed, when final NRC guidelines on ATWS are published, to establish what, if any, additional modifications are required.

## LICENSING ISSUE: 13 - LOW OR DEGRADED GRID VOLTAGE

### Issue 3

Applicants have been requested to provide for a second level of undervoltage protection with time delay for the onsite power system.

### Position

Nine Mile Unit 2 design includes a second set of undervoltage relays for protection of the onsite emergency power system against sustained degraded voltage conditions.

## LICENSING ISSUE: 14 - TEST RESULTS FOR DIESEL GENERATORS

### Issue

Applicants have been requested to provide test results for the standby diesel generators that include margin qualification tests to demonstrate some margin in excess of the design requirements with respect to the start and load capability of the diesel generators.

### Position

The margin qualification test for the Division I and Division II standby diesel generators will be performed

onsite. The margin qualification test for the Division III standby diesel generator (GE) has been addressed in GE HPCS diesel generator test report, NEDO-10905-3. These plant specific tests will be performed during the preoperational test phase.

LICENSING ISSUE: 15 - ADEQUACY OF THE 120-VAC RPS POWER SUPPLY

Issue

The reactor protection system M-G set design modification developed by General Electric is to be implemented for RPS power supply.

Position

The Unit 2 RPS power supply design includes the modification developed by General Electric.

3 LICENSING ISSUE: 16 - RELIABILITY OF DIESEL GENERATORS

Issue

Applicants have been requested to implement the appropriate recommendations of NUREG/CR-0660 that are applicable to the onsite emergency diesel generators.

Position

Nine Mile Point Unit 2 design meets the appropriate recommendations of NUREG/CR-0660, except as noted below:

1. Air dryers are not used in the starting air system. Division I and II standby diesel generators (Cooper Energy Services) are equipped with an air starting system that utilizes an air distributor to rotate the engine during starting by sequentially opening air starting valves on each cylinder head to apply pressurized air directly to the pistons. The ports on these starting systems can pass a considerably larger cross section of moisture and/or dirt than the turbine-type air starting system. Also, these starting systems are provided with a moisture separator between the starting system and the air accumulator tanks. The moisture separators are furnished with a slight glass to detect condensate level and a drain valve. The air accumulator tanks are also provided with bottom drain valves for blowdown of

# CHAPTER 2

# SITE CHARACTERISTICS

## TABLE OF CONTENTS


| Section | Title | Page |
|---|---|---|
| 2.1 | GEOGRAPHY AND DEMOGRAPHY | 2.1-1 |
| 2.1.1 | Site Location and Description | 2.1-1 |
| 2.1.1.1 | Specification of Location | 2.1-1 |
| 2.1.1.2 | Site Area Map | 2.1-1 |
| 2.1.1.3 | Boundaries for Establishing Effluent Release Limits | 2.1-2 |
| 2.1.2 | Exclusion Area Authority and Control | 2.1-3 |
| 2.1.2.1 | Authority | 2.1-3 |
| 2.1.2.2 | Control of Activities Unrelated to Plant Operation | 2.1-3 |
| 2.1.2.3 | Arrangements for Traffic Control | 2.1-3 |
| 2.1.2.4 | Abandonment or Relocation of Roads | 2.1-4 |
| 2.1.3 | Population Distribution | 2.1-4 |
| 2.1.3.1 | Population within 20 Km (12.4 Mi) | 2.1-4 |
| 2.1.3.2 | Population within 80 Km (50 Mi) | 2.1-5 |
| 2.1.3.3 | Transient Population | 2.1-6 |
| 2.1.3.4 | Low Population Zone | 2.1-7 |
| 2.1.3.5 | Population Centers | 2.1-7 |
| 2.1.3.6 | Population Density | 2.1-8 |
| 2.1.4 | References | 2.1-9 |
| 2.2 | NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES | 2.2-1 |
| 2.2.1 | Locations and Routes | 2.2-1 |
| 2.2.2 | Description | 2.2-2 |
| 2.2.2.1 | Description of Facilities | 2.2-2 |
| 2.2.2.2 | Description of Products and Materials | 2.2-3 |
| 2.2.2.3 | Projections of Industrial Growth | 2.2-4 |
| 2.2.3 | Evaluation of Potential Accidents | 2.2-4 |
| 2.2.3.1 | Determination of Design Basis Events | 2.2-4 |
| 2.2.3.1.1 | Explosions | 2.2-4 |
| 2.2.3.1.2 | Flammable Vapor Clouds (Delayed Ignition) | 2.2-5 |
| 2.2.3.1.3 | Toxic Chemicals | 2.2-5 |
| 2.2.3.1.4 | Fires | 2.2-7 |
| 2.2.3.1.5 | Collisions with Intake Structures | 2.2-7 |
| 2.2.3.1.6 | Liquid Spills | 2.2-8 |
| 2.2.3.1.7 | Airplane Crashes | 2.2-9 |
| 2.2.3.2 | Effects of Design Basis Events | 2.2-9 |
| 2.2.4 | References | 2.2-10 |

CHAPTER 2

TABLE OF CONTENTS (Cont)


| | Section | Title | Page |
|---|---|---|---|
| | 2.3 | METEOROLOGY | 2.3-1 |
| | 2.3.1 | Regional Climatology | 2.3-1 |
| | 2.3.1.1 | Data Sources | 2.3-1 |
| | 2.3.1.2 | General Climate | 2.3-1 |
| | 2.3.1.2.1 | Local Climatic Effects | 2.3-2 |
| | 2.3.1.2.2 | Climatological Normals and Extremes | 2.3-3 |
| 5 | 2.3.1.3 | Regional Meteorological Conditions for Design and Operating Bases | 2.3-5a |
| 5 | 2.3.1.3.1 | Seasonal and Annual Frequencies of Severe Weather | 2.3-5a |
| | 2.3.1.3.2 | Maximum Snow Load | 2.3-8 |
| | 2.3.1.3.3 | Design Basis Tornado | 2.3-9 |
| | 2.3.1.3.4 | Fastest Mile of Wind | 2.3-9 |
| | 2.3.1.3.5 | Ultimate Heat Sink | 2.3-10 |
| | 2.3.2 | Local Meteorology | 2.3-10 |
| | 2.3.2.1 | Data Sources | 2.3-11 |
| 5 | 2.3.2.2 | Normal and Extreme Values of Meteorological Parameters | 2.3-11a |
| | 2.3.2.2.1 | Wind Direction and Speed | 2.3-12 |
| | 2.3.2.2.2 | Wind Direction Persistence | 2.3-13 |
| | 2.3.2.2.3 | Atmospheric Stability | 2.3-14 |
| | 2.3.2.2.4 | Temperature Inversions | 2.3-15 |
| | 2.3.2.2.5 | Mixing Heights | 2.3-16 |
| | 2.3.2.2.6 | Temperature | 2.3-16 |
| | 2.3.2.2.7 | Precipitation | 2.3-17 |
| | 2.3.2.2.8 | Atmospheric Moisture | 2.3-19 |
| | 2.3.2.2.9 | Fog and Haze | 2.3-21 |
| | 2.3.2.2.10 | Hourly Data Tape | 2.3-21 |
| | 2.3.2.3 | Potential Influence of the Plant and Its Facilities on Local Meteorology | 2.3-21 |
| | 2.3.2.3.1 | Visible Plume Occurrence | 2.3-21 |
| | 2.3.2.3.2 | Ground Level Fogging and Icing | 2.3-22 |
| | 2.3.2.3.3 | Cooling Tower Drift | 2.3-23 |
| | 2.3.2.3.4 | Cloud Development and Cloud Shadowing | 2.3-25 |
| | 2.3.2.3.5 | Vapor Plume Interaction | 2.3-25 |
| | 2.3.2.3.6 | Humidity Increase | 2.3-26 |
| | 2.3.2.4 | Local Meteorological Conditions for Design and Operating Bases | 2.3-26 |
| | 2.3.3 | Onsite Meteorological Measurements Program | 2.3-27 |
| | 2.3.3.1 | Preoperational Measurements Program | 2.3-27 |
| | 2.3.3.1.1 | Description | 2.3-27 |
| | 2.3.3.1.2 | Instrument Siting | 2.3-27 |

# CHAPTER 2

## LIST OF TABLES


| Table Number | Title |
|---|---|
| 2.1-1 | MINIMUM DISTANCE BY SECTOR BETWEEN RESTRICTED AREA BOUNDARY AND ROUTINE RELEASE POINTS |
| 2.1-2 | 1980 POPULATION AND POPULATION DENSITIES FOR TOWNS AND CITIES WITHIN 20 KM (12.4 MI) OF UNIT 2 |
| 2.1-3 | 1970-1980 POPULATION GROWTH FOR TOWNS AND CITIES WITHIN 20 KM (12.4 MI) OF UNIT 2 |
| 2.1-4 | 1980 POPULATION DISTRIBUTION (20 KM/12.4 MI) |
| 2.1-5 | 1985 POPULATION DISTRIBUTION (20 KM/12.4 MI) |
| 2.1-6 | 1990 POPULATION DISTRIBUTION (20 KM/12.4 MI) |
| 2.1-7 | 2000 POPULATION DISTRIBUTION (20 KM/12.4 MI) |
| 2.1-8 | 2010 POPULATION DISTRIBUTION (20 KM/12.4 MI) |
| 2.1-9 | 2020 POPULATION DISTRIBUTION (20 KM/12.4 MI) |
| 2.1-10 | 2030 POPULATION DISTRIBUTION (20 KM/12.4 MI) |
| 2.1-11 | 1980 POPULATION DISTRIBUTION (80 KM/50 MI) |
| 2.1-12 | 1985 POPULATION DISTRIBUTION (80 KM/50 MI) |
| 2.1-13 | 1990 POPULATION DISTRIBUTION (80 KM/50 MI) |
| 2.1-14 | 2000 POPULATION DISTRIBUTION (80 KM/50 MI) |
| 2.1-15 | 2010 POPULATION DISTRIBUTION (80 KM/50 MI) |
| 2.1-16 | 2020 POPULATION DISTRIBUTION (80 KM/50 MI) |
| 2.1-17 | 2030 POPULATION DISTRIBUTION (80 KM/50 MI) |
| 2.1-18 | POPULATION CENTERS WITH OVER 25,000 PEOPLE IN 1980 |

CHAPTER 2

LIST OF TABLES (Cont)


| Table Number | Title |
|---|---|
| 2.1-19 | POPULATION DENSITY BY SECTOR, 1985 |
| 2.1-20 | POPULATION DENSITY BY SECTOR, 2030 |
| 2.1-21 | CUMULATIVE POPULATION DENSITY BY SECTOR, 1985 |
| 2.1-22 | CUMULATIVE POPULATION DENSITY BY SECTOR, 2030 |
| 2.2-1 | DAILY TRAFFIC VOLUME OF COUNTY HIGHWAYS IN THE VICINITY OF UNIT 2 |
| 2.2-2 | 1978 FREIGHT TRAFFIC FOR LAKE ONTARIO AROUND OSWEGO HARBOR |
| 2.2-3 | INDUSTRIAL FIRMS WITHIN 8 KM (5 MI) OF UNIT 2 |
| 2.2-4 | ARMY CORPS OF ENGINEERS HAZARDOUS MATERIAL COMMODITY DESIGNATION FOR WATERBORNE COMMERCE |
| 2.2-5 | HAZARDOUS MATERIALS STORED/USED BY INDUSTRIES WITHIN 8 KM (5 MI) |
| 2.2-6 | 1978 LAKE ONTARIO CARGO TRANSPORT FOR OSWEGO HARBOR |
| 2.2-7 | SOURCES OF TOXIC CHEMICALS WITHIN 8 KM (5 MI) OF UNIT 2 SITE |
| 2.2-8 | PREDICTED VAPOR CONCENTRATIONS IN THE UNIT 2 CONTROL ROOM |
| 3 2.2-9 | INPUT DATA FOR VAPOR RUN |
| 2.3-1 | DESIGN BASIS TORNADO PARAMETERS |
| 2.3-2 | VERTICAL PROFILE OF THE 100-YEAR RECURRENCE INTERVAL FASTEST MILE OF WIND |

THIS PAGE INTENTIONALLY BLANK

# CHAPTER 2

## LIST OF FIGURES


| Figure Number | Title |
|---|---|
| 2.1-1 | REGION WITHIN 80 KILOMETERS OF SITE - NEW YORK STATE AND ONTARIO PROVINCE CENSUS DISTRICTS |
| 2.1-2 | SITE BOUNDARIES AND TRANSPORTATION ROUTES |
| 2.1-3 | SITE PLAN |
| 2.1-4 | COUNTIES AND TOWNS WITHIN 20 KILOMETERS OF SITE |
| 2.1-5 | 1980 POPULATION DISTRIBUTION - 20 KM |
| 2.1-6 | 1985 POPULATION DISTRIBUTION - 20 KM |
| 2.1-7 | 1990 POPULATION DISTRIBUTION - 20 KM |
| 2.1-8 | 2000 POPULATION DISTRIBUTION - 20 KM |
| 2.1-9 | 2010 POPULATION DISTRIBUTION - 20 KM |
| 2.1-10 | 2020 POPULATION DISTRIBUTION - 20 KM |
| 2.1-11 | 2030 POPULATION DISTRIBUTION - 20 KM |
| 2.1-12 | 1980 POPULATION DISTRIBUTION - 80 KM |
| 2.1-13 | 1985 POPULATION DISTRIBUTION - 80 KM |
| 2.1-14 | 1990 POPULATION DISTRIBUTION - 80 KM |
| 2.1-15 | 2000 POPULATION DISTRIBUTION - 80 KM |
| 2.1-16 | 2010 POPULATION DISTRIBUTION - 80 KM |
| 2.1-17 | 2020 POPULATION DISTRIBUTION - 80 KM |
| 2.1-18 | 2030 POPULATION DISTRIBUTION - 80 KM |
| 2.1-19 | LOW POPULATION ZONE BOUNDARY |
| 2.2-1 | TRANSPORTATION ROUTES WITHIN A 10-KM RADIUS OF UNIT 2 |

THIS PAGE INTENTIONALLY BLANK

#### 2.1.2.4 Abandonment or Relocation of Roads

No public roads within the exclusion area have been abandoned or relocated.

### 2.1.3 Population Distribution

#### 2.1.3.1 Population Within 20 km (12.4 mi)

Unit 2 is located on Lake Ontario in the town of Scriba, NY, in the north-central portion of Oswego County, approximately 10 km (6.2 mi) north-northeast of the nearest boundary of the city of Oswego. In 1980, Oswego County had an estimated population of 113,901 at an average density of 43 people/sq km (111 people/sq mi)[3]. This population density is considerably lower than the state average of 137 people/sq km (356 people/sq mi). The 1980 population and population density for the ten towns and one city within 20 km (12 mi) of Unit 2 are listed in Table 2.1-2.

The total 1980 population within 20 km of Unit 2 is estimated to be 46,349, a 1.1-percent increase over the 1970 total. This population is projected to increase to approximately 106,509 by 2030[4]. The 20-km area contains all or portions of one city and ten towns: the city of Oswego, and the towns of Minetto, Scriba, New Haven, Oswego, Mexico, Palermo, Richland, Volney, Granby, and Hannibal. City and town boundaries are shown on Figure 2.1-4.

Of the ten towns and one city in the 20-km area, the city of Oswego is the largest in population, containing approximately 19,793 people in 1980. Following the city of Oswego in population size are Granby, Richland, Scriba, and Volney with estimated 1980 populations of 6,341, 5,594, 5,455, and 5,358, respectively[3]. Population growth and the 1970-1980 percent change in population for the towns and city within the 20-km area are listed in Table 2.1-3.

It is expected that a large portion of the population growth in the 20-km area will occur around the southeastern fringes of the city of Oswego, with the surrounding towns of Scriba, Palermo, New Haven, and Volney absorbing much of the city's satellite growth[5].

Population distribution within 8 km (5 mi) of the station is based on a house count conducted in October 1981 and town-specific people per household factors. Population distribution between 8 and 10 km is based on a house count from U.S. Geological Survey maps, photorevised in 1978, on which

houses have been symbolically identified. Houses were used to estimate the area population by applying a factor of 2.65 persons/household for each house in the town of Scriba, and 2.43 persons/household for each house in the town of New Haven[3]. Population projections within 10 km of the site were then adjusted by multiplying population value by Oswego County growth factor, supplied by the New York State Department of Commerce, Economic Development Board, which used the cohort-component method to obtain projections[4].

Polar-grid sector populations between 10 and 20 km are based on 1980 U.S. Census data and New York State population projections. Sector populations were determined by assuming that the population of a minor civil division (i.e., town) is evenly distributed over its geographic area. The proportion of each civil divisions area in each grid sector was then determined and applied to each civil division's total population, yielding the population in each grid sector. Population projections, based on 1978 projections supplied by the New York State Department of Commerce, Economic Development Board, were applied to each civil division assuming that each portion would maintain its relative share of any population change. Population density was calculated by dividing the population in each section by its land area. Population distribution within a 20-km radius of the plant for 1980 through 2030 is shown on Figures 2.1-5 through 2.1-11 and listed in Tables 2.1-4 through 2.1-10.

Population projections for the year 1985 are being used for the year of initial plant operation. The difference between the populations of 1985 and 1986, the year of actual commercial operation, should not differ to any significant extent. Therefore, since projections are calculated at 5-yr intervals based on the decennial census, 1985 provides the best estimate of population distribution at the start of commercial operation.

2.1.3.2 Population Within 80 km (50 mi)

The area within 80 km of Unit 2, containing a total population of approximately 930,848 in 1980, is expected to grow to approximately 1,095,741 in the year 2000 and to reach a total of approximately 1,572,006 by the year 2030[3]. Population distribution in the 80-km area for the years 1980, 1985, 1990, 2000, 2010, 2020, and 2030 is shown on Figures 2.1-12 through 2.1-18 and listed in Tables 2.1-11 through 2.1-17.

The 80-km area contains portions of three Canadian Census Divisions located in the Province of Ontario: Prince Edward, Frontenac, and Addington and Lennox. For these census divisions 1981 population statistics are included.

The 80-km region is moderately populated. In 1980, only the population in the city of Syracuse and its satellite towns exceeded 100,000, and only seven other population centers contained more than 10,000 people[3]. Table 2.1-18 lists cities with more than 25,000 people.

Three standard metropolitan statistical areas (SMSAs) are located partially within an 80-km radius of the station: Syracuse SMSA, Rochester SMSA, and Utica-Rome SMSA. The Syracuse SMSA, including the counties of Onondaga, Oswego, and Madison, contained a total of 647,500 people in 1977 at a density of 105 people/sq km (273 people/sq mi). This SMSA is expected to reach a total population of approximately 686,000 by the year 1985, and approximately 782,000 by the year 2000[4]. The Rochester SMSA includes five counties, only one of which (Wayne County) falls within the 80-km region. In 1975, 971,465 people resided in the Rochester SMSA at a density of 127 people/sq km (328 people/sq mi)[6]. By the years 1985 and 2000 the Rochester SMSA is expected to support approximate populations of 1,022,000 and 1,194,000, respectively[4]. Finally, the Utica-Rome SMSA contains only two counties, Oneida and Herkimer. Of the two, only Oneida County is located in part in the 80-km region. In 1975, 334,046 people lived in the Utica-Rome SMSA at a density of 49 people/sq km (126 people/sq mi)[6]. This SMSA is expected to decline to, and stabilize at, a population of approximately 327,000 in 1985[4].

Population distribution and projections for areas within 80 km were calculated in the same manner as described for the area between 10 and 20 km (Section 2.1.3.1). Population distributions for rings corresponding to Regulatory Guide 1.70 are presented in Appendix 2L.

### 2.1.3.3 Transient Population

Transient population within 20 km of the station is limited due to the predominantly rural, undeveloped character of the area. There are, however, a number of school, industry, and recreational facilities that create small daily and seasonal changes in sector populations.

#### 2.1.3.4 Low Population Zone

The low population zone (LPZ) surrounding Unit 2 encompasses an area within a 6.4 km (4 mi) radius from the Nine Mile Point Unit 1 stack. LPZ boundary accident doses for Unit 2 are calculated at a distance of approximately 6.1 km (3.8 mi) from the Unit 2 stack, which is 6.4 km, adjusted for the distance between the Unit 1 and Unit 2 stacks. Figure 2.1-19 depicts the LPZ. The distance for the LPZ was chosen based on the requirements of 10CFR100.11.

The LPZ is expected to contain approximately 2,224 people in the year 1985 at an average density of 46 people/sq km (118 people/sq mi). By the year 2030, the LPZ population is expected to have increased to approximately 5,468 at an average density of 112 people/sq km (291 people/sq mi). Tables 2.1-4 through 2.1-10 show population distribution in the LPZ.

The only facility in the LPZ that attracts a transient population is the Ontario Bible Campground at Lakeview, located approximately 1.5 km (2.4 mi) west-southwest of the station. This campground is a privately-owned facility operated on a 12-acre lakeshore plot. Groups of up to 500 persons use this camp during the summer and as many as 1,500 people may gather there for short periods on Sundays throughout the summer. The facility is unused during the balance of the year except for an occasional weekend in the spring and fall.

#### 2.1.3.5 Population Centers

In 1980, the closest population center, as defined by 10CFR100, to Unit 2 was the city of Syracuse, which contained approximately 170,105 people. The city's closest corporate boundary to Unit 2 is approximately 53 km (33 mi) south-southeast. The city of Syracuse is part of the Syracuse SMSA, which encompasses Onondaga, Oswego, and Madison Counties. This SMSA contained a total of 647,500 people in 1977 at a density of approximately 105 people/sq km (273 people/sq mi)[6]. The Syracuse SMSA is expected to contain a population of approximately 686,000 by the year 1985[4].

In 1990, the population of the city of Oswego is expected to exceed 25,000 people. At that time, Oswego will become the closest population center to the site. While Oswego's closest political boundary is about 7.24 km (4.5 mi) from the site, the boundary at the beginning of the city's

concentrated residential area is actually located approximately 8.85 km (5.5 mi) away; over 1.33 times the distance of the LPZ. Due to the industrial use of the portion of Oswego between 7.24 km and 8.85 km from the site, residential expansion into this area is unlikely.

The 80-km region is moderately populated. In 1980 only the population of the city of Syracuse and its satellite towns exceeded 100,000, and only three other population centers contained more than 25,000 people. Population centers with populations larger than 25,000 are listed in Table 2.1-18.

### 2.1.3.6 Population Density

The area within 60 km (37 mi) of Unit 2 is expected to contain approximately 597,998 people at an average density of 92 people/sq km (238 people/sq mi) in 1985. The density is considerably lower than the NRC comparison figure of 193 people/sq km (500 people/sq mi) given in Regulatory Guide 1.70. Population within the area is expected to increase to a total of approximately 1,032,654 by the year 2030. Population density in 2030 will reach an average of approximately 159 people/sq km (411 people/sq mi), also well below the NRC comparison for the end year of plant life of 386 people/sq km (1,000 people/sq mi).

Tables 2.1-19 and 2.1-20 list population density by sector for the years 1985 and 2030. Tables 2.1-21 and 2.1-22 provide cumulative densities for the years 1985 and 2030.

### 2.1.4 References

1. Niagara Mohawk Power Corporation. Preliminary Safety Analysis Report - Volume I, Nine Mile Point Nuclear Station - Unit 2, June 1972. Docket 50-410.

2. Niagara Mohawk Power Corporation. Environmental Report (Construction Permit Stage), Nine Mile Point Nuclear Station - Unit 2, June 1972. Docket 50-410.

3. U.S. Department of Commerce, Bureau of the Census. Final Population and Housing Counts for New York, Advance Report. PHO80-V-34, March 1981.

4. 1978 Official Population Projections for New York State Counties. New York State Department of Commerce, Economic Development Board, September 1980.

5. Oswego County Data Book, Oswego County Planning Board, 1977.

6. County and City Data Book 1977. U.S. Department of Commerce, Bureau of the Census, 1978.

TABLE 2.1-1

MINIMUM DISTANCE BY SECTOR
BETWEEN RESTRICTED AREA BOUNDARY
AND ROUTINE RELEASE POINTS[1]

| Sector | Stack | | Radwaste/Reactor Building Vent[2] | |
|---|---|---|---|---|
| | m | mi | m | mi |
| N[3] | 37 | 0.02 | 171 | 0.11 |
| NNE[3] | 49 | 0.03 | 189 | 0.12 |
| NE[3] | 67 | 0.04 | 272 | 0.17 |
| ENE[3] | 116 | 0.07 | 575 | 0.36 |
| E | 1,213 | 0.75 | 1,731 | 1.07 |
| ESE | 1,676 | 1.04 | 1,707 | 1.06 |
| SE | 1,902 | 1.18 | 2,006 | 1.25 |
| SSE | 2,329 | 1.45 | 2,152 | 1.34 |
| S | 2,286 | 1.42 | 2,128 | 1.32 |
| SSW | 1,981 | 1.23 | 1,811 | 1.13 |
| SW | 1,579 | 0.98 | 1,402 | 0.87 |
| WSW | 506 | 3.14 | 1,000 | 0.62 |
| W[3] | 61 | 0.04 | 408 | 0.25 |
| WNW[3] | 37 | 0.02 | 311 | 0.19 |
| NW[3] | 37 | 0.02 | 226 | 0.14 |
| NNW[3] | 37 | 0.02 | 171 | 0.11 |

[1] Minimum distance is the shortest length from the release point to the boundary within a 22 1/2-deg sector within compass points at the midpoint of each sector.

[2] Locations of release points are shown on Figure 11.3-2, and the restricted area boundary is shown on Figure 2.1-2.

[3] Restricted area boundary is located on the shoreline of Lake Ontario.

TABLE 2.1-2

1980 POPULATION AND POPULATION DENSITIES
FOR TOWNS AND CITIES WITHIN 20 KM (12.4 MI) OF UNIT 2

| | 1980 Population | Population Density (people/sq km) |
|---|---|---|
| City of Oswego | 19,793 | 1,029.0 |
| Oswego (town) | 7,865 | 116.9 |
| Granby | 6,341 | 55.2 |
| Richland | 5,594 | 40.9 |
| Scriba | 5,455 | 52.9 |
| Volney | 5,358 | 46.0 |
| Mexico | 4,790 | 41.8 |
| Hannibal | 4,027 | 38.5 |
| Palermo | 3,253 | 31.6 |
| New Haven | 2,421 | 31.7 |
| Minetto | 1,905 | 125.5 |

TABLE 2.1-3

1970-1980 POPULATION GROWTH FOR TOWNS AND CITIES
WITHIN 20 KM (12.4 MI) OF UNIT 2

| | 1970 | 1980 | 1970-1980 Percent Change |
|---|---|---|---|
| City of Oswego | 20,913 | 19,793 | -5.4 |
| Oswego (town) | 6,514 | 7,865 | 20.7 |
| Granby | 4,718 | 6,341 | 34.4 |
| Richland | 5,324 | 5,594 | 5.1 |
| Scriba | 3,619 | 5,455 | 50.7 |
| Volney | 4,520 | 5,358 | 18.5 |
| Mexico | 4,174 | 4,790 | 14.8 |
| Hannibal | 3,165 | 4,027 | 27.2 |
| Palermo | 2,321 | 3,253 | 40.2 |
| New Haven | 1,845 | 2,421 | 31.2 |
| Minetto | 1,688 | 1,905 | 12.9 |

TABLE 2.1-4

1980 POPULATION DISTRIBUTION (20 KM/12.4 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 21 | 0 | 0 | 0 | 0 | 584 | 605 |
| E | 0 | 119 | 119 | 107 | 61 | 1,842 | 2,248 |
| ESE | 13 | 59 | 63 | 156 | 241 | 2,405 | 2,937 |
| SE | 0 | 122 | 93 | 56 | 134 | 2,137 | 2,542 |
| SSE | 0 | 111 | 130 | 233 | 115 | 2,247 | 2,836 |
| S | 0 | 74 | 159 | 215 | 135 | 2,815 | 3,398 |
| SSW | 11 | 77 | 273 | 358 | 302 | 4,429 | 5,450 |
| SW | 19 | 127 | 366 | 329 | 4,624 | 19,205 | 24,670 |
| WSW | 0 | 34 | 21 | 3 | 0 | 1,605 | 1,663 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 64 | 723 | 1,224 | 1,457 | 5,612 | 37,269 | 46,349 |

TABLE 2.1-5

1985 POPULATION DISTRIBUTION (20 KM/12.4 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 23 | 0 | 0 | 0 | 0 | 646 | 669 |
| E | 0 | 132 | 132 | 118 | 68 | 2,037 | 2,487 |
| ESE | 14 | 65 | 70 | 173 | 267 | 2,661 | 3,250 |
| SE | 0 | 135 | 103 | 62 | 148 | 2,365 | 2,813 |
| SSE | 0 | 123 | 144 | 258 | 127 | 2,485 | 3,137 |
| S | 0 | 82 | 176 | 238 | 149 | 3,113 | 3,758 |
| SSW | 12 | 85 | 302 | 396 | 334 | 4,899 | 6,028 |
| SW | 21 | 141 | 405 | 364 | 5,115 | 21,243 | 27,289 |
| WSW | 0 | 38 | 23 | 3 | 0 | 1,775 | 1,839 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 70 | 801 | 1,355 | 1,612 | 6,208 | 41,224 | 51,270 |

TABLE 2.1-6

1990 POPULATION DISTRIBUTION (20 KM/12.4 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 33 | 0 | 0 | 0 | 0 | 761 | 794 |
| E | 0 | 183 | 171 | 154 | 88 | 2,468 | 3,064 |
| ESE | 20 | 88 | 91 | 225 | 347 | 3,107 | 3,878 |
| SE | 0 | 187 | 137 | 80 | 193 | 2,656 | 3,253 |
| SSE | 0 | 173 | 201 | 357 | 171 | 2,741 | 3,643 |
| S | 0 | 115 | 246 | 333 | 210 | 3,189 | 4,093 |
| SSW | 16 | 119 | 423 | 555 | 468 | 4,992 | 6,573 |
| SW | 29 | 197 | 567 | 510 | 6,749 | 22,810 | 30,862 |
| WSW | 0 | 54 | 33 | 4 | 0 | 1,522 | 1,613 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 98 | 1,116 | 1,869 | 2,218 | 8,226 | 44,246 | 57,773 |

TABLE 2.1-7

2000 POPULATION DISTRIBUTION (20 KM/12.4 MI)

| | Distance (km/mi) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 38 | 0 | 0 | 0 | 0 | 897 | 935 |
| E | 0 | 211 | 197 | 177 | 101 | 2,939 | 3,625 |
| ESE | 23 | 101 | 105 | 258 | 398 | 3,728 | 4,613 |
| SE | 0 | 215 | 157 | 92 | 221 | 3,206 | 3,891 |
| SSE | 0 | 198 | 230 | 410 | 197 | 3,277 | 4,312 |
| S | 0 | 132 | 283 | 383 | 241 | 3,635 | 4,674 |
| SSW | 18 | 137 | 485 | 638 | 538 | 5,734 | 7,550 |
| SW | 34 | 226 | 651 | 585 | 7,749 | 24,366 | 33,611 |
| WSW | 0 | 61 | 38 | 5 | 0 | 1,655 | 1,759 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 113 | 1,281 | 2,146 | 2,548 | 9,445 | 49,437 | 64,970 |

## TABLE 2.1-8

## 2010 POPULATION DISTRIBUTION (20 KM/12.4 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 45 | 0 | 0 | 0 | 0 | 976 | 1,021 |
| E | 0 | 245 | 229 | 317 | 118 | 3,094 | 4,003 |
| ESE | 27 | 118 | 122 | 301 | 464 | 3,775 | 4,807 |
| SE | 0 | 251 | 183 | 108 | 258 | 3,107 | 3,907 |
| SSE | 0 | 231 | 269 | 478 | 229 | 3,140 | 4,347 |
| S | 0 | 154 | 330 | 446 | 281 | 4,015 | 5,226 |
| SSW | 22 | 160 | 566 | 744 | 627 | 6,455 | 8,574 |
| SW | 39 | 263 | 760 | 683 | 9,038 | 34,249 | 45,032 |
| WSW | 0 | 72 | 45 | 5 | 0 | 2,656 | 2,778 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 133 | 1,494 | 2,504 | 3,082 | 11,015 | 61,467 | 79,695 |

TABLE 2.1-9

2020 POPULATION DISTRIBUTION (20 KM/12.4 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 52 | 0 | 0 | 0 | 0 | 1,131 | 1,183 |
| E | 0 | 285 | 266 | 239 | 137 | 3,586 | 4,513 |
| ESE | 31 | 137 | 141 | 349 | 538 | 4,377 | 5,573 |
| SE | 0 | 291 | 212 | 98 | 299 | 3,603 | 4,503 |
| SSE | 0 | 268 | 312 | 555 | 266 | 3,642 | 5,043 |
| S | 0 | 179 | 382 | 517 | 326 | 4,655 | 6,059 |
| SSW | 25 | 185 | 657 | 862 | 727 | 7,483 | 9,939 |
| SW | 46 | 305 | 881 | 792 | 10,480 | 39,711 | 52,215 |
| WSW | 0 | 83 | 52 | 6 | 0 | 3,080 | 3,221 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 154 | 1,733 | 2,903 | 3,418 | 12,773 | 71,268 | 92,249 |

TABLE 2.1-10

2030 POPULATION DISTRIBUTION (20 KM/12.4 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | Total |
|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 60 | 0 | 0 | 0 | 0 | 1,306 | 1,366 |
| E | 0 | 329 | 307 | 276 | 158 | 4,140 | 5,210 |
| ESE | 36 | 158 | 163 | 403 | 621 | 5,053 | 6,434 |
| SE | 0 | 336 | 245 | 144 | 345 | 4,158 | 5,228 |
| SSE | 0 | 309 | 360 | 640 | 307 | 4,203 | 5,819 |
| S | 0 | 206 | 441 | 597 | 377 | 5,374 | 6,995 |
| SSW | 29 | 213 | 758 | 995 | 839 | 8,637 | 11,471 |
| SW | 53 | 353 | 1,017 | 914 | 12,096 | 45,836 | 60,269 |
| WSW | 0 | 96 | 60 | 7 | 0 | 3,554 | 3,717 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 178 | 2,000 | 3,351 | 3,976 | 14,743 | 82,261 | 106,509 |

TABLE 2.1-11

1980 POPULATION DISTRIBUTION (80 KM/50 MI)

| Direction | 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | 20-40/ 12.4-24.8 | 40-60/ 24.8-37.3 | 60-80/ 37.3-50.0 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Distance (km/mi) | | | | | | | | | |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 108 | 6,732* | 6,840* |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 937 | 3,489 | 9,495 | 13,921 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3,265 | 13,196 | 41,842 | 58,303 |
| ENE | 21 | 0 | 0 | 0 | 0 | 584 | 4,203 | 949 | 7,409 | 13,166 |
| E | 0 | 119 | 119 | 107 | 61 | 1,842 | 4,481 | 807 | 4,340 | 11,876 |
| ESE | 13 | 59 | 63 | 156 | 241 | 2,405 | 4,405 | 7,458 | 37,291 | 52,091 |
| SE | 0 | 122 | 93 | 56 | 134 | 2,137 | 9,762 | 14,451 | 39,934 | 66,689 |
| SSE | 0 | 111 | 130 | 233 | 115 | 2,247 | 31,909 | 272,279 | 63,365 | 370,389 |
| S | 0 | 74 | 159 | 215 | 135 | 2,815 | 32,901 | 67,605 | 26,595 | 130,499 |
| SSW | 11 | 77 | 273 | 358 | 302 | 4,429 | 8,041 | 13,680 | 60,768 | 87,939 |
| SW | 19 | 127 | 366 | 329 | 4,624 | 19,205 | 8,392 | 9,783 | 34,095 | 76,940 |
| WSW | 0 | 34 | 21 | 3 | 0 | 1,605 | 318 | 4,383 | 25,424 | 31,788 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 645* | 645* |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 265* | 6,944* | 7,209* |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,553* | 2,553* |
| Total | 64 | 723 | 1,224 | 1,457 | 5,612 | 37,269 | 108,614 | 408,453* | 367,432* | 930,848* |

*Sectors contain portions of Canada, for which 1981 population data were used.

TABLE 2.1-12

1985 POPULATION DISTRIBUTION (80 KM/50 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | 20-40/ 12.4-24.8 | 40-60/ 24.8-37.3 | 60-80/ 37.3-50.0 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 114 | 7,269 | 7,383 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 989 | 3,683 | 10,022 | 14,694 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3,463 | 13,929 | 44,167 | 61,559 |
| ENE | 23 | 0 | 0 | 0 | 0 | 646 | 4,616 | 1,017 | 8,005 | 14,307 |
| E | 0 | 132 | 132 | 118 | 68 | 2,037 | 4,955 | 882 | 4,679 | 13,003 |
| ESE | 14 | 65 | 70 | 173 | 267 | 2,661 | 4,873 | 7,695 | 38,009 | 53,827 |
| SE | 0 | 135 | 103 | 62 | 148 | 2,365 | 10,800 | 15,510 | 43,396 | 72,519 |
| SSE | 0 | 123 | 144 | 258 | 127 | 2,485 | 34,165 | 287,067 | 66,240 | 390,609 |
| S | 0 | 82 | 176 | 238 | 149 | 3,113 | 35,733 | 71,245 | 27,754 | 138,490 |
| SSW | 12 | 85 | 302 | 396 | 334 | 4,899 | 8,599 | 13,701 | 60,138 | 88,466 |
| SW | 21 | 141 | 405 | 364 | 5,115 | 21,243 | 8,747 | 10,089 | 35,248 | 81,373 |
| WSW | 0 | 38 | 23 | 3 | 0 | 1,775 | 331 | 4,525 | 26,244 | 32,939 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 676 | 676 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 278 | 7,268 | 7,546 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,653 | 2,653 |
| Total | 70 | 801 | 1,355 | 1,612 | 6,208 | 41,224 | 117,271 | 429,735 | 381,768 | 980,044 |

TABLE 2.1-13

1990 POPULATION DISTRIBUTION (80 KM/50 MI)

| | Distance (km/mi) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | 20-40/ 12.4-24.8 | 40-60/ 24.8-37.3 | 60-80/ 37.3-50.0 | Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110 | 7,647 | 7,757 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 1,020 | 3,447 | 9,433 | 13,900 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3,504 | 14,353 | 45,826 | 63,683 |
| ENE | 33 | 0 | 0 | 0 | 0 | 761 | 4,373 | 1,050 | 9,082 | 15,299 |
| E | 0 | 183 | 171 | 154 | 88 | 2,468 | 5,657 | 826 | 4,758 | 14,305 |
| ESE | 20 | 88 | 91 | 225 | 347 | 3,107 | 5,679 | 6,973 | 36,826 | 53,356 |
| SE | 0 | 187 | 137 | 80 | 193 | 2,656 | 13,383 | 15,363 | 44,611 | 76,610 |
| SSE | 0 | 173 | 201 | 357 | 171 | 2,741 | 31,739 | 308,253 | 68,733 | 412,368 |
| S | 0 | 115 | 246 | 333 | 210 | 3,189 | 34,467 | 75,781 | 26,251 | 140,592 |
| SSW | 16 | 119 | 423 | 555 | 468 | 4,992 | 8,218 | 13,216 | 64,270 | 92,277 |
| SW | 29 | 197 | 567 | 510 | 6,749 | 22,810 | 7,454 | 10,289 | 38,990 | 87,595 |
| WSW | 0 | 54 | 33 | 4 | 0 | 1,522 | 276 | 4,721 | 26,309 | 32,919 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 695 | 695 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 285 | 7,465 | 7,750 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,685 | 2,685 |
| Total | 98 | 1,116 | 1,869 | 2,218 | 8,226 | 44,246 | 115,770 | 454,667 | 393,581 | 1,021,791 |

TABLE 2.1-14

2000 POPULATION DISTRIBUTION (80 KM/50 MI)

| Direction | Distance (km/mi) 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | 20-40/ 12.4-24.8 | 40-60/ 24.8-37.3 | 60-80/ 37.3-50.0 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 109 | 7,835 | 7,944 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 1,009 | 3,411 | 9,333 | 13,753 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3,506 | 14,201 | 45,346 | 63,053 |
| ENE | 38 | 0 | 0 | 0 | 0 | 897 | 4,810 | 1,077 | 9,402 | 16,224 |
| E | 0 | 211 | 197 | 177 | 101 | 2,939 | 6,862 | 899 | 4,921 | 16,307 |
| ESE | 23 | 101 | 105 | 258 | 398 | 3,728 | 7,068 | 7,081 | 36,543 | 55,305 |
| SE | 0 | 215 | 157 | 92 | 221 | 3,206 | 15,962 | 17,060 | 48,004 | 84,917 |
| SSE | 0 | 198 | 230 | 410 | 197 | 3,277 | 35,642 | 332,731 | 74,269 | 446,954 |
| S | 0 | 132 | 283 | 383 | 241 | 3,635 | 36,669 | 81,771 | 28,113 | 151,227 |
| SSW | 18 | 137 | 485 | 638 | 538 | 5,734 | 9,039 | 13,781 | 66,018 | 96,388 |
| SW | 34 | 226 | 651 | 585 | 7,749 | 24,366 | 8,080 | 11,388 | 42,947 | 96,026 |
| WSW | 0 | 61 | 38 | 5 | 0 | 1,655 | 300 | 5,234 | 29,170 | 36,463 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 698 | 698 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 287 | 7,500 | 7,787 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,695 | 2,695 |
| Total | 113 | 1,281 | 2,146 | 2,548 | 9,445 | 49,437 | 128,947 | 489,030 | 412,794 | 1,095,741 |

TABLE 2.1-15

2010 POPULATION DISTRIBUTION (80 KM/50 MI)

| | Distance (km/mi) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | 20-40/ 12.4-24.8 | 40-60/ 24.8-37.3 | 60-80/ 37.3-50.0 | Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 111 | 8,323 | 8,434 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 1,030 | 3,482 | 9,527 | 14,039 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3,685 | 14,498 | 46,303 | 64,486 |
| ENE | 45 | 0 | 0 | 0 | 0 | 976 | 5,914 | 1,139 | 9,943 | 18,017 |
| E | 0 | 245 | 229 | 317 | 118 | 3,094 | 7,173 | 1,039 | 5,206 | 17,421 |
| ESE | 27 | 118 | 122 | 301 | 464 | 3,775 | 6,601 | 7,530 | 38,543 | 57,481 |
| SE | 0 | 251 | 183 | 108 | 258 | 3,107 | 14,073 | 18,094 | 54,536 | 90,610 |
| SSE | 0 | 231 | 269 | 478 | 229 | 3,140 | 34,071 | 380,085 | 84,897 | 503,400 |
| S | 0 | 154 | 330 | 446 | 281 | 4,015 | 50,088 | 93,351 | 31,538 | 180,203 |
| SSW | 22 | 160 | 566 | 744 | 627 | 6,455 | 10,025 | 14,385 | 68,072 | 101,056 |
| SW | 39 | 263 | 760 | 683 | 9,038 | 34,249 | 9,965 | 12,651 | 47,686 | 115,334 |
| WSW | 0 | 72 | 45 | 5 | 0 | 2,656 | 386 | 5,824 | 32,464 | 41,452 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 695 | 695 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 286 | 7,436 | 7,722 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,534 | 2,534 |
| Total | 133 | 1,494 | 2,504 | 3,082 | 11,015 | 61,467 | 143,011 | 552,475 | 447,703 | 1,222,884 |

TABLE 2.1-16

2020 POPULATION DISTRIBUTION (80 KM/50 MI)

| | Distance (km/mi) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | 20-40/ 12.4-24.8 | 40-60/ 24.8-37.3 | 60-80/ 37.3-50.0 | Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 112 | 8,691 | 8,803 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 1,041 | 3,518 | 9,625 | 14,184 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3,792 | 14,650 | 46,784 | 65,226 |
| ENE | 52 | 0 | 0 | 0 | 0 | 1,131 | 6,756 | 1,204 | 10,365 | 19,508 |
| E | 0 | 285 | 266 | 239 | 137 | 3,586 | 8,318 | 1,180 | 5,437 | 19,448 |
| ESE | 31 | 137 | 141 | 349 | 538 | 4,377 | 7,654 | 8,247 | 41,599 | 63,073 |
| SE | 0 | 291 | 212 | 98 | 299 | 3,603 | 16,317 | 20,814 | 62,140 | 103,774 |
| SSE | 0 | 268 | 312 | 555 | 266 | 3,642 | 39,521 | 441,045 | 98,421 | 584,030 |
| S | 0 | 179 | 382 | 517 | 326 | 4,655 | 58,091 | 108,249 | 35,914 | 208,313 |
| SSW | 25 | 185 | 657 | 862 | 727 | 7,483 | 11,309 | 15,075 | 70,665 | 106,988 |
| SW | 46 | 305 | 881 | 792 | 10,480 | 39,711 | 11,059 | 14,156 | 53,264 | 130,694 |
| WSW | 0 | 83 | 52 | 6 | 0 | 3,080 | 428 | 6,528 | 36,386 | 46,563 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 671 | 671 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 275 | 7,120 | 7,395 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,223 | 2,223 |
| Total | 154 | 1,733 | 2,903 | 3,418 | 12,773 | 71,268 | 164,286 | 635,053 | 489,305 | 1,380,893 |

TABLE 2.1-17

2030 POPULATION DISTRIBUTION (80 KM/50 MI)

| | Distance (km/mi) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-2/ 0-1.2 | 2-4/ 1.2-2.5 | 4-6/ 2.5-3.7 | 6-8/ 3.7-5.0 | 8-10/ 5.0-6.2 | 10-20/ 6.2-12.4 | 20-40/ 12.4-24.8 | 40-60/ 24.8-37.3 | 60-80/ 37.3-50.0 | Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 113 | 9,009 | 9,122 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 1,048 | 3,542 | 9,690 | 14,280 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 3,898 | 14,750 | 47,105 | 65,753 |
| ENE | 60 | 0 | 0 | 0 | 0 | 1,306 | 7,699 | 1,268 | 10,723 | 21,056 |
| E | 0 | 329 | 307 | 276 | 158 | 4,140 | 9,601 | 1,339 | 5,640 | 21,790 |
| ESE | 36 | 158 | 163 | 403 | 621 | 5,053 | 8,836 | 9,191 | 45,913 | 70,374 |
| SE | 0 | 336 | 245 | 144 | 345 | 4,158 | 18,832 | 24,063 | 71,167 | 119,290 |
| SSE | 0 | 309 | 360 | 640 | 307 | 4,203 | 46,018 | 517,144 | 115,209 | 684,190 |
| S | 0 | 206 | 441 | 597 | 377 | 5,374 | 67,366 | 126,839 | 41,340 | 242,540 |
| SSW | 29 | 213 | 758 | 995 | 839 | 8,637 | 12,754 | 15,847 | 73,762 | 113,834 |
| SW | 53 | 353 | 1,017 | 914 | 12,096 | 45,836 | 12,291 | 15,890 | 59,674 | 148,124 |
| WSW | 0 | 96 | 60 | 7 | 0 | 3,554 | 477 | 7,339 | 40,904 | 52,437 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 626 | 626 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 257 | 6,576 | 6,833 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,757 | 1,757 |
| Total | 178 | 2,000 | 3,351 | 3,976 | 14,743 | 82,261 | 188,820 | 737,582 | 539,095 | 1,572,006 |

TABLE 2.1-19

POPULATION DENSITY BY SECTOR, 1985

(people/sq km)

| Direction | Distance (km/mi) 10-20/ (6.2-12.4) | 20-40/ (12.4-24.8) | 40-60/ (24.8-37.3) | 60-80/ (37.3-50) |
|---|---|---|---|---|
| N | 0 | 0 | 16 | 19 |
| NNE | 0 | 14 | 26 | 20 |
| NE | 0 | 18 | 36 | 80 |
| ENE | 43 | 20 | 3 | 15 |
| E | 45 | 21 | 2 | 9 |
| ESE | 45 | 21 | 20 | 69 |
| SE | 40 | 46 | 40 | 79 |
| SSE | 42 | 145 | 731 | 121 |
| S | 53 | 152 | 181 | 51 |
| SSW | 83 | 37 | 35 | 109 |
| SW | 361 | 38 | 26 | 64 |
| WSW | 205 | 43 | 40 | 68 |
| W | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 22 |
| NW | 0 | 0 | 22 | 21 |
| NNW | 0 | 0 | 0 | 13 |

TABLE 2.1-20

POPULATION DENSITY BY SECTOR, 2030

(people/sq km)

| Direction | Distance (km) | | | |
|---|---|---|---|---|
| | 10-20 | 20-40 | 40-60 | 60-80 |
| N | 0 | 0 | 16 | 23 |
| NNE | 0 | 15 | 25 | 19 |
| NE | 0 | 20 | 38 | 86 |
| ENE | 87 | 33 | 3 | 20 |
| E | 92 | 41 | 3 | 10 |
| ESE | 86 | 38 | 23 | 84 |
| SE | 71 | 80 | 61 | 129 |
| SSE | 71 | 195 | 1,317 | 210 |
| S | 91 | 286 | 323 | 75 |
| SSW | 145 | 54 | 40 | 134 |
| SW | 778 | 53 | 41 | 109 |
| WSW | 411 | 62 | 65 | 106 |
| W | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 20 |
| NW | 0 | 0 | 20 | 19 |
| NNW | 0 | 0 | 0 | 8 |

TABLE 2.1-21

CUMULATIVE POPULATION DENSITY BY SECTOR, 1985

(people/sq km)

| Direction | Distance (km) | | | |
|---|---|---|---|---|
| | 0-20 | 0-40 | 0-60 | 0-80 |
| N | 0 | 0 | 16 | 13 |
| NNE | 0 | 14 | 22 | 21 |
| NE | 0 | 18 | 30 | 54 |
| ENE | 43 | 21 | 10 | 12 |
| E | 51 | 26 | 12 | 11 |
| ESE | 41 | 26 | 22 | 43 |
| SE | 36 | 43 | 41 | 58 |
| SSE | 40 | 119 | 459 | 311 |
| S | 48 | 126 | 157 | 110 |
| SSW | 77 | 47 | 40 | 70 |
| SW | 348 | 116 | 66 | 65 |
| WSW | 145 | 107 | 50 | 64 |
| W | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 22 |
| NW | 0 | 0 | 22 | 21 |
| NNW | 0 | 0 | 0 | 13 |
| Average | 93 | 62 | 92 | 73 |

TABLE 2.1-22

CUMULATIVE POPULATION DENSITY BY SECTOR, 2030

(people/sq km)

| Direction | Distance (km) 0-20 | 0-40 | 0-60 | 0-80 |
|---|---|---|---|---|
| N | 0 | 0 | 16 | 16 |
| NNE | 0 | 15 | 22 | 20 |
| NE | 0 | 20 | 32 | 58 |
| ENE | 88 | 36 | 16 | 18 |
| E | 106 | 52 | 24 | 18 |
| ESE | 82 | 49 | 35 | 56 |
| SE | 67 | 77 | 68 | 95 |
| SSE | 74 | 165 | 805 | 545 |
| S | 89 | 237 | 285 | 193 |
| SSW | 146 | 77 | 57 | 91 |
| SW | 768 | 234 | 126 | 118 |
| WSW | 294 | 206 | 87 | 101 |
| W | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 20 |
| NW | 0 | 0 | 20 | 19 |
| NNW | 0 | 0 | 0 | 8 |
| Average | 194 | 109 | 159 | 117 |

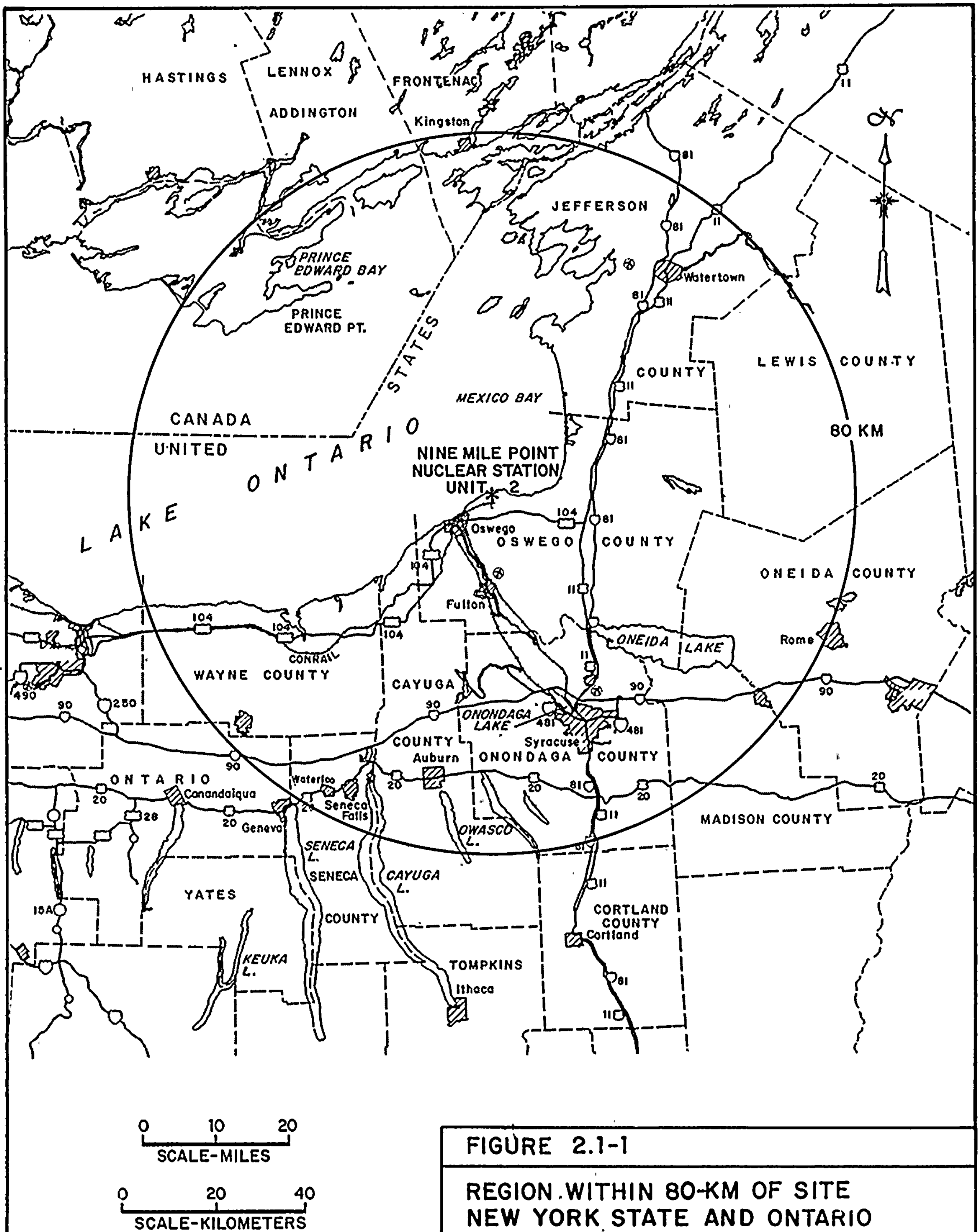



FIGURE 2.1-1

REGION WITHIN 80-KM OF SITE
NEW YORK STATE AND ONTARIO
PROVINCE CENSUS DISTRICTS

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT

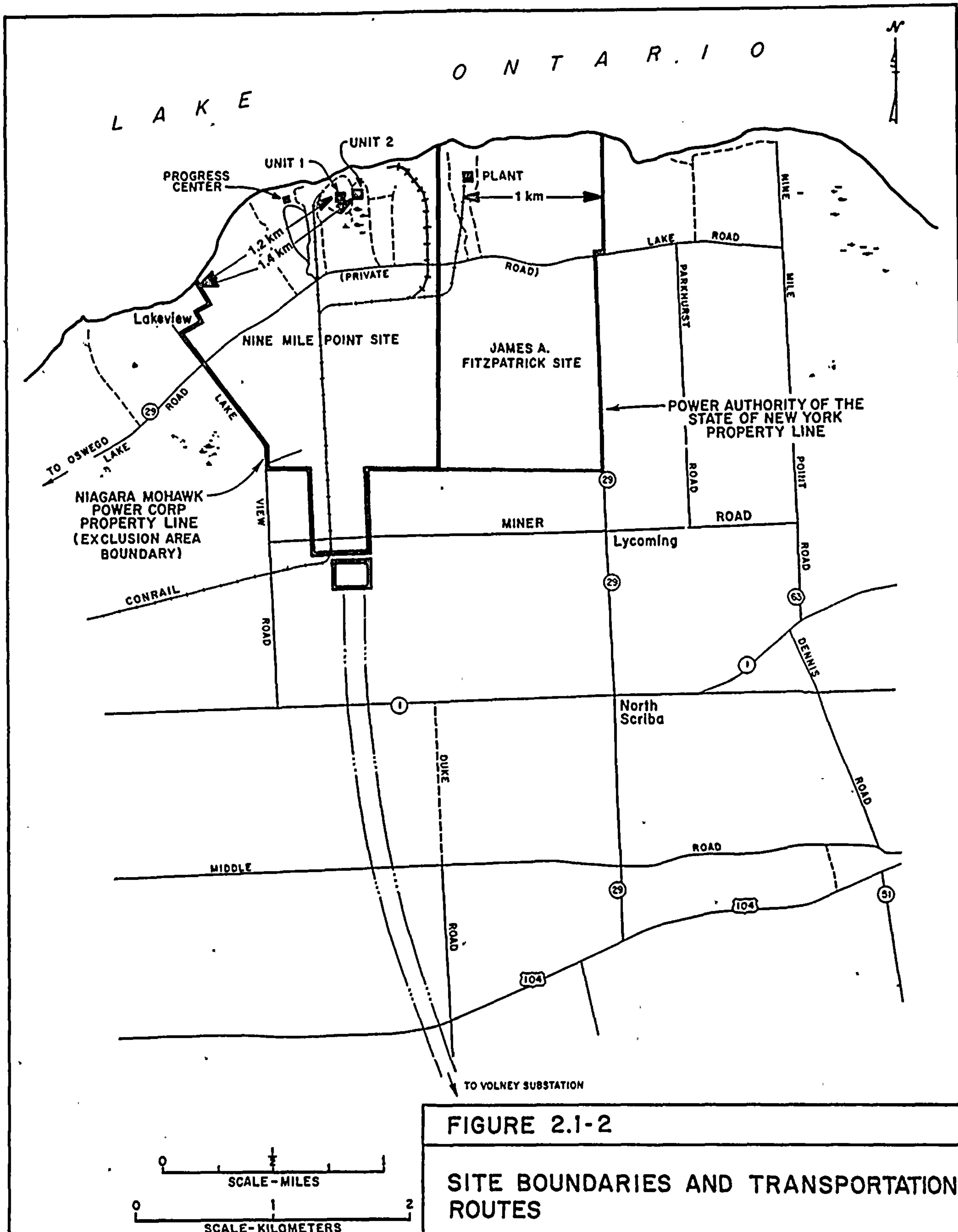



FIGURE 2.1-2

SITE BOUNDARIES AND TRANSPORTATION ROUTES

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT

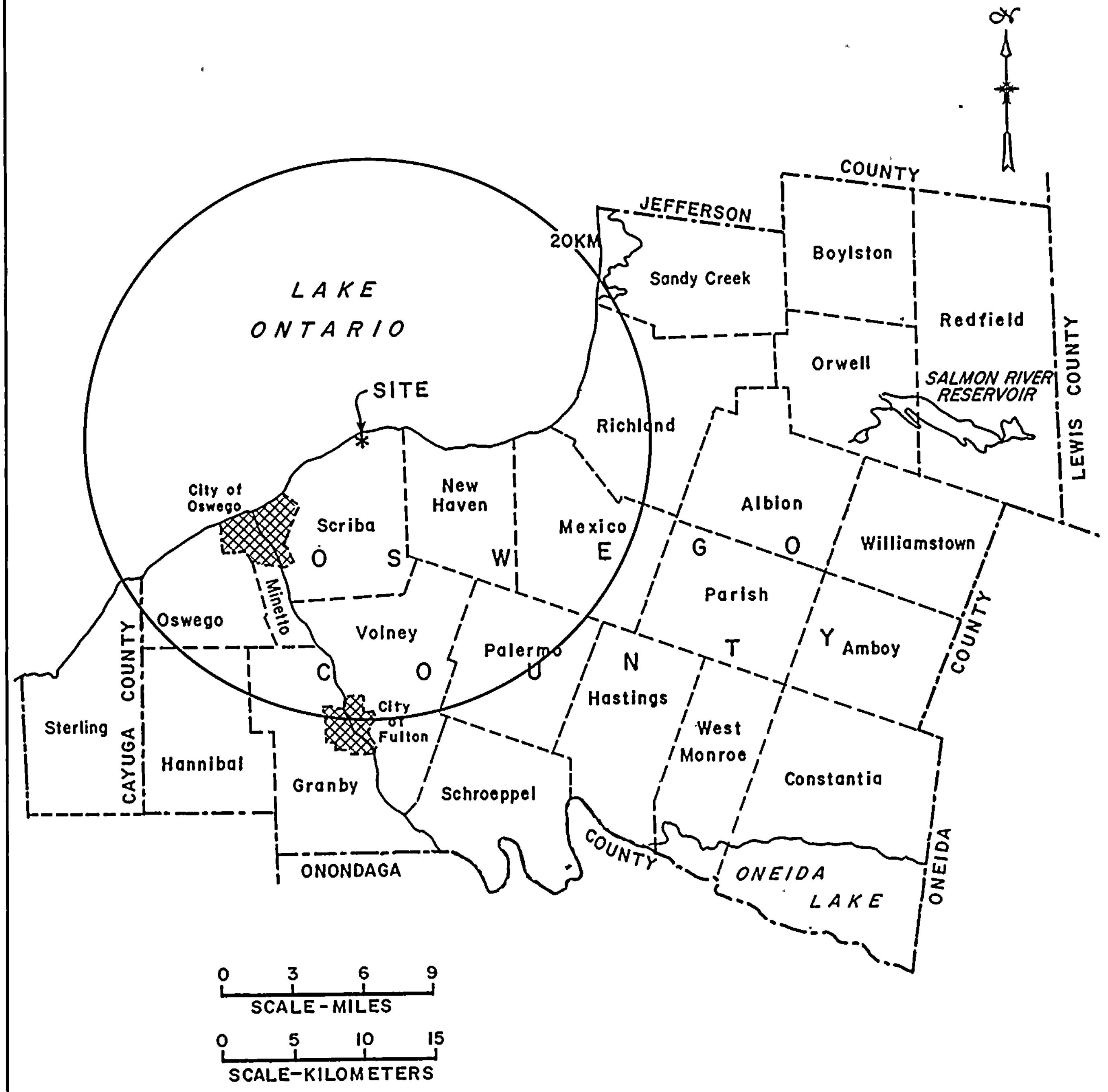



FIGURE 2.1-4

COUNTIES AND TOWNS WITHIN 20-KM OF SITE

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT

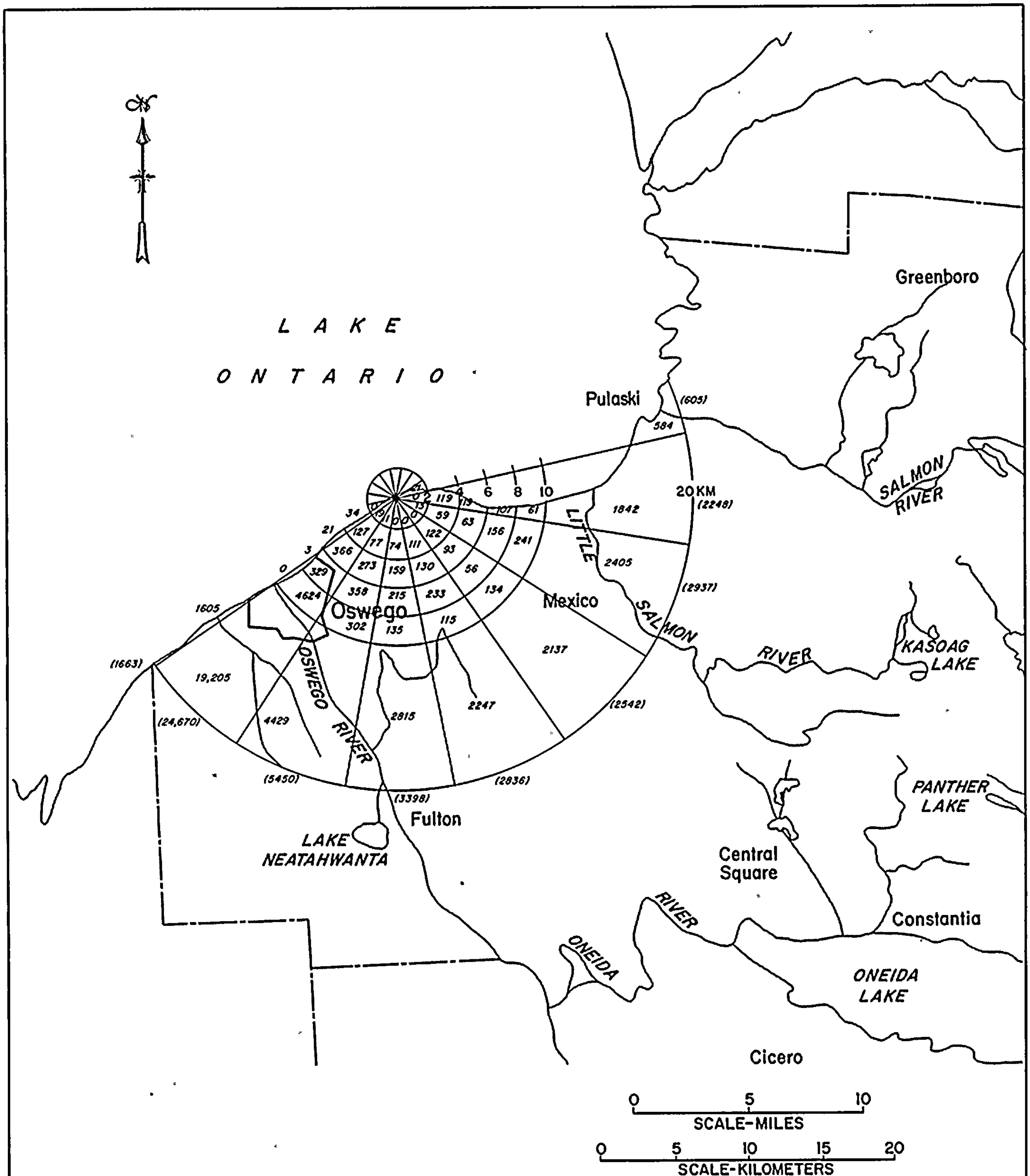



FIGURE 2.1-5

1980

POPULATION DISTRIBUTION - 20 KM

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT- UNIT 2
FINAL SAFETY ANALYSIS REPORT

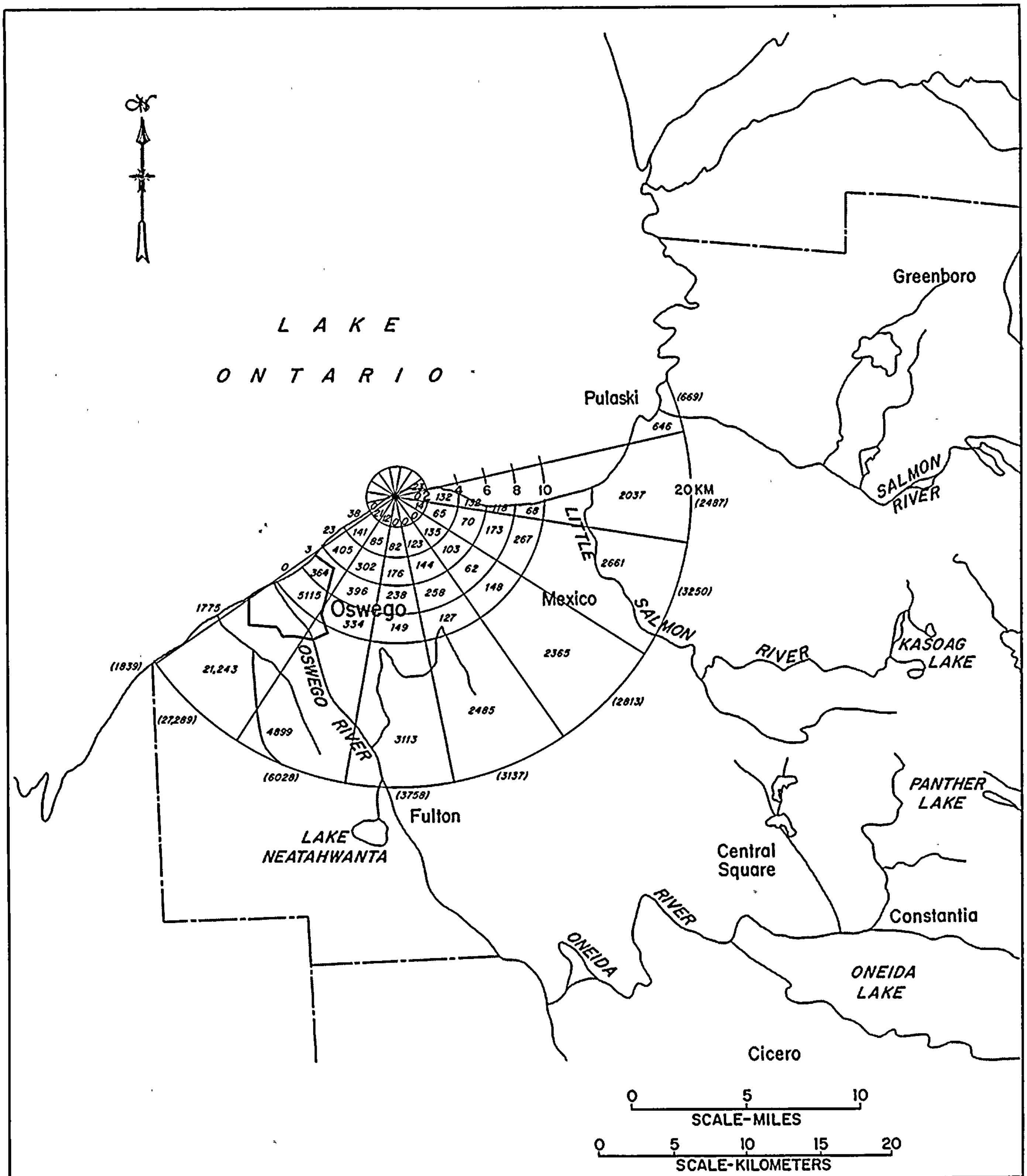



FIGURE 2.1-6

1985

POPULATION DISTRIBUTION - 20 KM

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT - UNIT 2

FINAL SAFETY ANALYSIS REPORT

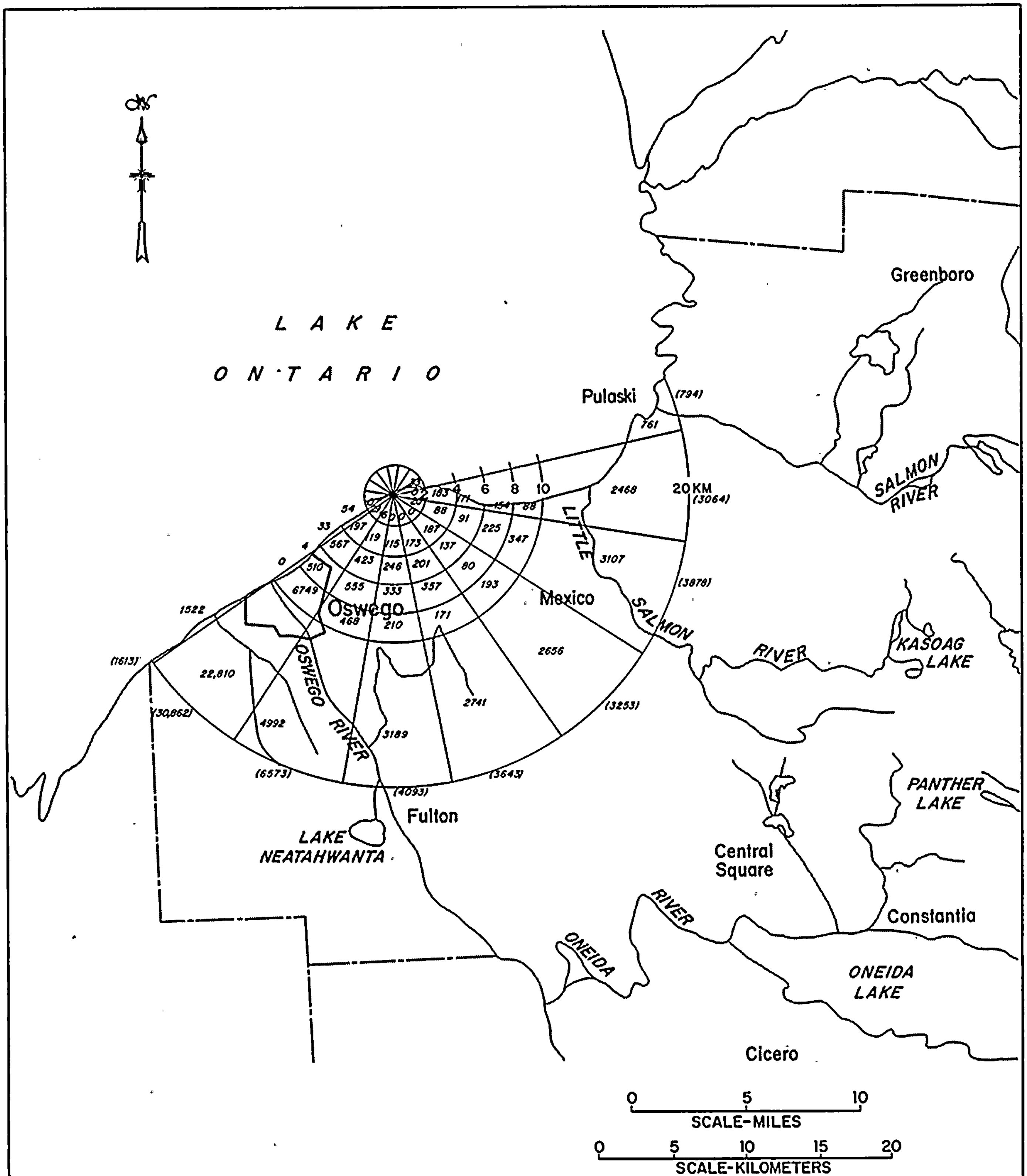



FIGURE 2.1-7

1990

POPULATION DISTRIBUTION - 20 KM

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT - UNIT 2

FINAL SAFETY ANALYSIS REPORT

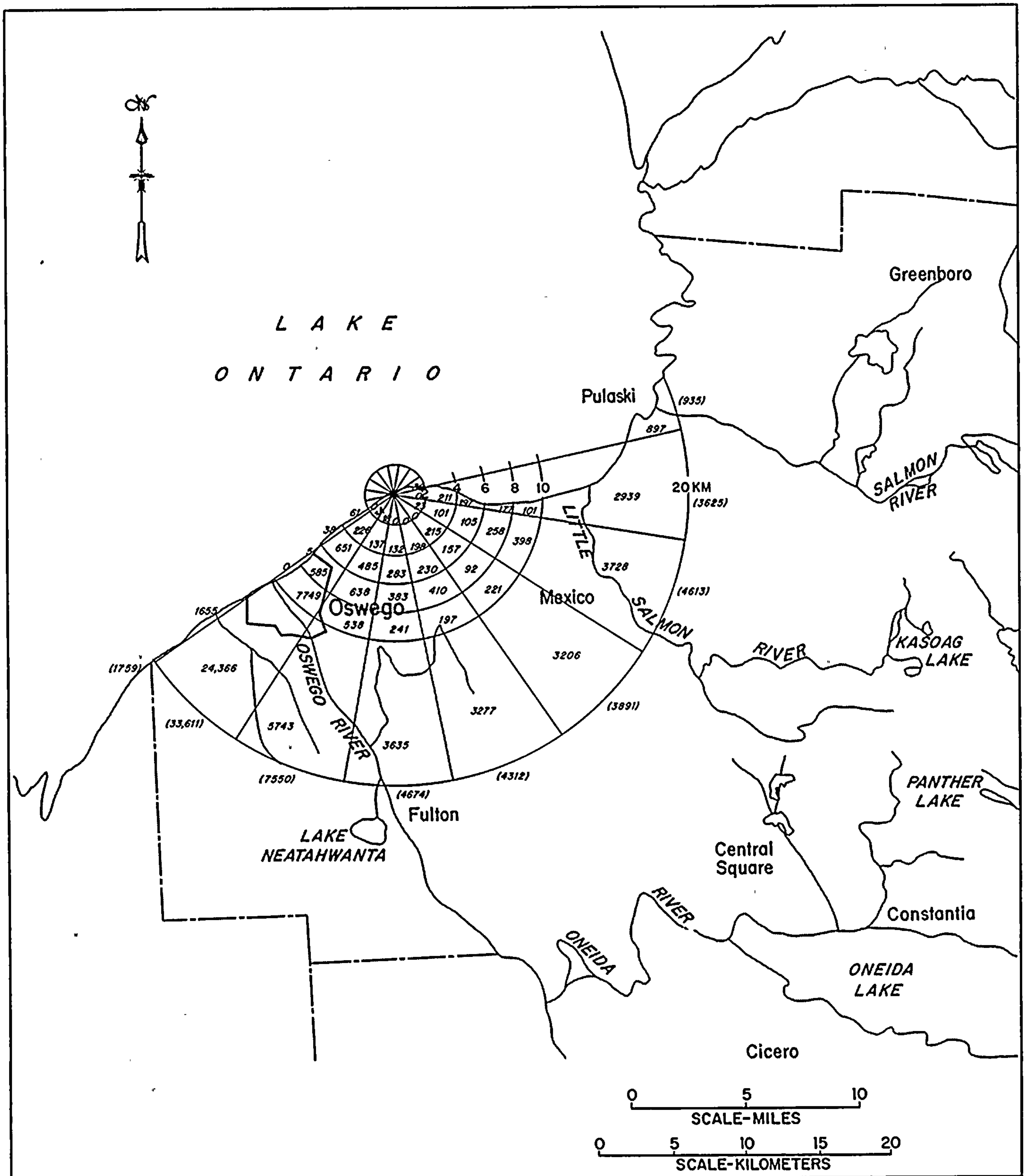



FIGURE 2.1-8

2000

POPULATION DISTRIBUTION – 20 KM

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT – UNIT 2

FINAL SAFETY ANALYSIS REPORT

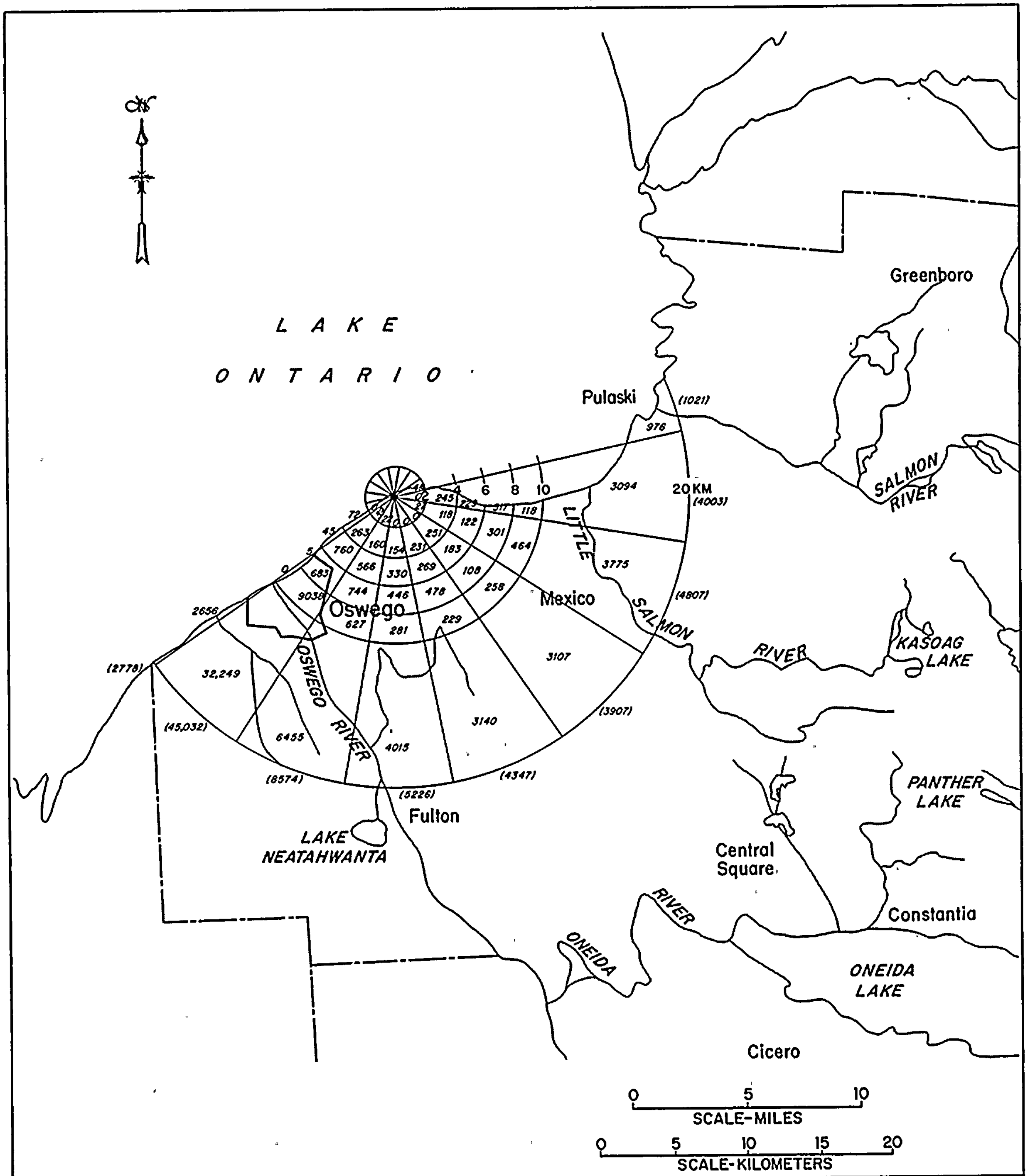



FIGURE 2.1-9

2010

POPULATION DISTRIBUTION - 20 KM

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT- UNIT 2

FINAL SAFETY ANALYSIS REPORT

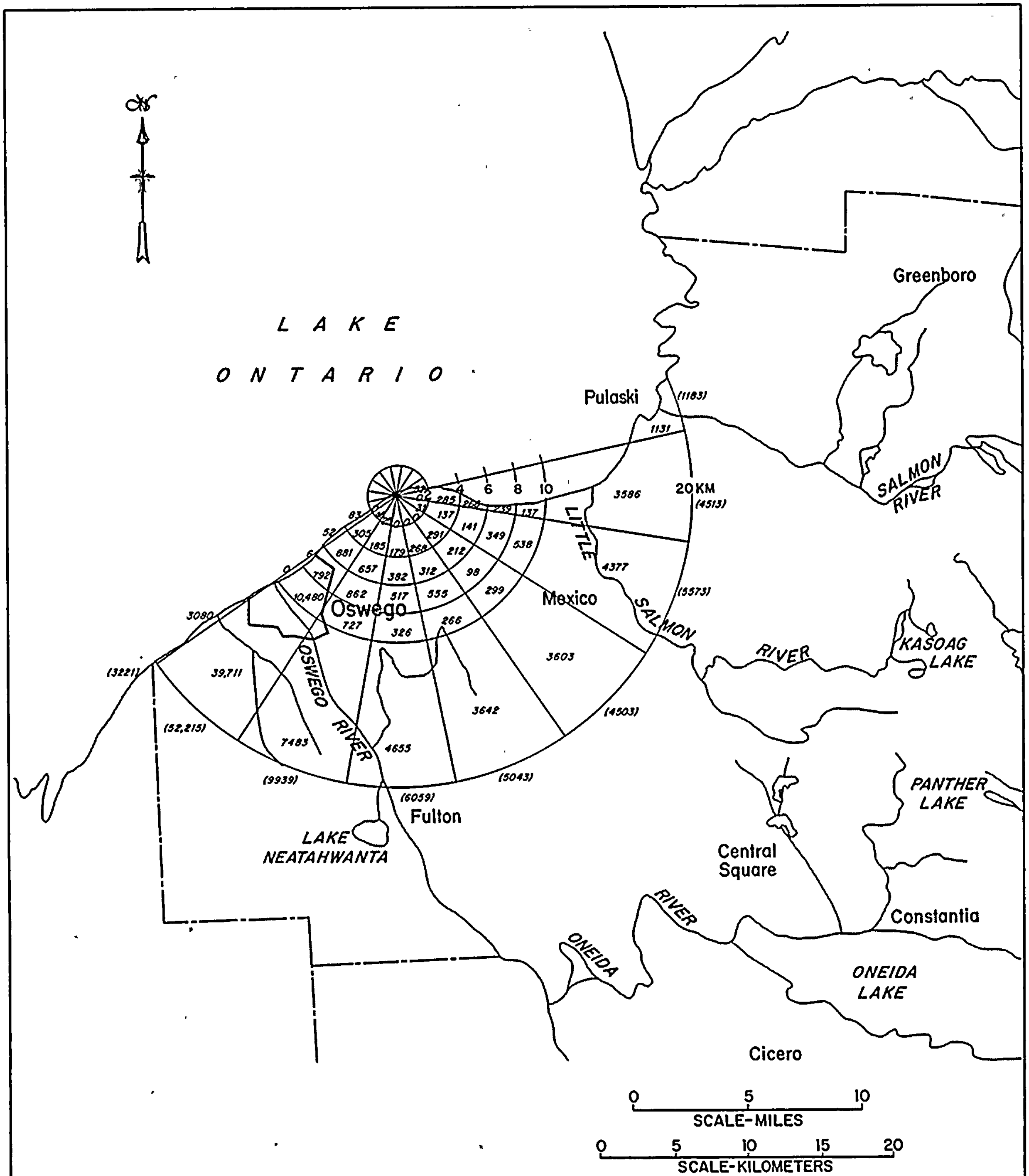



FIGURE 2.1-10

2020

POPULATION DISTRIBUTION - 20 KM

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT - UNIT 2

FINAL SAFETY ANALYSIS REPORT

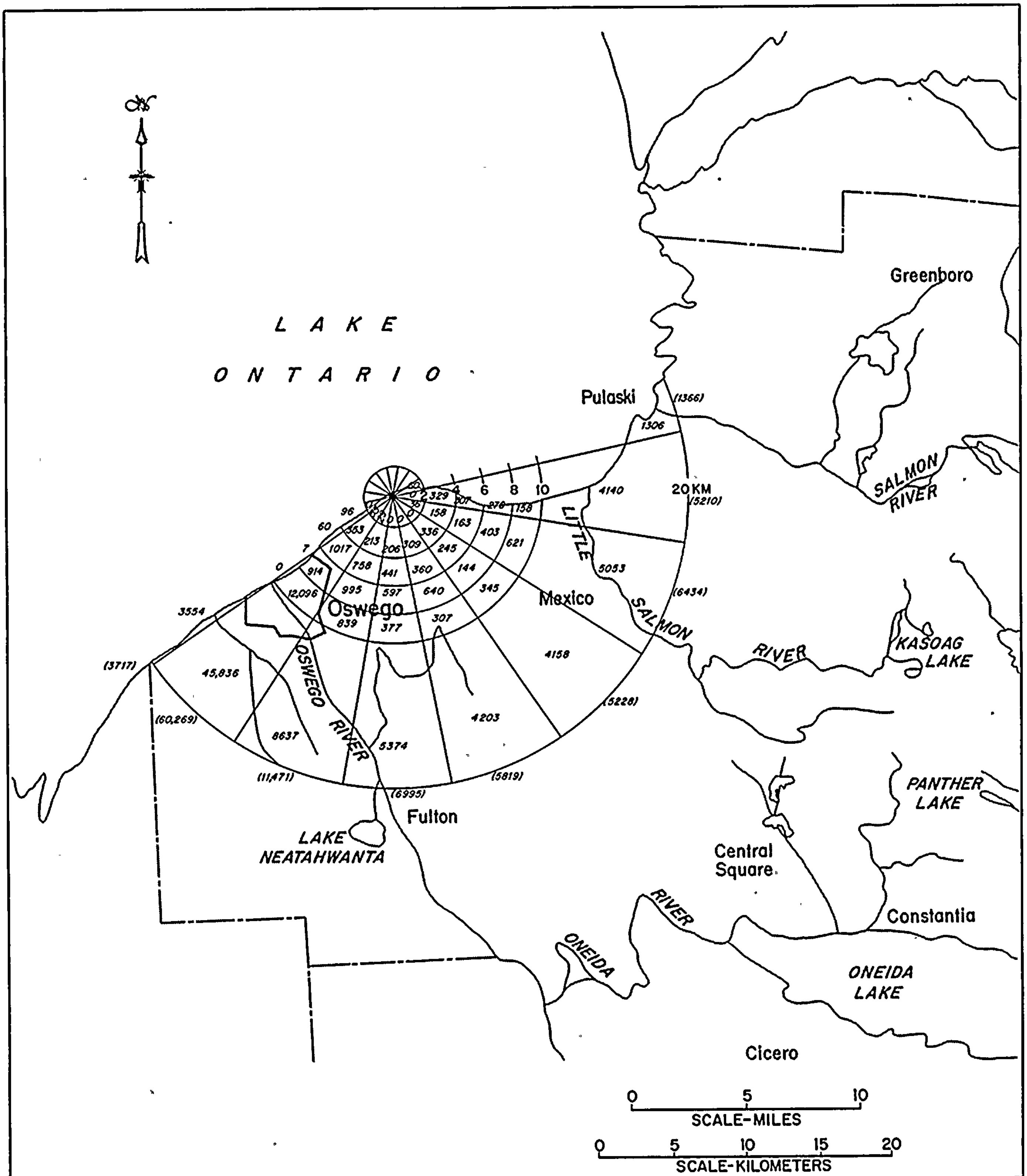



FIGURE 2.1-11

2030

POPULATION DISTRIBUTION - 20 KM

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT - UNIT 2

FINAL SAFETY ANALYSIS REPORT

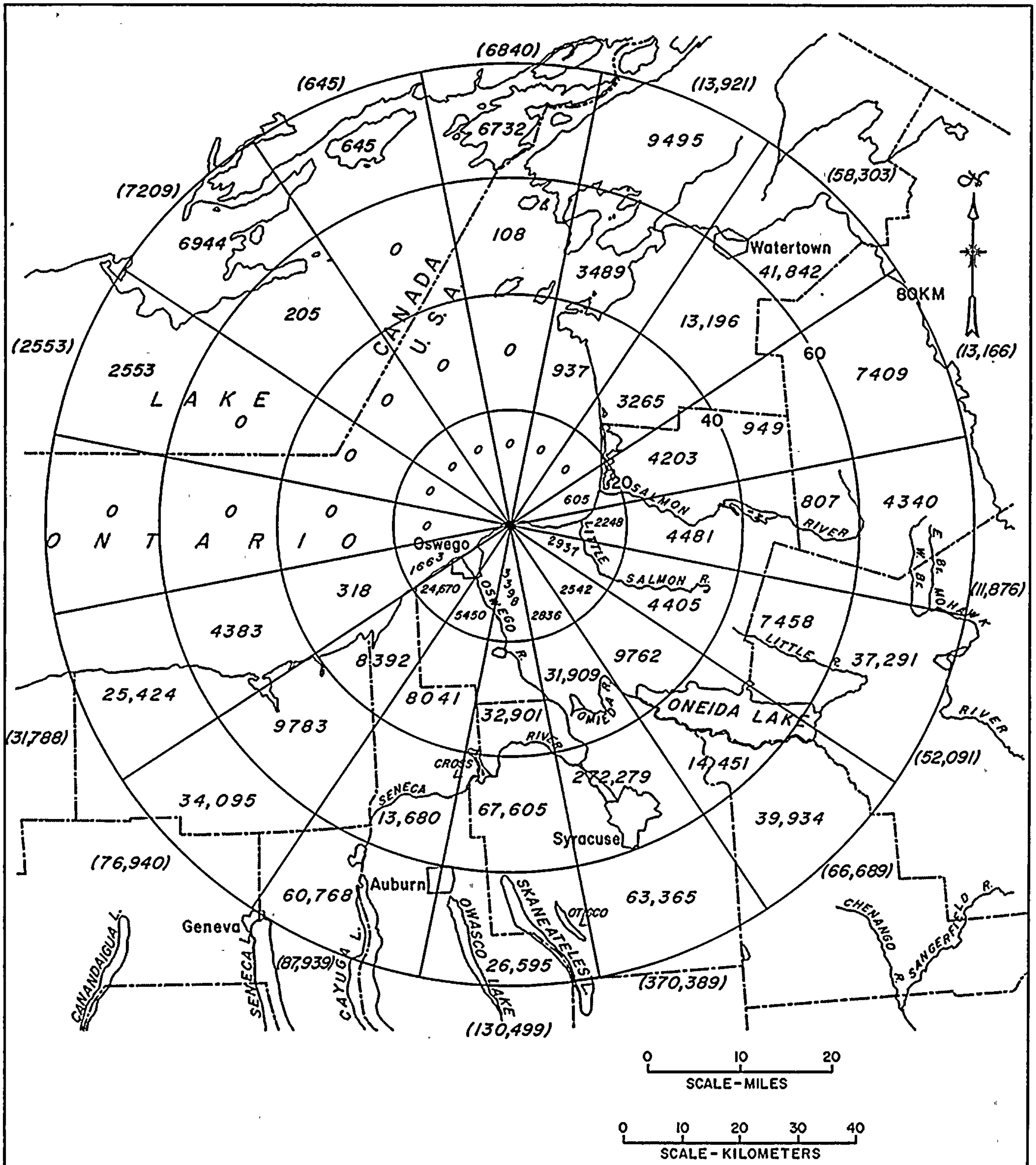



FIGURE 2.1-12

1980
POPULATION DISTRIBUTION - 80 KM

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT - UNIT 2
FINAL SAFETY ANALYSIS REPORT

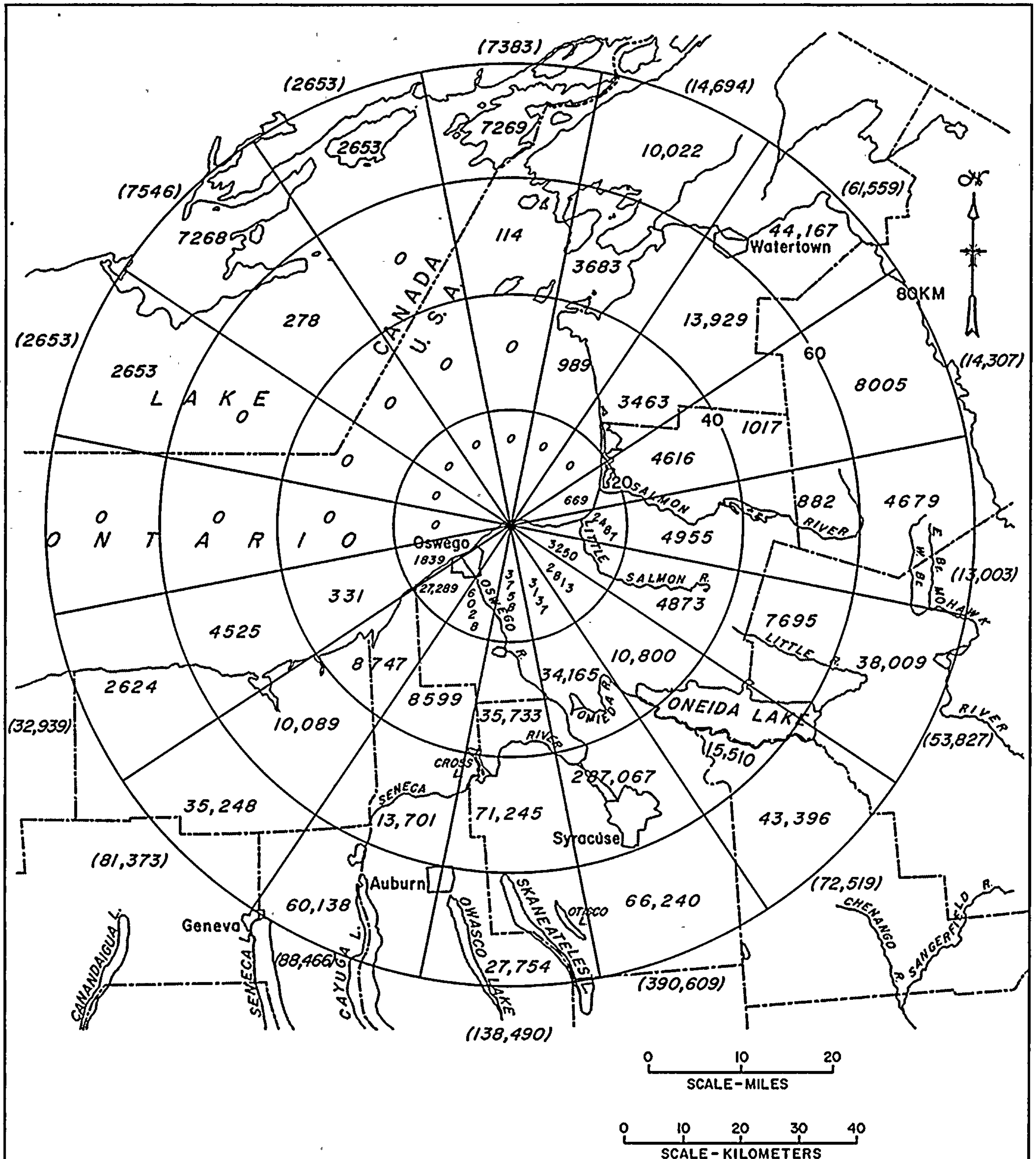



FIGURE 2.1-13

1985
POPULATION DISTRIBUTION - 80 KM

NIAGARA MOHAWK POWER CORPORATION
**NINE MILE POINT - UNIT 2**
FINAL SAFETY ANALYSIS REPORT

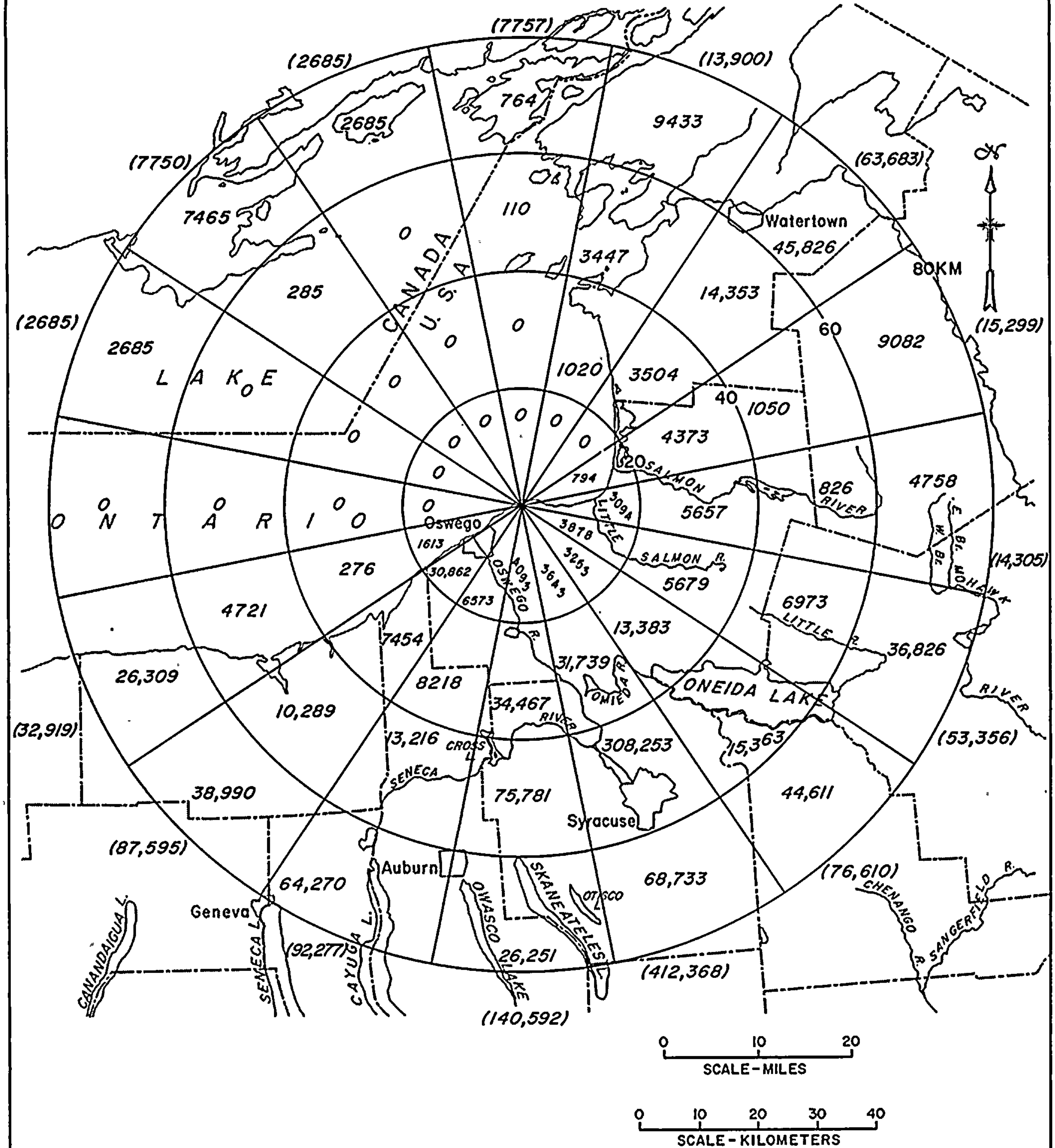



FIGURE 2.1-14

1990
POPULATION DISTRIBUTION - 80 KM

NIAGARA MOHAWK POWER CORPORATION

**NINE MILE POINT- UNIT 2**

FINAL SAFETY ANALYSIS REPORT

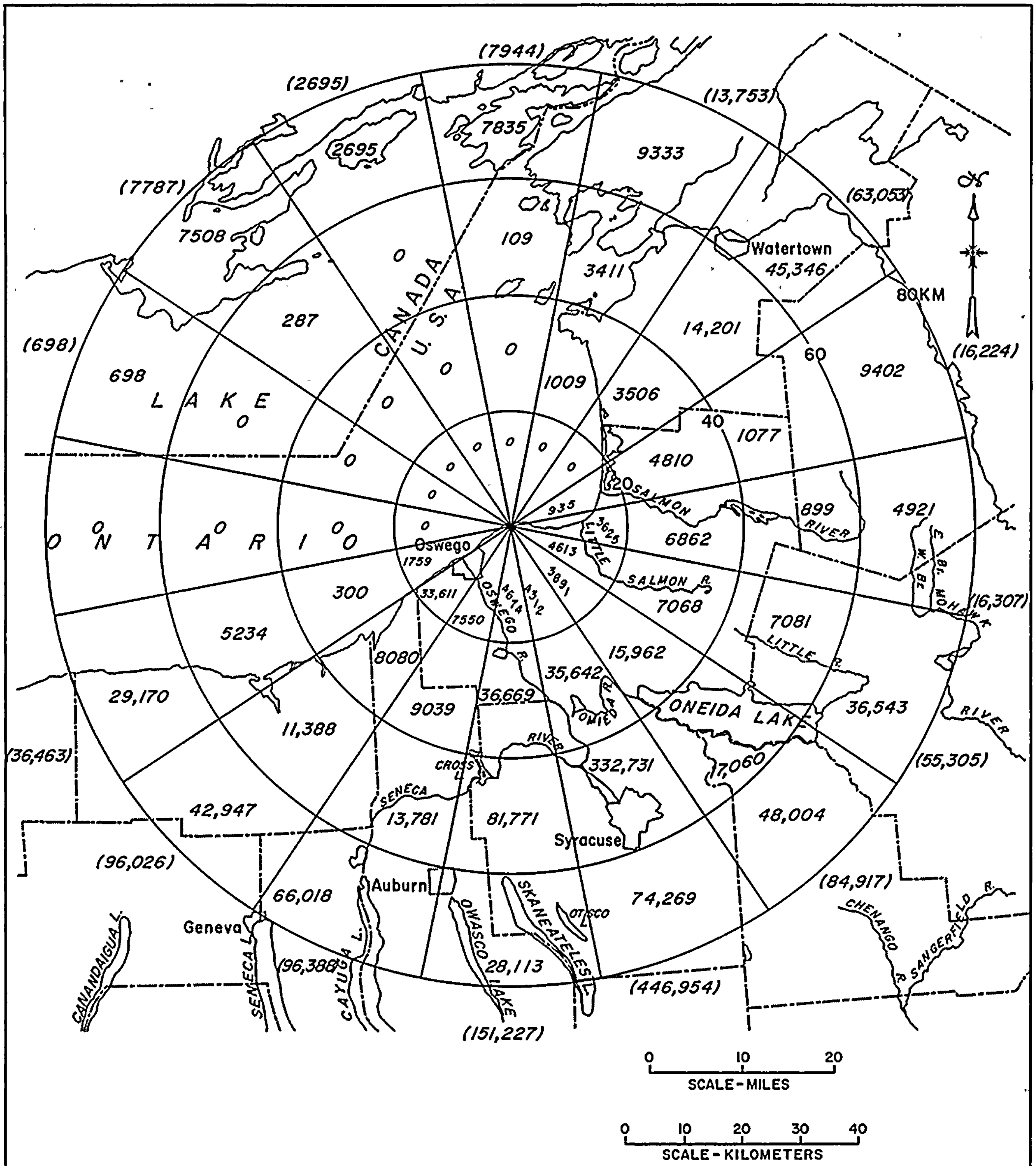



FIGURE 2.1-15

2000
POPULATION DISTRIBUTION - 80 KM

NIAGARA MOHAWK POWER CORPORATION
**NINE MILE POINT - UNIT 2**
FINAL SAFETY ANALYSIS REPORT

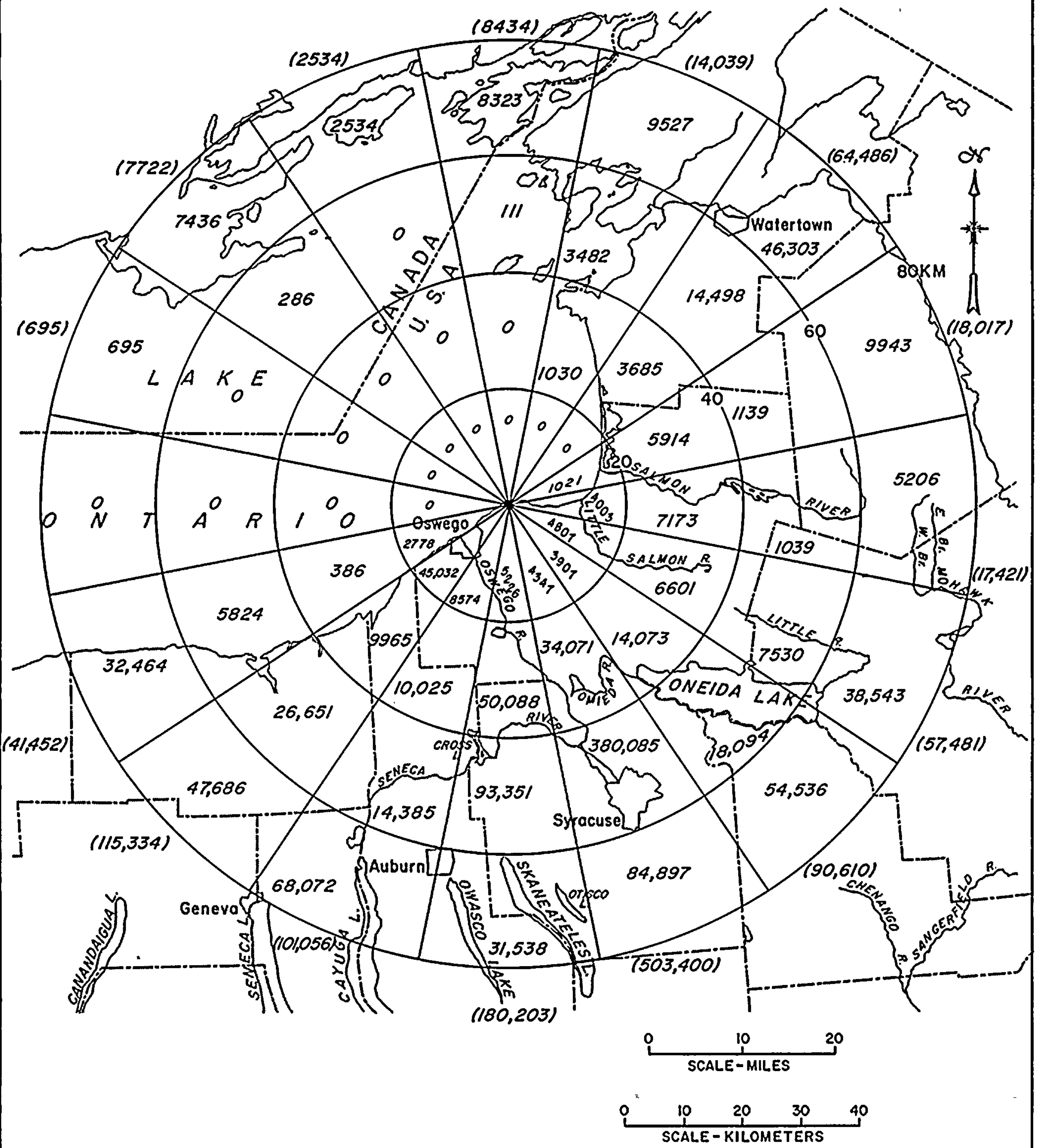



FIGURE 2.1-16

2010
POPULATION DISTRIBUTION - 80 KM

NIAGARA MOHAWK POWER CORPORATION
**NINE MILE POINT - UNIT 2**
FINAL SAFETY ANALYSIS REPORT

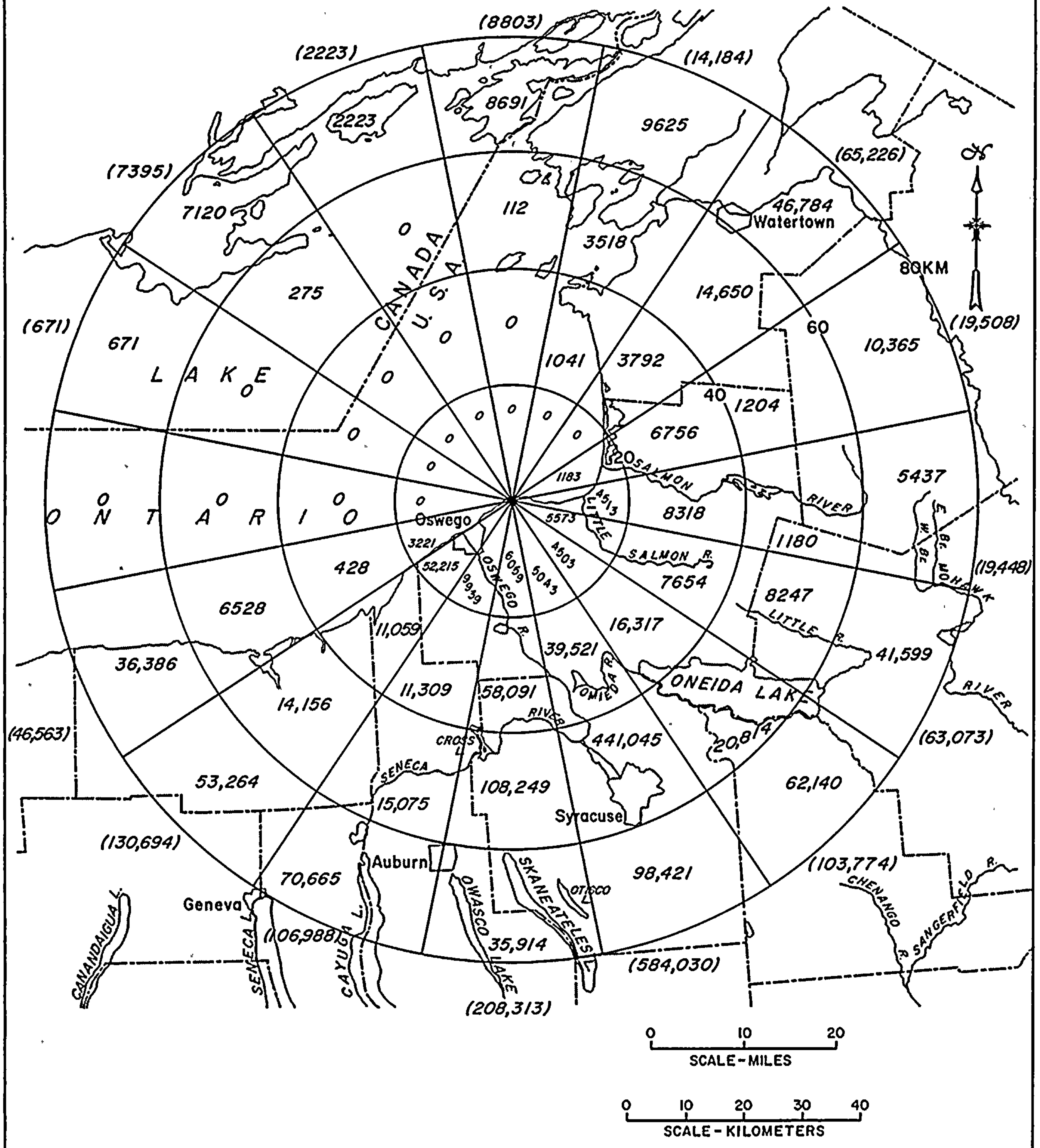



FIGURE 2.1-17

2020
POPULATION DISTRIBUTION - 80 KM

NIAGARA MOHAWK POWER CORPORATION
**NINE MILE POINT- UNIT 2**
FINAL SAFETY ANALYSIS REPORT

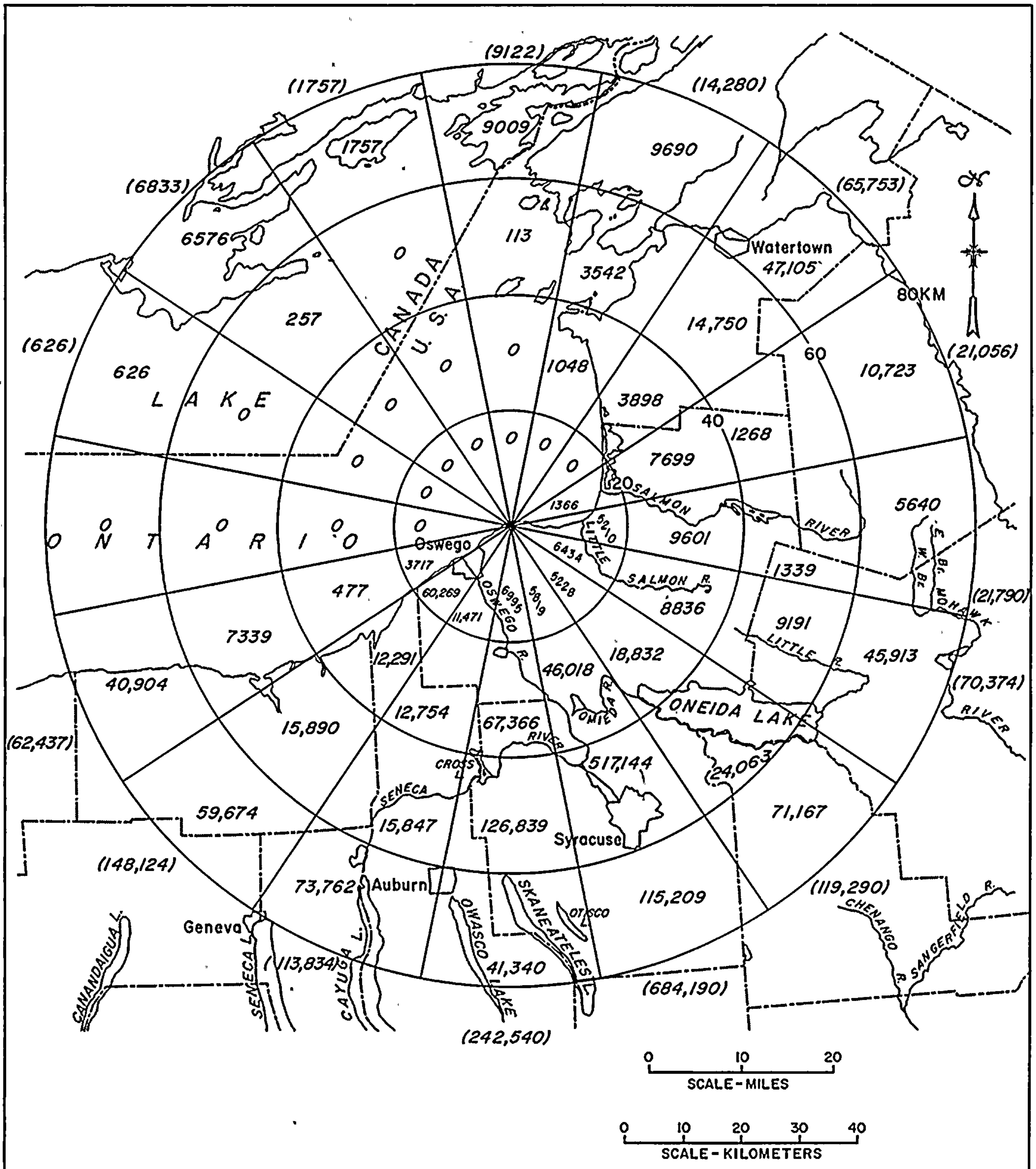



FIGURE 2.1-18

2030
POPULATION DISTRIBUTION - 80 KM

NIAGARA MOHAWK POWER CORPORATION
**NINE MILE POINT- UNIT 2**
FINAL SAFETY ANALYSIS REPORT

## TABLE 2.3-5A

## OPERATIONAL METEOROLOGICAL INSTRUMENTATION SYSTEM ACCURACIES

| Parameter | Component | Component Error | Analog System Accuracy | Digital System Accuracy | |
|---|---|---|---|---|---|
| Wind direction | Sensor | ±0.70 deg | ±1.20 deg | ±0.79 deg | |
| | Translator | ±0.36 deg | | | |
| | Recorder | ±0.90 deg | | | |
| | Data acquisition | ±0.044 deg | | | 5 |
| Wind speed | Sensor | ±0.09 m/sec (±0.20 mph) | ±0.26 m/sec (±0.59 mph) | ±0.14 m/sec (±0.32 mph) | |
| | Translator | ±0.11 m/sec (±0.25 mph) | | | |
| | Recorder | ±0.22 m/sec (±0.50 mph) | | | |
| | Data acquisition | ±0.005 m/sec (±0.012 mph) | | | |
| Ambient temperature | Sensor | ±0.17°C (±0.30°F) | ±0.27°C (±0.48°F) | ±0.17°C (±0.31°F) | |
| | Translator | ±0.05°C (±0.09°F) | | | |
| | Recorder | ±0.20°C (±0.36°F) | | | |
| | Data acquisition | ±0.010°C (±0.018°F) | | | |
| Temperature difference | Sensor | ±0.17°C (±0.30°F) | ±0.20°C (±0.036°F) | ±0.19°C (±0.35°F) | |
| | Translator | ±0.10°C (±0.18°F) | | | |

TABLE 2.5-43

FOUNDATION DESIGN PARAMETERS FOR MAJOR CATEGORY I STRUCTURES

| Category I Structure | Bearing Pressures[1] Actual Maximum | Bearing Pressures[1] Maximum Allowable | Description of Foundation Material (Section 2.5.1.2.2) | Estimated Displacement[2] Due To Rock Squeeze (inches) | Estimated Displacement[2] Due To Rock Swell (inches) | Estimated Settlement Total (inches) | Estimated Settlement Differential (inches) |
|---|---|---|---|---|---|---|---|
| Control Building | 12.85 kip/sq.ft. | 20 kip/sq.ft. for el 242'-0" 40 kip/sq.ft. for el 209'-6" | Pulaski Formation-Sandstone interbedded with shale and siltstone | 1.0 | 0.018 | 0 | 0 |
| Diesel Generator Building | 19.10 kip/sq.ft. | 20 kip/sq.ft. | Oswego Formation - Sandstone | 1.0 | 0.0014 | 0 | 0 |
| Electrical Tunnels | 14.00 kip/sq.ft. | 40 kip/sq.ft. | Oswego Formation - Sandstone | 1.0 | 0.035 | 0 | 0 |
| Main Stack | 9.80 kip/sq.ft. | 20 kip/sq.ft. | Oswego Formation (Transition Zone) - Alternating sandstone, siltstone, and shale | 1.0 | - | 0 | 0 |
| Reactor Building | 12.54 kip/sq.ft. | 40 kip/sq.ft. | Pulaski Formation - Sandstone interbedded with shale and siltstone | 2.0 | - | 0 | 0 |
| Screenwell Building | 12.27 kip/sq.ft. | 40 kip/sq.ft. | Oswego Formation (Transition Zone) - Alternating sandstone, siltstone, and shale | 1.0 | 0.009 | 0 | 0 |
| Standby Gas Treatment Building | 10.24 kip/sq.ft. | 20 kip/sq.ft. | Oswego Formation - Sandstone | 1.0 | 0.05 | 0 | 0 |
| Electrical Ductline 907 Manhole No. 1 CL-IE Portion of electrical ductline 922 | | 40 kip/sq.ft. | Category I structural fill | NA | NA | 0.15 | 0 |

(1)Bearing pressures listed represent most critical static or dynamic loading conditions.
(2)Estimated displacement along the fault plane is discussed in Section 2.5.4.11. No Category I structures are founded on a fault plane.

# APPENDIX 2L

## LIST OF TABLES


| Table Number | Title |
|---|---|
| 2L-1 | POPULATION DISTRIBUTION FOR 1980 0- TO 10-MILE RADIUS |
| 2L-2 | POPULATION DISTRIBUTION FOR 1986 0- TO 10-MILE RADIUS |
| 2L-3 | POPULATION DISTRIBUTION FOR 1990 0- TO 10-MILE RADIUS |
| 2L-4 | POPULATION DISTRIBUTION FOR 2000 0- TO 10-MILE RADIUS |
| 2L-5 | POPULATION DISTRIBUTION FOR 2010 0- TO 10-MILE RADIUS |
| 2L-6 | POPULATION DISTRIBUTION FOR 2020 0- TO 10-MILE RADIUS |
| 2L-7 | POPULATION DISTRIBUTION FOR 2030 0- TO 10-MILE RADIUS |
| 2L-8 | POPULATION DISTRIBUTION FOR 1980 0- TO 50-MILE RADIUS |
| 2L-9 | POPULATION DISTRIBUTION FOR 1986 0- TO 50-MILE RADIUS |
| 2L-10 | POPULATION DISTRIBUTION FOR 1990 0- TO 50-MILE RADIUS |
| 2L-11 | POPULATION DISTRIBUTION FOR 2000 0- TO 50-MILE RADIUS |
| 2L-12 | POPULATION DISTRIBUTION FOR 2010 0- TO 50-MILE RADIUS |
| 2L-13 | POPULATION DISTRIBUTION FOR 2020 0- TO 50-MILE RADIUS |
| 2L-14 | POPULATION DISTRIBUTION FOR 2030 0- TO 50-MILE RADIUS |

APPENDIX 2L

LIST OF TABLES (Cont)


| Table Number | Title |
|---|---|
| 2L-15 | POPULATION DENSITY FOR 1980 0- TO 10-MILE RADIUS |
| 2L-16 | POPULATION DENSITY FOR 1986 0- TO 10-MILE RADIUS |
| 2L-17 | POPULATION DENSITY FOR 1990 0- TO 10-MILE RADIUS |
| 2L-18 | POPULATION DENSITY FOR 2000 0- TO 10-MILE RADIUS |
| 2L-19 | POPULATION DENSITY FOR 2010 0- TO 10-MILE RADIUS |
| 2L-20 | POPULATION DENSITY FOR 2020 0- TO 10-MILE RADIUS |
| 2L-21 | POPULATION DENSITY FOR 2030 0- TO 10-MILE RADIUS |
| 2L-22 | POPULATION DENSITY FOR 1980 10- TO 50-MILE RADIUS |
| 2L-23 | POPULATION DENSITY FOR 1986 10- TO 50-MILE RADIUS |
| 2L-24 | POPULATION DENSITY FOR 1990 10- TO 50-MILE RADIUS |
| 2L-25 | POPULATION DENSITY FOR 2000 10- TO 50-MILE RADIUS |
| 2L-26 | POPULATION DENSITY FOR 2010 10- TO 50-MILE RADIUS |
| 2L-27 | POPULATION DENSITY FOR 2020 10- TO 50-MILE RADIUS |
| 2L-28 | POPULATION DENSITY FOR 2030 10- TO 50-MILE RADIUS |

# APPENDIX 2L

## POPULATION DISTRIBUTION

Population distribution within a 50-mi radius of Nine Mile Point Unit 2 is listed by distance and direction in Tables 2L-1 through 2L-14. Population densities are listed in Tables 2L-15 through 2L-28. Figures 2L-1 and 2L-2 show the 10- and 50-mi areas with sector overlays corresponding to the tables.

Population distribution between 0 and 6 km (3.7 mi) was determined through a door-to-door survey conducted by SWEC May 9 through 13, 1982. Population distribution beyond 6 km (3.7 mi) was calculated using the same methods as those described in Section 2.1.3. Data from the 1980 U.S. Census of Population and the 1981 Canadian Census of Population provided the basis for the estimates.

Differences between total 0-50 mi population and 0-80 km population (Section 2.1.2) are due to rounding differences caused by different subsector definition.

Bibliography

1. Bureau of the Census. 1980 Census of Population, Advance Reports, U.S. Department of Commerce, New York, 1981.

2. Statistics Canada. Interim Population Counts for Census Divisions and Census Subdivisions, 1981, Ottawa, Canada, 1982.

3. Statistics Canada. Population: Geographic Distributions. 1976 Census, Census Divisions and Subdivisions: Ontario, Ottawa, Canada, June 1977.

4. Statistics Canada. Population Projections for Canada and Provinces 1976-2001, June 1980.

5. New York Department of Commerce. 1978 Official Population Projections by Age and Sex for New York State Counties, 1979.

6. Envirodata Corp. Digitized Maps of Area Within 50 Miles of Nine Mile Point, 1982.

TABLE 2L-1

POPULATION DISTRIBUTION FOR 1980
0- TO 10-MILE RADIUS

| Direction | Distance (mi) 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 | Inner Rings Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 3 | 21 | 30 | 13 | 0 | 53 | 136 | 127 | 96 | 0 | 421 | 220 | 1,120 |
| ESE | 0 | 0 | 8 | 24 | 55 | 13 | 74 | 96 | 118 | 123 | 364 | 158 | 193 | 1,618 | 2,844 |
| SE | 0 | 0 | 0 | 45 | 50 | 82 | 65 | 66 | 13 | 44 | 197 | 79 | 131 | 180 | 952 |
| SSE | 0 | 0 | 0 | 25 | 101 | 87 | 17 | 109 | 249 | 110 | 115 | 107 | 191 | 176 | 1,287 |
| S | 0 | 0 | 0 | 7 | 45 | 22 | 81 | 132 | 60 | 56 | 176 | 212 | 229 | 217 | 1,237 |
| SSW | 0 | 0 | 8 | 4 | 36 | 75 | 147 | 146 | 196 | 180 | 436 | 172 | 758 | 1,817 | 3,975 |
| SW | 0 | 0 | 44 | 38 | 32 | 28 | 51 | 126 | 160 | 272 | 2,904 | 8,959 | 7,081 | 1,765 | 21,460 |
| WSW | 0 | 0 | 0 | 16 | 2 | 8 | 0 | 8 | 4 | 0 | 3 | 491 | 5,206 | 954 | 6,692 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 63 | 180 | 351 | 328 | 435 | 736 | 936 | 912 | 4,291 | 10,178 | 14,210 | 6,947 | 39,567 |

TABLE 2L-2

POPULATION DISTRIBUTION FOR 1986
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 | Inner Rings Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 3 | 23 | 33 | 15 | 0 | 58 | 150 | 141 | 107 | 0 | 467 | 244 | 1,241 |
| ESE | 0 | 0 | 9 | 27 | 61 | 14 | 82 | 107 | 131 | 136 | 403 | 175 | 214 | 1,791 | 3,150 |
| SE | 0 | 0 | 0 | 50 | 56 | 89 | 72 | 73 | 15 | 49 | 218 | 87 | 146 | 199 | 1,054 |
| SSE | 0 | 0 | 0 | 27 | 112 | 96 | 18 | 120 | 276 | 122 | 128 | 118 | 211 | 194 | 1,422 |
| S | 0 | 0 | 0 | 8 | 50 | 24 | 90 | 146 | 66 | 62 | 195 | 235 | 254 | 240 | 1,370 |
| SSW | 0 | 0 | 9 | 4 | 40 | 83 | 163 | 162 | 217 | 199 | 483 | 191 | 840 | 2,012 | 4,403 |
| SW | 0 | 0 | 49 | 42 | 35 | 31 | 56 | 140 | 177 | 302 | 3,216 | 9,923 | 7,842 | 1,956 | 23,769 |
| WSW | 0 | 0 | 0 | 18 | 2 | 9 | 0 | 9 | 4 | 0 | 3 | 544 | 5,324 | 1,057 | 6,970 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 70 | 199 | 389 | 361 | 481 | 815 | 1,036 | 1,011 | 4,753 | 11,273 | 15,298 | 7,693 | 43,379 |

TABLE 2L-3

POPULATION DISTRIBUTION FOR 1990
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 | Inner Rings Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 4 | 25 | 36 | 16 | 0 | 63 | 162 | 151 | 115 | 0 | 501 | 261 | 1,334 |
| ESE | 0 | 0 | 10 | 29 | 65 | 15 | 88 | 115 | 141 | 146 | 432 | 188 | 230 | 1,924 | 3,383 |
| SE | 0 | 0 | 0 | 53 | 60 | 97 | 77 | 78 | 16 | 52 | 234 | 94 | 156 | 214 | 1,131 |
| SSE | 0 | 0 | 0 | 29 | 120 | 103 | 20 | 129 | 297 | 131 | 137 | 127 | 228 | 209 | 1,530 |
| S | 0 | 0 | 0 | 8 | 54 | 26 | 96 | 157 | 71 | 67 | 209 | 252 | 273 | 258 | 1,471 |
| SSW | 0 | 0 | 10 | 5 | 43 | 89 | 175 | 173 | 233 | 214 | 519 | 205 | 903 | 2,161 | 4,730 |
| SW | 0 | 0 | 52 | 45 | 38 | 33 | 60 | 150 | 190 | 323 | 3,454 | 10,657 | 8,423 | 2,100 | 25,525 |
| WSW | 0 | 0 | 0 | 19 | 2 | 10 | 0 | 10 | 5 | 0 | 3 | 584 | 5,415 | 1,135 | 7,183 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 76 | 213 | 418 | 389 | 516 | 875 | 1,115 | 1,084 | 5,103 | 12,107 | 16,129 | 8,262 | 46,287 |

TABLE 2L-4

POPULATION DISTRIBUTION FOR 2000
0- TO 10-MILE RADIUS

| Direction | Distance (mi) 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 | Inner Rings Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 4 | 28 | 41 | 18 | 0 | 71 | 184 | 173 | 131 | 0 | 572 | 299 | 1,521 |
| ESE | 0 | 0 | 11 | 33 | 75 | 18 | 101 | 131 | 161 | 167 | 494 | 214 | 262 | 2,197 | 3,864 |
| SE | 0 | 0 | 0 | 61 | 68 | 111 | 87 | 89 | 18 | 59 | 268 | 107 | 178 | 244 | 1,290 |
| SSE | 0 | 0 | 0 | 34 | 137 | 118 | 23 | 148 | 338 | 150 | 157 | 144 | 259 | 239 | 1,747 |
| S | 0 | 0 | 0 | 10 | 62 | 30 | 110 | 179 | 81 | 76 | 239 | 288 | 311 | 294 | 1,680 |
| SSW | 0 | 0 | 11 | 5 | 49 | 101 | 200 | 198 | 266 | 244 | 592 | 234 | 1,031 | 2,468 | 5,399 |
| SW | 0 | 0 | 60 | 51 | 43 | 38 | 69 | 171 | 217 | 370 | 3,944 | 12,167 | 9,616 | 2,398 | 29,144 |
| WSW | 0 | 0 | 0 | 22 | 3 | 11 | 0 | 11 | 5 | 0 | 4 | 667 | 5,601 | 1,296 | 7,620 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 86 | 244 | 478 | 445 | 590 | 998 | 1,270 | 1,239 | 5,829 | 13,821 | 17,830 | 9,435 | 52,265 |

TABLE 2L-5

POPULATION DISTRIBUTION FOR 2010
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 | Inner Rings Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 5 | 33 | 47 | 21 | 0 | 83 | 214 | 200 | 152 | 0 | 665 | 347 | 1,767 |
| ESE | 0 | 0 | 13 | 38 | 87 | 21 | 117 | 152 | 187 | 194 | 574 | 249 | 304 | 2,552 | 4,488 |
| SE | 0 | 0 | 0 | 71 | 79 | 128 | 101 | 104 | 21 | 69 | 311 | 124 | 207 | 284 | 1,499 |
| SSE | 0 | 0 | 0 | 40 | 160 | 137 | 27 | 172 | 393 | 174 | 181 | 169 | 301 | 278 | 2,032 |
| S | 0 | 0 | 0 | 11 | 71 | 35 | 128 | 208 | 95 | 88 | 278 | 334 | 362 | 342 | 1,952 |
| SSW | 0 | 0 | 13 | 6 | 57 | 118 | 232 | 231 | 309 | 284 | 688 | 271 | 1,197 | 2,867 | 6,273 |
| SW | 0 | 0 | 69 | 60 | 51 | 44 | 80 | 198 | 252 | 429 | 4,581 | 14,135 | 11,173 | 2,786 | 33,858 |
| WSW | 0 | 0 | 0 | 25 | 3 | 13 | 0 | 13 | 6 | 0 | 4 | 775 | 5,844 | 1,505 | 8,188 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 100 | 284 | 555 | 517 | 685 | 1,161 | 1,477 | 1,438 | 6,769 | 16,057 | 20,053 | 10,961 | 60,057 |

TABLE 2L-6

POPULATION DISTRIBUTION FOR 2020
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 | Inner Rings Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 5 | 38 | 55 | 24 | 0 | 96 | 247 | 231 | 175 | 0 | 767 | 401 | 2,039 |
| ESE | 0 | 0 | 15 | 44 | 101 | 24 | 135 | 175 | 215 | 223 | 662 | 287 | 351 | 2,945 | 5,177 |
| SE | 0 | 0 | 0 | 82 | 91 | 148 | 118 | 120 | 24 | 80 | 359 | 143 | 239 | 327 | 1,731 |
| SSE | 0 | 0 | 0 | 46 | 184 | 158 | 31 | 199 | 453 | 201 | 210 | 194 | 348 | 320 | 2,344 |
| S | 0 | 0 | 0 | 13 | 82 | 40 | 147 | 240 | 109 | 102 | 320 | 386 | 417 | 395 | 2,251 |
| SSW | 0 | 0 | 15 | 7 | 66 | 136 | 268 | 266 | 357 | 328 | 793 | 313 | 1,380 | 3,307 | 7,236 |
| SW | 0 | 0 | 80 | 69 | 58 | 51 | 93 | 229 | 291 | 495 | 5,285 | 16,304 | 12,886 | 3,212 | 39,053 |
| WSW | 0 | 0 | 0 | 29 | 4 | 15 | 0 | 15 | 7 | 0 | 5 | 894 | 6,112 | 1,736 | 8,817 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 115 | 328 | 641 | 596 | 792 | 1,340 | 1,703 | 1,660 | 7,809 | 18,521 | 22,500 | 12,643 | 68,648 |

TABLE 2L-7

POPULATION DISTRIBUTION FOR 2030
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 | Inner Rings Total |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 6 | 44 | 63 | 28 | 0 | 110 | 284 | 265 | 201 | 0 | 880 | 460 | 2,341 |
| ESE | 0 | 0 | 17 | 50 | 115 | 27 | 155 | 201 | 247 | 256 | 759 | 329 | 402 | 3,380 | 5,938 |
| SE | 0 | 0 | 0 | 94 | 105 | 171 | 135 | 137 | 27 | 91 | 412 | 165 | 274 | 375 | 1,986 |
| SSE | 0 | 0 | 0 | 52 | 211 | 182 | 35 | 228 | 520 | 230 | 240 | 222 | 399 | 367 | 2,686 |
| S | 0 | 0 | 0 | 15 | 94 | 46 | 169 | 276 | 125 | 117 | 368 | 443 | 478 | 453 | 2,584 |
| SSW | 0 | 0 | 17 | 8 | 75 | 157 | 307 | 305 | 409 | 376 | 911 | 359 | 1,585 | 3,795 | 8,304 |
| SW | 0 | 0 | 92 | 79 | 67 | 58 | 106 | 264 | 334 | 568 | 6,067 | 18,715 | 14,793 | 3,688 | 44,831 |
| WSW | 0 | 0 | 0 | 33 | 4 | 17 | 0 | 17 | 8 | 0 | 5 | 1,026 | 6,409 | 1,993 | 9,512 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 0 | 0 | 132 | 375 | 734 | 686 | 907 | 1,538 | 1,954 | 1,903 | 8,963 | 21,259 | 25,220 | 14,511 | 78,182 |

TABLE 2L-8

POPULATION DISTRIBUTION FOR 1980
0- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-10 | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Total 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 341 | 1,699 | 25,985 | 28,049 |
| NNE | 0 | 0 | 0 | 0 | 42 | 956 | 771 | 2,364 | 4,604 | 2,799 | 2,801 | 14,337 |
| NE | 0 | 0 | 56 | 396 | 711 | 1,911 | 3,872 | 2,199 | 21,085 | 15,349 | 6,910 | 52,489 |
| ENE | 0 | 232 | 2,282 | 1,061 | 2,130 | 879 | 449 | 242 | 176 | 1,086 | 5,554 | 14,091 |
| E | 1,120 | 703 | 1,343 | 729 | 760 | 1,393 | 758 | 421 | 615 | 1,086 | 1,895 | 10,823 |
| ESE | 2,844 | 1,024 | 1,069 | 1,210 | 881 | 1,549 | 1,976 | 3,518 | 5,103 | 11,287 | 22,726 | 53,187 |
| SE | 952 | 899 | 1,151 | 1,880 | 2,320 | 6,489 | 7,246 | 9,746 | 10,058 | 19,254 | 17,549 | 77,544 |
| SSE | 1,287 | 1,242 | 1,368 | 1,976 | 2,698 | 26,358 | 48,390 | 132,885 | 141,059 | 20,648 | 7,100 | 385,011 |
| S | 1,237 | 1,546 | 14,068 | 2,712 | 2,511 | 8,490 | 15,259 | 22,658 | 16,621 | 25,329 | 4,750 | 115,181 |
| SSW | 3,975 | 1,687 | 1,403 | 1,891 | 1,259 | 2,063 | 3,521 | 6,258 | 6,165 | 19,616 | 20,648 | 68,486 |
| SW | 21,460 | 1,482 | 1,234 | 767 | 929 | 3,121 | 4,062 | 3,541 | 7,089 | 9,583 | 18,091 | 71,359 |
| WSW | 6,692 | 15 | 0 | 0 | 0 | 0 | 31 | 1,404 | 4,286 | 6,496 | 10,308 | 29,232 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 164 | 323 | 487 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 233 | 1,221 | 7,309 | 8,763 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 211 | 2,819 | 3,030 |
| Total | 39,567 | 8,830 | 23,974 | 12,622 | 14,241 | 53,209 | 86,335 | 185,260 | 217,435 | 135,828 | 154,768 | 932,069 |

TABLE 2L-9

POPULATION DISTRIBUTION FOR 1986
0- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-10 | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Total 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 353 | 1,781 | 28,051 | 30,209 |
| NNE | 0 | 0 | 0 | 0 | 43 | 990 | 797 | 2,443 | 4,760 | 2,895 | 2,896 | 14,824 |
| NE | 0 | 0 | 62 | 428 | 739 | 1,976 | 4,002 | 2,274 | 21,798 | 15,890 | 7,162 | 54,331 |
| ENE | 0 | 257 | 2,528 | 1,173 | 2,359 | 963 | 482 | 259 | 185 | 1,155 | 5,898 | 15,259 |
| E | 1,241 | 778 | 1,489 | 809 | 841 | 1,542 | 836 | 440 | 635 | 1,130 | 1,972 | 11,713 |
| ESE | 3,150 | 1,135 | 1,183 | 1,341 | 977 | 1,715 | 2,157 | 3,556 | 5,103 | 11,293 | 22,738 | 54,348 |
| SE | 1,054 | 995 | 1,275 | 2,082 | 2,569 | 7,141 | 7,648 | 10,274 | 10,679 | 20,778 | 18,925 | 83,420 |
| SSE | 1,422 | 1,376 | 1,515 | 2,188 | 2,983 | 27,775 | 50,483 | 138,635 | 147,163 | 21,544 | 7,426 | 402,510 |
| S | 1,370 | 1,712 | 15,581 | 3,005 | 2,780 | 8,857 | 15,906 | 23,606 | 17,204 | 25,850 | 4,863 | 120,734 |
| SSW | 4,403 | 1,869 | 1,554 | 2,094 | 1,371 | 2,095 | 3,569 | 6,375 | 6,281 | 19,807 | 20,319 | 69,737 |
| SW | 23,769 | 1,641 | 1,346 | 802 | 942 | 3,220 | 4,270 | 3,727 | 7,459 | 10,058 | 19,090 | 76,324 |
| WSW | 6,970 | 16 | 0 | 0 | 0 | 0 | 32 | 1,478 | 4,510 | 6,837 | 10,849 | 30,692 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 171 | 338 | 509 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 245 | 1,279 | 7,650 | 9,174 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 220 | 2,932 | 3,152 |
| Total | 43,379 | 9,779 | 26,533 | 13,922 | 15,604 | 56,274 | 90,182 | 193,091 | 226,375 | 140,688 | 161,109 | 976,936 |

TABLE 2L-10

POPULATION DISTRIBUTION FOR 1990
0- TO 50-MILE RADIUS

| Direction | Distance (m) 0-10 | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Total 0-50.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 363 | 1,848 | 30,355 | 32,591 |
| NNE | 0 | 0 | 0 | 0 | 44 | 1,017 | 820 | 2,513 | 4,893 | 2,977 | 2,980 | 15,244 |
| NE | 0 | 0 | 67 | 453 | 761 | 2,032 | 4,115 | 2,340 | 22,416 | 16,352 | 7,373 | 55,909 |
| ENE | 0 | 277 | 2,715 | 1,261 | 2,532 | 1,027 | 508 | 273 | 195 | 1,205 | 6,151 | 16,144 |
| E | 1,334 | 836 | 1,599 | 869 | 903 | 1,657 | 896 | 458 | 655 | 1,166 | 2,037 | 12,410 |
| ESE | 3,383 | 1,218 | 1,271 | 1,439 | 1,047 | 1,842 | 2,299 | 3,626 | 5,169 | 11,437 | 23,030 | 55,761 |
| SE | 1,131 | 1,069 | 1,370 | 2,236 | 2,760 | 7,645 | 8,025 | 10,777 | 11,259 | 22,117 | 20,130 | 88,519 |
| SSE | 1,530 | 1,478 | 1,627 | 2,350 | 3,200 | 29,117 | 52,652 | 144,589 | 153,485 | 22,468 | 7,755 | 420,251 |
| S | 1,471 | 1,839 | 16,735 | 3,228 | 2,984 | 9,234 | 16,573 | 24,583 | 17,783 | 26,283 | 4,965 | 125,678 |
| SSW | 4,730 | 2,007 | 1,669 | 2,249 | 1,455 | 2,116 | 3,601 | 6,453 | 6,363 | 19,927 | 20,148 | 70,718 |
| SW | 25,525 | 1,762 | 1,433 | 827 | 949 | 3,294 | 4,435 | 3,871 | 7,748 | 10,432 | 19,869 | 80,145 |
| WSW | 7,183 | 17 | 0 | 0 | 0 | 0 | 34 | 1,536 | 4,685 | 7,103 | 11,271 | 31,829 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 176 | 348 | 524 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 252 | 1,315 | 7,853 | 9,420 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 225 | 2,969 | 3,194 |
| Total | 46,287 | 10,503 | 28,486 | 14,912 | 16,635 | 58,981 | 93,958 | 201,044 | 235,266 | 145,031 | 167,234 | 1,018,337 |

TABLE 2L-11

POPULATION DISTRIBUTION FOR 2000
0- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-10 | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Total 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 361 | 1,862 | 30,460 | 32,708 |
| NNE | 0 | 0 | 0 | 0 | 44 | 1,014 | 817 | 2,506 | 4,881 | 2,970 | 2,972 | 15,204 |
| NE | 0 | 0 | 76 | 493 | 767 | 2,026 | 4,104 | 2,333 | 22,364 | 16,341 | 7,378 | 55,882 |
| ENE | 0 | 315 | 3,100 | 1,440 | 2,888 | 1,150 | 549 | 289 | 199 | 1,240 | 6,334 | 17,504 |
| E | 1,521 | 954 | 1,824 | 991 | 1,031 | 1,890 | 1,019 | 479 | 664 | 1,188 | 2,074 | 13,635 |
| ESE | 3,864 | 1,392 | 1,451 | 1,645 | 1,196 | 2,104 | 2,583 | 3,658 | 5,125 | 11,340 | 22,833 | 57,191 |
| SE | 1,290 | 1,221 | 1,562 | 2,553 | 3,150 | 8,676 | 8,756 | 11,714 | 12,231 | 24,172 | 21,893 | 97,218 |
| SSE | 1,747 | 1,687 | 1,857 | 2,683 | 3,646 | 31,719 | 56,769 | 155,897 | 165,485 | 24,225 | 8,371 | 454,086 |
| S | 1,680 | 2,099 | 19,104 | 3,684 | 3,404 | 9,956 | 17,848 | 26,460 | 18,985 | 27,539 | 5,226 | 135,985 |
| SSW | 5,399 | 2,292 | 1,905 | 2,568 | 1,635 | 2,203 | 3,743 | 6,763 | 6,677 | 20,597 | 20,236 | 74,018 |
| SW | 29,144 | 2,012 | 1,615 | 891 | 984 | 3,531 | 4,905 | 4,288 | 8,583 | 11,511 | 21,979 | 89,443 |
| WSW | 7,620 | 20 | 0 | 0 | 0 | 0 | 37 | 1,700 | 5,189 | 7,865 | 12,479 | 34,910 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 177 | 349 | 526 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 253 | 1,321 | 7,890 | 9,464 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 225 | 2,983 | 3,208 |
| Total | 52,265 | 11,992 | 32,494 | 16,948 | 18,745 | 64,269 | 101,130 | 216,112 | 250,997 | 152,573 | 173,457 | 1,090,982 |

TABLE 2L-12

POPULATION DISTRIBUTION FOR 2010
0- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-10 | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Total 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 373 | 1,938 | 35,193 | 37,530 |
| NNE | 0 | 0 | 0 | 0 | 45 | 1,043 | 841 | 2,580 | 5,024 | 3,056 | 3,061 | 15,650 |
| NE | 0 | 0 | 89 | 552 | 798 | 2,085 | 4,225 | 2,401 | 23,022 | 16,833 | 7,607 | 57,612 |
| ENE | 0 | 366 | 3,600 | 1,673 | 3,353 | 1,314 | 609 | 316 | 209 | 1,297 | 6,632 | 19,369 |
| E | 1,767 | 1,110 | 2,121 | 1,152 | 1,198 | 2,196 | 1,181 | 522 | 697 | 1,246 | 2,176 | 15,366 |
| ESE | 4,488 | 1,617 | 1,686 | 1,909 | 1,389 | 2,442 | 2,971 | 3,902 | 5,400 | 11,948 | 24,056 | 61,808 |
| SE | 1,499 | 1,418 | 1,816 | 2,966 | 3,661 | 10,061 | 10,026 | 13,394 | 14,025 | 27,827 | 25,092 | 111,785 |
| SSE | 2,032 | 1,960 | 2,157 | 3,117 | 4,234 | 36,299 | 64,745 | 177,797 | 188,734 | 27,627 | 9,555 | 518,257 |
| S | 1,952 | 2,439 | 22,195 | 4,281 | 3,953 | 11,327 | 20,304 | 30,056 | 21,142 | 29,246 | 5,616 | 152,511 |
| SSW | 6,273 | 2,662 | 2,214 | 2,984 | 1,864 | 2,284 | 3,876 | 7,082 | 7,014 | 21,233 | 20,558 | 78,044 |
| SW | 33,858 | 2,337 | 1,849 | 967 | 1,018 | 3,808 | 5,493 | 4,809 | 9,627 | 12,873 | 24,655 | 101,294 |
| WSW | 8,188 | 23 | 0 | 0 | 0 | 0 | 42 | 1,908 | 5,821 | 8,823 | 13,999 | 38,804 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 176 | 348 | 524 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 252 | 1,316 | 7,812 | 9,380 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 217 | 2,811 | 3,028 |
| Total | 60,057 | 13,932 | 37,727 | 19,601 | 21,513 | 72,859 | 114,313 | 244,793 | 281,340 | 165,656 | 189,171 | 1,220,962 |

TABLE 2L-13

POPULATION DISTRIBUTION FOR 2020
0- TO 50-MILE RADIUS

| Direction | Distance (mi) 0-10 | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Total 0-50.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 381 | 1,999 | 41,000 | 43,406 |
| NNE | 0 | 0 | 0 | 0 | 47 | 1,068 | 861 | 2,639 | 5,140 | 3,127 | 3,131 | 16,013 |
| NE | 0 | 0 | 102 | 616 | 824 | 2,133 | 4,323 | 2,457 | 23,552 | 17,227 | 7,788 | 59,022 |
| ENE | 0 | 422 | 4,153 | 1,930 | 3,866 | 1,494 | 674 | 344 | 215 | 1,336 | 6,829 | 21,263 |
| E | 2,039 | 1,279 | 2,444 | 1,328 | 1,382 | 2,533 | 1,360 | 571 | 732 | 1,302 | 2,274 | 17,244 |
| ESE | 5,177 | 1,864 | 1,945 | 2,204 | 1,602 | 2,819 | 3,402 | 4,249 | 5,821 | 12,879 | 25,933 | 67,895 |
| SE | 1,731 | 1,635 | 2,095 | 3,421 | 4,222 | 11,608 | 11,601 | 15,482 | 16,219 | 32,117 | 28,821 | 128,952 |
| SSE | 2,344 | 2,261 | 2,489 | 3,595 | 4,885 | 42,005 | 74,977 | 205,894 | 218,560 | 31,994 | 11,064 | 600,068 |
| S | 2,251 | 2,813 | 25,601 | 4,938 | 4,558 | 13,083 | 23,453 | 34,668 | 23,884 | 31,342 | 6,101 | 172,692 |
| SSW | 7,236 | 3,071 | 2,553 | 3,441 | 2,118 | 2,378 | 4,028 | 7,452 | 7,409 | 21,992 | 21,252 | 82,930 |
| SW | 39,053 | 2,696 | 2,108 | 1,051 | 1,056 | 4,135 | 6,194 | 5,431 | 10,868 | 14,498 | 27,801 | 114,891 |
| WSW | 8,817 | 27 | 0 | 0 | 0 | 0 | 47 | 2,154 | 6,569 | 9,959 | 15,804 | 43,377 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 170 | 336 | 506 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 243 | 1,269 | 7,462 | 8,974 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 198 | 2,468 | 2,666 |
| Total | 68,648 | 16,068 | 43,490 | 22,524 | 24,560 | 83,256 | 130,920 | 281,367 | 319,593 | 181,409 | 208,064 | 1,379,899 |

TABLE 2L-14

POPULATION DISTRIBUTION FOR 2030
0- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0-10 | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Total 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 390 | 2,056 | 48,470 | 50,943 |
| NNE | 0 | 0 | 0 | 0 | 48 | 1,093 | 881 | 2,699 | 5,257 | 3,198 | 3,204 | 16,380 |
| NE | 0 | 0 | 118 | 686 | 853 | 2,182 | 4,421 | 2,513 | 24,095 | 17,621 | 7,965 | 60,454 |
| ENE | 0 | 485 | 4,768 | 2,215 | 4,435 | 1,696 | 744 | 374 | 219 | 1,361 | 6,965 | 23,262 |
| E | 2,341 | 1,468 | 2,806 | 1,525 | 1,587 | 2,909 | 1,560 | 631 | 772 | 1,364 | 2,378 | 19,341 |
| ESE | 5,938 | 2,139 | 2,233 | 2,529 | 1,840 | 3,235 | 3,891 | 4,712 | 6,417 | 14,201 | 28,594 | 75,729 |
| SE | 1,986 | 1,877 | 2,404 | 3,926 | 4,846 | 13,351 | 13,518 | 18,034 | 18,883 | 37,203 | 33,237 | 149,265 |
| SSE | 2,686 | 2,595 | 2,856 | 4,127 | 5,610 | 48,978 | 87,730 | 240,924 | 255,743 | 37,436 | 12,937 | 701,622 |
| S | 2,584 | 3,229 | 29,388 | 5,667 | 5,230 | 15,266 | 27,373 | 40,409 | 27,277 | 33,841 | 6,686 | 196,950 |
| SSW | 8,304 | 3,526 | 2,930 | 3,951 | 2,401 | 2,481 | 4,196 | 7,865 | 7,856 | 22,848 | 22,302 | 88,660 |
| SW | 44,831 | 3,095 | 2,394 | 1,144 | 1,096 | 4,508 | 7,006 | 6,150 | 12,307 | 16,389 | 31,433 | 130,353 |
| WSW | 9,512 | 31 | 0 | 0 | 0 | 0 | 53 | 2,438 | 7,441 | 11,278 | 17,897 | 48,650 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 159 | 313 | 472 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 227 | 1,186 | 6,868 | 8,281 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 169 | 1,954 | 2,123 |
| Total | 78,182 | 18,445 | 49,897 | 25,770 | 27,946 | 95,699 | 151,373 | 326,776 | 366,884 | 200,310 | 231,203 | 1,572,485 |

TABLE 2L-15

POPULATION DENSITY FOR 1980
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 13 | 74 | 104 | 119 | 0 | 3,118 | 6,800 | 1,104 | 405 | 0 | 145 | 47 |
| ESE | 0 | 0 | 33 | 70 | 124 | 24 | 118 | 131 | 142 | 132 | 169 | 62 | 42 | 297 |
| SE | 0 | 0 | 0 | 131 | 113 | 152 | 102 | 90 | 16 | 47 | 91 | 31 | 29 | 33 |
| SSE | 0 | 0 | 0 | 73 | 229 | 161 | 27 | 148 | 298 | 118 | 107 | 89 | 42 | 32 |
| S | 0 | 0 | 0 | 20 | 102 | 41 | 127 | 179 | 72 | 60 | 81 | 83 | 50 | 40 |
| SSW | 0 | 0 | 33 | 12 | 81 | 139 | 230 | 198 | 235 | 193 | 202 | 67 | 166 | 333 |
| SW | 0 | 0 | 179 | 111 | 72 | 52 | 80 | 171 | 192 | 300 | 1,350 | 3,917 | 1,551 | 324 |
| WSW | 0 | 0 | 0 | 112 | 15 | 44 | 0 | 45 | 73 | 0 | 150 | 3,610 | 7,736 | 877 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 2L-16

POPULATION DENSITY FOR 1986
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 13 | 81 | 115 | 138 | 0 | 3,412 | 7,500 | 1,226 | 451 | 0 | 160 | 52 |
| ESE | 0 | 0 | 37 | 79 | 138 | 26 | 130 | 146 | 158 | 146 | 187 | 69 | 47 | 329 |
| SE | 0 | 0 | 0 | 146 | 127 | 165 | 113 | 99 | 18 | 53 | 101 | 34 | 32 | 37 |
| SSE | 0 | 0 | 0 | 79 | 254 | 178 | 28 | 163 | 331 | 131 | 119 | 99 | 46 | 36 |
| S | 0 | 0 | 0 | 23 | 113 | 44 | 141 | 198 | 79 | 66 | 90 | 92 | 56 | 44 |
| SSW | 0 | 0 | 37 | 12 | 91 | 154 | 255 | 220 | 260 | 213 | 224 | 75 | 184 | 369 |
| SW | 0 | 0 | 200 | 122 | 79 | 57 | 88 | 190 | 212 | 333 | 1,495 | 4,339 | 1,718 | 359 |
| WSW | 0 | 0 | 0 | 126 | 15 | 49 | 0 | 50 | 73 | 0 | 150 | 4,000 | 7,911 | 972 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 2L-17

POPULATION DENSITY FOR 1990
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 17 | 88 | 125 | 147 | 0 | 3,706 | 8,100 | 1,313 | 485 | 0 | 172 | 55 |
| ESE | 0 | 0 | 41 | 84 | 147 | 28 | 140 | 157 | 170 | 157 | 200 | 74 | 50 | 353 |
| SE | 0 | 0 | 0 | 154 | 136 | 180 | 121 | 106 | 19 | 56 | 108 | 37 | 34 | 39 |
| SSE | 0 | 0 | 0 | 84 | 272 | 191 | 31 | 175 | 356 | 140 | 127 | 106 | 50 | 38 |
| S | 0 | 0 | 0 | 23 | 122 | 48 | 150 | 213 | 85 | 72 | 97 | 99 | 60 | 47 |
| SSW | 0 | 0 | 41 | 15 | 97 | 165 | 274 | 235 | 279 | 229 | 240 | 80 | 198 | 397 |
| SW | 0 | 0 | 212 | 131 | 86 | 61 | 94 | 204 | 228 | 356 | 1,606 | 4,660 | 1,845 | 385 |
| WSW | 0 | 0 | 0 | 133 | 15 | 55 | 0 | 56 | 91 | 0 | 150 | 4,294 | 8,046 | 1,043 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 2L-18

POPULATION DENSITY FOR 2000
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 17 | 99 | 142 | 165 | 0 | 4,176 | 9,200 | 1,504 | 553 | 0 | 196 | 63 |
| ESE | 0 | 0 | 45 | 96 | 170 | 33 | 161 | 179 | 194 | 179 | 229 | 84 | 57 | 403 |
| SE | 0 | 0 | 0 | 178 | 154 | 206 | 136 | 121 | 22 | 63 | 124 | 42 | 39 | 45 |
| SSE | 0 | 0 | 0 | 99 | 310 | 219 | 36 | 201 | 405 | 161 | 146 | 120 | 57 | 44 |
| S | 0 | 0 | 0 | 29 | 140 | 56 | 172 | 243 | 97 | 81 | 111 | 113 | 68 | 54 |
| SSW | 0 | 0 | 45 | 15 | 111 | 187 | 313 | 269 | 319 | 262 | 274 | 92 | 226 | 453 |
| SW | 0 | 0 | 244 | 148 | 97 | 70 | 108 | 232 | 260 | 407 | 1,834 | 5,320 | 2,106 | 440 |
| WSW | 0 | 0 | 0 | 154 | 22 | 60 | 0 | 61 | 91 | 0 | 200 | 4,904 | 8,322 | 1,191 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 2L-19

POPULATION DENSITY FOR 2010
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 21 | 116 | 163 | 193 | 0 | 4,882 | 10,700 | 1,739 | 641 | 0 | 228 | 74 |
| ESE | 0 | 0 | 53 | 111 | 197 | 39 | 186 | 208 | 225 | 208 | 266 | 98 | 67 | 468 |
| SE | 0 | 0 | 0 | 207 | 179 | 237 | 158 | 141 | 25 | 74 | 144 | 49 | 45 | 52 |
| SSE | 0 | 0 | 0 | 116 | 362 | 254 | 42 | 234 | 471 | 187 | 168 | 141 | 66 | 51 |
| S | 0 | 0 | 0 | 32 | 161 | 65 | 201 | 282 | 114 | 94 | 129 | 131 | 79 | 63 |
| SSW | 0 | 0 | 53 | 17 | 129 | 219 | 364 | 314 | 370 | 305 | 319 | 106 | 262 | 526 |
| SW | 0 | 0 | 281 | 175 | 115 | 81 | 125 | 269 | 302 | 472 | 2,130 | 6,181 | 2,447 | 511 |
| WSW | 0 | 0 | 0 | 175 | 22 | 71 | 0 | 73 | 109 | 0 | 200 | 5,699 | 8,684 | 1,383 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 2L-20

POPULATION DISTRIBUTION FOR 2020
0- TO 10-MILE RADIUS

| | Distance (mi) | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 21 | 134 | 191 | 220 | 0 | 5,647 | 12,350 | 2,009 | 738 | 0 | 263 | 85 |
| ESE | 0 | 0 | 61 | 128 | 229 | 44 | 215 | 239 | 259 | 239 | 307 | 112 | 77 | 540 |
| SE | 0 | 0 | 0 | 239 | 206 | 274 | 185 | 163 | 29 | 86 | 166 | 56 | 52 | 60 |
| SSE | 0 | 0 | 0 | 134 | 416 | 293 | 49 | 270 | 543 | 216 | 195 | 162 | 76 | 59 |
| S | 0 | 0 | 0 | 38 | 186 | 74 | 230 | 326 | 131 | 109 | 148 | 151 | 91 | 72 |
| SSW | 0 | 0 | 61 | 20 | 149 | 252 | 420 | 361 | 428 | 352 | 367 | 123 | 302 | 607 |
| SW | 0 | 0 | 326 | 201 | 131 | 94 | 146 | 311 | 349 | 545 | 2,457 | 7,129 | 2,823 | 589 |
| WSW | 0 | 0 | 0 | 203 | 29 | 82 | 0 | 84 | 127 | 0 | 250 | 6,574 | 9,082 | 1,596 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 2L-21

POPULATION DISTRIBUTION FOR 2030
0- TO 10-MILE RADIUS

| Direction | Distance (mi) 0.0-0.5 | 0.5-1.0 | 1.0-1.5 | 1.5-2.0 | 2.0-2.5 | 2.5-3.0 | 3.0-3.5 | 3.5-4.0 | 4.0-4.5 | 4.5-5.0 | 5.0-6.0 | 6.0-7.0 | 7.0-8.5 | 8.5-10.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ENE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 25 | 155 | 219 | 257 | 0 | 6,471 | 14,200 | 2,304 | 848 | 0 | 302 | 98 |
| ESE | 0 | 0 | 69 | 146 | 260 | 50 | 246 | 275 | 297 | 274 | 351 | 129 | 88 | 620 |
| SE | 0 | 0 | 0 | 274 | 238 | 317 | 212 | 186 | 32 | 98 | 191 | 65 | 60 | 69 |
| SSE | 0 | 0 | 0 | 151 | 478 | 337 | 55 | 310 | 623 | 247 | 223 | 185 | 87 | 67 |
| S | 0 | 0 | 0 | 44 | 213 | 85 | 265 | 375 | 150 | 125 | 170 | 174 | 105 | 83 |
| SSW | 0 | 0 | 69 | 23 | 170 | 291 | 481 | 414 | 490 | 403 | 422 | 141 | 347 | 696 |
| SW | 0 | 0 | 375 | 230 | 152 | 107 | 166 | 359 | 400 | 626 | 2,821 | 8,183 | 3,240 | 677 |
| WSW | 0 | 0 | 0 | 231 | 29 | 93 | 0 | 95 | 145 | 0 | 250 | 7,544 | 9,523 | 1,832 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

TABLE 2L-22

POPULATION DENSITY FOR 1980
10- TO 50-MILE RADIUS

| Direction | Distance (mi) 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Average 0-50.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 20 | 37 | 618 | 264 |
| NNE | 0 | 0 | 0 | 33 | 33 | 36 | 63 | 92 | 36 | 36 | 49 |
| NE | 0 | 49 | 41 | 42 | 43 | 72 | 34 | 286 | 184 | 74 | 119 |
| ENE | 63 | 181 | 67 | 116 | 20 | 10 | 4 | 3 | 13 | 61 | 32 |
| E | 65 | 99 | 46 | 43 | 33 | 15 | 7 | 8 | 13 | 20 | 23 |
| ESE | 93 | 79 | 76 | 52 | 46 | 37 | 56 | 73 | 139 | 246 | 113 |
| SE | 81 | 86 | 118 | 126 | 162 | 221 | 306 | 209 | 243 | 193 | 193 |
| SSE | 112 | 101 | 124 | 147 | 619 | 936 | 2,212 | 1,934 | 248 | 76 | 803 |
| S | 144 | 1,126 | 171 | 139 | 212 | 298 | 355 | 226 | 345 | 59 | 251 |
| SSW | 153 | 104 | 119 | 68 | 47 | 66 | 107 | 85 | 271 | 245 | 148 |
| SW | 137 | 96 | 60 | 77 | 94 | 82 | 59 | 96 | 115 | 194 | 155 |
| WSW | 139 | 0 | 0 | 0 | 0 | 55 | 449 | 169 | 154 | 185 | 226 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 31 | 33 | 33 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 29 | 95 | 68 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 57 | 49 |

TABLE 2L-23

POPULATION DENSITY FOR 1986
10- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Average 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 20 | 39 | 667 | 285 |
| NNE | 0 | 0 | 0 | 34 | 34 | 38 | 65 | 95 | 37 | 37 | 50 |
| NE | 0 | 55 | 45 | 44 | 45 | 74 | 36 | 296 | 190 | 77 | 124 |
| ENE | 70 | 200 | 74 | 128 | 22 | 11 | 4 | 3 | 14 | 65 | 35 |
| E | 72 | 110 | 51 | 48 | 37 | 17 | 7 | 9 | 14 | 21 | 25 |
| ESE | 103 | 88 | 84 | 58 | 51 | 40 | 56 | 73 | 139 | 246 | 115 |
| SE | 90 | 95 | 131 | 140 | 178 | 233 | 322 | 222 | 262 | 208 | 208 |
| SSE | 125 | 112 | 137 | 162 | 653 | 977 | 2,308 | 2,018 | 259 | 80 | 840 |
| S | 159 | 1,247 | 189 | 154 | 222 | 311 | 370 | 234 | 352 | 61 | 263 |
| SSW | 169 | 115 | 131 | 74 | 47 | 67 | 109 | 87 | 274 | 241 | 150 |
| SW | 152 | 104 | 63 | 78 | 97 | 86 | 63 | 101 | 121 | 205 | 166 |
| WSW | 148 | 0 | 0 | 0 | 0 | 57 | 473 | 178 | 162 | 195 | 237 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 35 | 34 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 30 | 99 | 71 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 59 | 51 |

TABLE 2L-24

POPULATION DENSITY FOR 1990
10- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Average 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 21 | 41 | 722 | 307 |
| NNE | 0 | 0 | 0 | 34 | 35 | 39 | 67 | 98 | 38 | 39 | 52 |
| NE | 0 | 59 | 47 | 45 | 46 | 76 | 37 | 304 | 196 | 79 | 127 |
| ENE | 75 | 215 | 79 | 138 | 23 | 12 | 4 | 3 | 15 | 68 | 37 |
| E | 77 | 118 | 54 | 51 | 40 | 18 | 7 | 9 | 14 | 22 | 26 |
| ESE | 110 | 94 | 90 | 62 | 54 | 43 | 57 | 74 | 140 | 249 | 118 |
| SE | 97 | 102 | 140 | 150 | 191 | 244 | 338 | 234 | 279 | 221 | 221 |
| SSE | 134 | 121 | 147 | 174 | 684 | 1,019 | 2,407 | 2,104 | 270 | 83 | 877 |
| S | 171 | 1,339 | 203 | 165 | 231 | 324 | 385 | 242 | 358 | 62 | 274 |
| SSW | 182 | 124 | 141 | 79 | 48 | 68 | 110 | 88 | 275 | 239 | 153 |
| SW | 163 | 111 | 65 | 79 | 99 | 90 | 65 | 105 | 125 | 213 | 174 |
| WSW | 158 | 0 | 0 | 0 | 0 | 60 | 492 | 185 | 169 | 203 | 246 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 | 36 | 35 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 31 | 102 | 73 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 60 | 52 |

TABLE 2L-25

POPULATION DENSITY FOR 2000
10- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Average 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 21 | 41 | 725 | 308 |
| NNE | 0 | 0 | 0 | 34 | 35 | 39 | 67 | 97 | 38 | 38 | 52 |
| NE | 0 | 67 | 51 | 46 | 46 | 76 | 37 | 304 | 196 | 79 | 127 |
| ENE | 86 | 245 | 90 | 157 | 26 | 13 | 5 | 3 | 15 | 70 | 40 |
| E | 88 | 135 | 62 | 59 | 45 | 20 | 8 | 9 | 14 | 22 | 29 |
| ESE | 126 | 107 | 103 | 71 | 62 | 48 | 58 | 73 | 139 | 247 | 121 |
| SE | 111 | 116 | 160 | 171 | 216 | 267 | 368 | 254 | 305 | 240 | 242 |
| SSE | 153 | 138 | 168 | 198 | 745 | 1,099 | 2,595 | 2,269 | 291 | 90 | 947 |
| S | 196 | 1,529 | 232 | 189 | 249 | 349 | 415 | 258 | 375 | 65 | 297 |
| SSW | 208 | 141 | 161 | 89 | 50 | 70 | 115 | 92 | 284 | 240 | 160 |
| SW | 186 | 125 | 70 | 82 | 106 | 99 | 72 | 117 | 138 | 236 | 194 |
| WSW | 186 | 0 | 0 | 0 | 0 | 65 | 544 | 205 | 187 | 224 | 270 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 | 36 | 35 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 31 | 102 | 74 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 60 | 52 |

TABLE 2L-26

POPULATION DENSITY FOR 2010
10- TO 50-MILE RADIUS

| Direction | Distance (mi) 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Average 0-50.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 22 | 42 | 837 | 354 |
| NNE | 0 | 0 | 0 | 35 | 36 | 40 | 69 | 100 | 39 | 40 | 53 |
| NE | 0 | 78 | 58 | 48 | 47 | 78 | 38 | 313 | 202 | 82 | 131 |
| ENE | 99 | 285 | 105 | 182 | 30 | 14 | 5 | 3 | 16 | 73 | 44 |
| E | 102 | 157 | 72 | 68 | 52 | 24 | 8 | 9 | 15 | 23 | 33 |
| ESE | 146 | 125 | 120 | 82 | 72 | 55 | 62 | 77 | 147 | 261 | 131 |
| SE | 128 | 135 | 186 | 199 | 251 | 305 | 420 | 292 | 351 | 275 | 279 |
| SSE | 177 | 160 | 195 | 230 | 853 | 1,253 | 2,960 | 2,588 | 332 | 102 | 1,081 |
| S | 227 | 1,776 | 270 | 219 | 283 | 397 | 471 | 288 | 398 | 70 | 333 |
| SSW | 241 | 164 | 187 | 101 | 52 | 73 | 121 | 97 | 293 | 244 | 168 |
| SW | 216 | 143 | 76 | 84 | 114 | 111 | 81 | 131 | 154 | 264 | 220 |
| WSW | 213 | 0 | 0 | 0 | 0 | 74 | 611 | 230 | 210 | 252 | 300 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 | 36 | 35 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29 | 31 | 101 | 73 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 | 56 | 49 |

TABLE 2L-27

POPULATION DENSITY FOR 2020
10- TO 50-MILE RADIUS

| | Distance (mi) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Direction | 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Average 0-50.0 |
| N | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 22 | 44 | 975 | 409 |
| NNE | 0 | 0 | 0 | 37 | 37 | 41 | 70 | 103 | 40 | 40 | 54 |
| NE | 0 | 90 | 64 | 49 | 48 | 80 | 39 | 320 | 206 | 84 | 134 |
| ENE | 115 | 329 | 121 | 210 | 34 | 16 | 6 | 3 | 16 | 75 | 48 |
| E | 118 | 181 | 83 | 78 | 61 | 27 | 9 | 10 | 16 | 24 | 36 |
| ESE | 169 | 144 | 138 | 95 | 83 | 63 | 67 | 83 | 158 | 281 | 144 |
| SE | 148 | 156 | 214 | 229 | 289 | 353 | 486 | 337 | 405 | 316 | 321 |
| SSE | 205 | 184 | 225 | 265 | 987 | 1,451 | 3,428 | 2,996 | 385 | 119 | 1,252 |
| S | 262 | 2,049 | 311 | 252 | 327 | 458 | 543 | 325 | 426 | 76 | 377 |
| SSW | 278 | 189 | 216 | 115 | 54 | 76 | 127 | 102 | 304 | 252 | 179 |
| SW | 249 | 163 | 83 | 88 | 124 | 125 | 91 | 148 | 174 | 298 | 250 |
| WSW | 251 | 0 | 0 | 0 | 0 | 83 | 689 | 260 | 237 | 284 | 335 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 | 35 | 34 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 | 30 | 97 | 70 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 50 | 44 |

TABLE 2L-28

POPULATION DENSITY FOR 2030
10- TO 50-MILE RADIUS

| Direction | Distance (mi) 10.0-12.5 | 12.5-15.0 | 15.0-17.5 | 17.5-20.0 | 20.0-25.0 | 25.0-30.0 | 30.0-35.0 | 35.0-40.0 | 40.0-45.0 | 45.0-50.0 | Average 0-50.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| N | 0 | 0 | 0 | 0 | 0 | 0 | 24 | 23 | 45 | 1,153 | 480 |
| NNE | 0 | 0 | 0 | 37 | 37 | 42 | 72 | 105 | 41 | 41 | 56 |
| NE | 0 | 104 | 72 | 51 | 49 | 82 | 39 | 327 | 211 | 86 | 138 |
| ENE | 132 | 377 | 139 | 241 | 38 | 17 | 6 | 3 | 17 | 77 | 53 |
| E | 135 | 208 | 96 | 90 | 70 | 31 | 10 | 10 | 16 | 25 | 41 |
| ESE | 194 | 165 | 159 | 109 | 95 | 72 | 75 | 92 | 174 | 310 | 161 |
| SE | 170 | 179 | 246 | 263 | 333 | 411 | 566 | 393 | 469 | 365 | 372 |
| SSE | 235 | 212 | 259 | 305 | 1,151 | 1,698 | 4,011 | 3,506 | 450 | 139 | 1,464 |
| S | 301 | 2,352 | 357 | 290 | 382 | 535 | 633 | 371 | 460 | 83 | 430 |
| SSW | 319 | 217 | 248 | 130 | 56 | 79 | 134 | 108 | 316 | 265 | 191 |
| SW | 286 | 186 | 90 | 91 | 135 | 142 | 103 | 167 | 196 | 337 | 283 |
| WSW | 288 | 0 | 0 | 0 | 0 | 94 | 780 | 294 | 268 | 322 | 376 |
| W | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 32 | 31 |
| NW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 28 | 89 | 64 |
| NNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 39 | 35 |

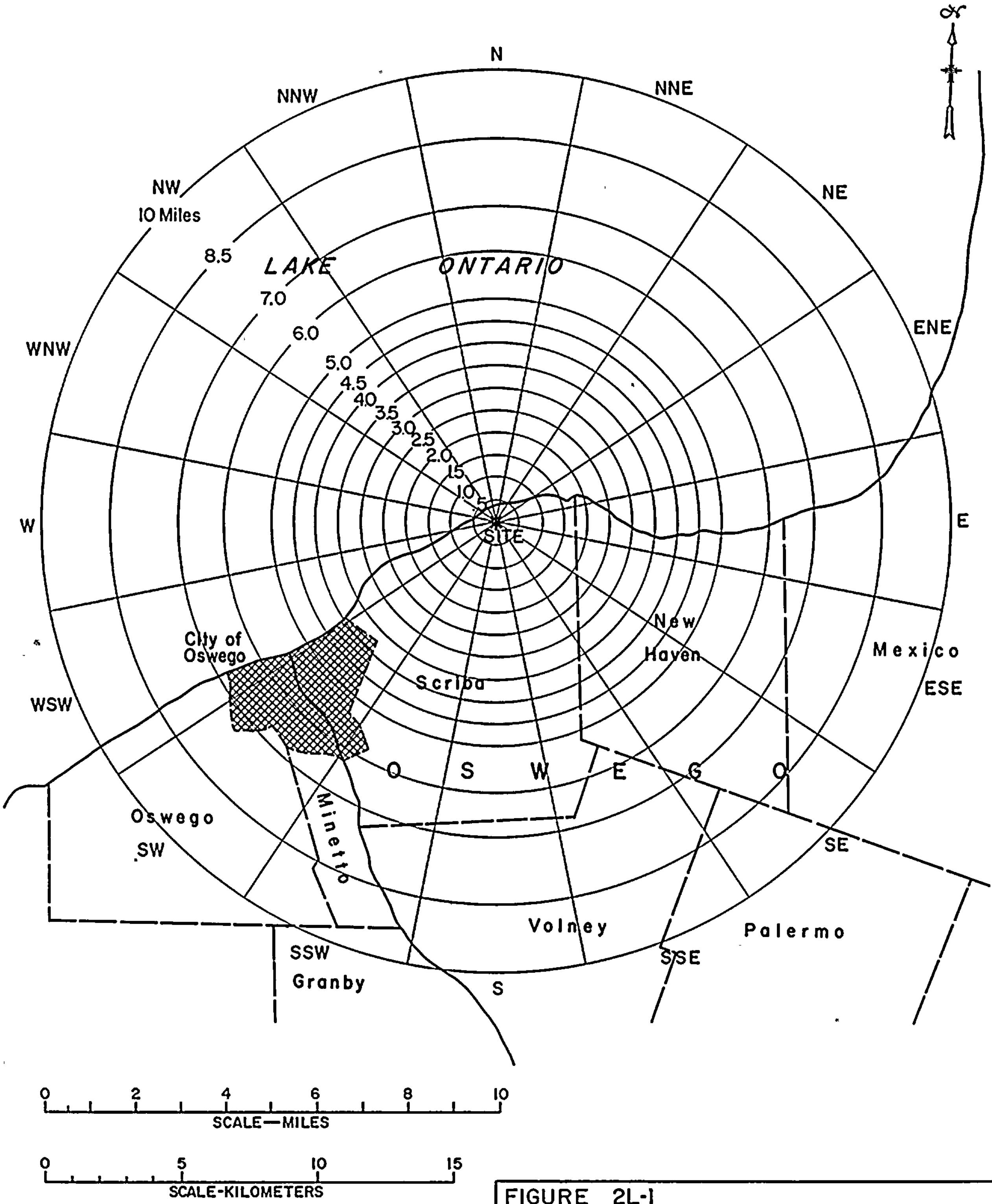
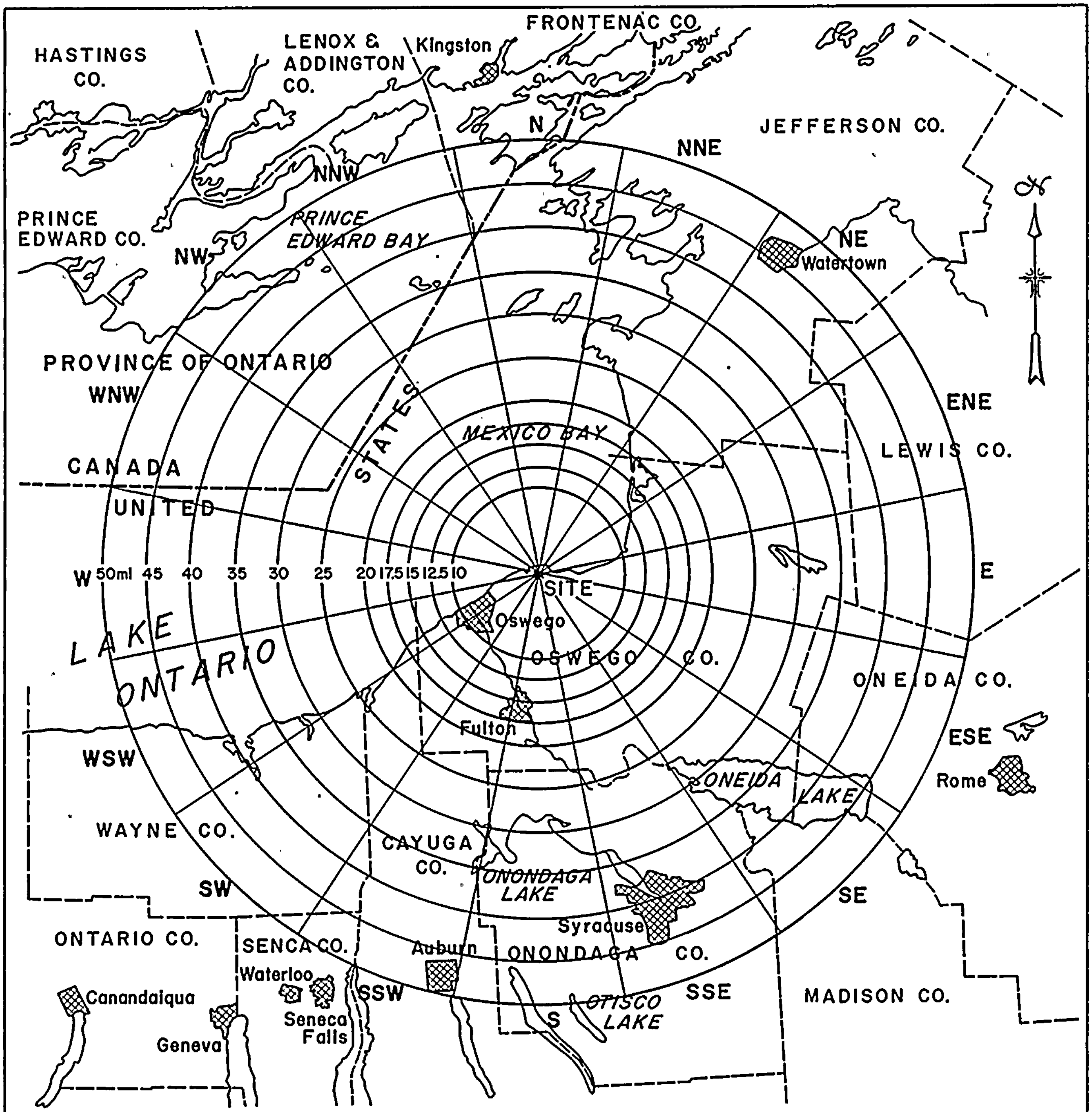



FIGURE 2L-1

0-10 MILE POPULATION ROSE

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT




0 10 20

SCALE - MILES

0 10 20 30

SCALE - KILOMETERS

FIGURE 2L-2

50 MILE POPULATION ROSE

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT - UNIT 2

FINAL SAFETY ANALYSIS REPORT

CHAPTER 3

TABLE OF CONTENTS (Cont)


| Section | Title | Page |
|---|---|---|
| 3.1.2.42 | Inspection of Containment Atmosphere Cleanup Systems (Criterion 42) | 3.1-52 |
| 3.1.2.43 | Testing of Containment Atmospheric Cleanup Systems (Criterion 43) | 3.1-53 |
| 3.1.2.44 | Cooling Water (Criterion 44) | 3.1-54 |
| 3.1.2.45 | Inspection of Cooling Water System (Criterion 45) | 3.1-55 |
| 3.1.2.46 | Testing of Cooling Water System (Criterion 46) | 3.1-56 |
| 3.1.2.47 | (Not Promulgated by NRC) | 3.1-57 |
| 3.1.2.48 | (Not Promulgated by NRC) | 3.1-57 |
| 3.1.2.49 | (Not Promulgated by NRC) | 3.1-57 |
| 3.1.2.50 | Containment Design Basis (Criterion 50) | 3.1-57 |
| 3.1.2.51 | Fracture Prevention of Containment Pressure Boundary (Criterion 51) | 3.1-58 |
| 3.1.2.52 | Capability for Containment Leakage Rate Testing (Criterion 52) | 3.1-59 |
| 3.1.2.53 | Provisions for Containment Testing and Inspection (Criterion 53) | 3.1-60 |
| 3.1.2.54 | Piping Systems Penetrating Containment (Criterion 54) | 3.1-60 |
| 3.1.2.55 | Reactor Coolant Pressure Boundary Penetrating Containment (Criterion 55) | 3.1-61 |
| 3.1.2.56 | Primary Containment Isolation (Criterion 56) | 3.1-63 |
| 3.1.2.57 | Closed-System Isolation Valves (Criterion 57) | 3.1-64 |
| 3.1.2.58 | (Not Promulgated by NRC) | 3.1-64 |
| 3.1.2.59 | (Not Promulgated by NRC) | 3.1-64 |
| 3.1.2.60 | Control of Releases of Radioactive Materials to the Environment (Criterion 60) | 3.1-65 |
| 3.1.2.61 | Fuel Storage and Handling and Radioactivity Control (Criterion 61) | 3.1-66 |
| 3.1.2.62 | Prevention of Criticality in Fuel Storage and Handling (Criterion 62) | 3.1-68 |
| 3.1.2.63 | Monitoring Fuel and Waste Storage (Criterion 63) | 3.1-69 |

CHAPTER 3

TABLE OF CONTENTS (Cont)


| Section | Title | Page |
|---|---|---|
| 3.1.2.64 | Monitoring Radioactivity Releases (Criterion 64) | 3.1-70 |
| 3.2 | CLASSIFICATION OF STRUCTURES, SYSTEMS, AND COMPONENTS | 3.2-1 |
| 3.2.1 | Seismic Classification | 3.2-1 |
| 3.2.2 | System Quality Group Classifications | 3.2-2 |
| 3.2.3 | Quality Assurance | 3.2-2 |
| 3.2.4 | Correlation of Safety Classes with Industry Codes | 3.2-2 |
| 3.3 | WIND AND TORNADO LOADINGS | 3.3-1 |
| 3.3.1 | Wind Loadings | 3.3-1 |
| 3.3.1.1 | Design Wind Velocity | 3.3-1 |
| 3.3.1.1.1 | Basis for Design Wind Velocity Selection | 3.3-1 |
| 3.3.1.1.2 | Vertical Velocity Distribution and Gust Factor | 3.3-1 |
| 3.3.1.2 | Determination of Applied Forces | 3.3-1 |
| 3.3.2 | Tornado Loadings | 3.3-2 |
| 3.3.2.1 | Applicable Design Parameters | 3.3-2 |
| 3.3.2.2 | Determination of Forces on Structures | 3.3-2 |
| 3.3.2.2.1 | Transformation of Tornadic Winds | 3.3-2 |
| 3.3.2.2.2 | Venting of Structures | 3.3-3 |
| 3.3.2.2.3 | Missile Impact Loads | 3.3-3 |
| 3.3.2.2.4 | Tornado Load Combinations | 3.3-3 |
| 3.3.2.3 | Effect of Failure of Structures or Components Not Designed for Tornado Loads | 3.3-4 |
| 3.3.3 | References | 3.3-6 |
| 3.4 | WATER LEVEL (FLOOD) DESIGN | 3.4-1 |
| 3.4.1 | Flood Protection | 3.4-1 |
| 3.4.1.1 | Flood Protection Measures for Category I Structures | 3.4-1 |
| 3.4.1.1.1 | Identification of Safety-Related Systems and Components | 3.4-1 |
| 3.4.1.1.2 | Description of Structures Housing Safety-Related Equipment | 3.4-1 |
| 3.4.1.1.3 | Means of Providing Flood Protection | 3.4-1 |

CHAPTER 3

TABLE OF CONTENTS (Cont)


| Section | Title | Page |
|---|---|---|
| 3.11.5.1 | Chemical Environment | 3.11-5 |
| 3.11.5.1.1 | Normal Operation | 3.11-5 |
| 3.11.5.1.2 | Design Basis Accident | 3.11-6 |
| 3.11.5.2 | Radiation Environment | 3.11-6 |
| APPENDIX 3A | COMPUTER PROGRAMS FOR DYNAMIC AND STATIC ANALYSIS OF CATEGORY I STRUCTURES, EQUIPMENT, AND COMPONENTS | |
| APPENDIX 3B | PRESSURE ANALYSIS FOR SUBCOMPARTMENTS OUTSIDE CONTAINMENT | |
| APPENDIX 3C | FAILURE MODE ANALYSIS FOR PIPE BREAKS AND CRACKS | |
| APPENDIX 3D | METHOD OF PANEL FREQUENCY ANALYSIS | |

CHAPTER 3

LIST OF TABLES


| Table Number | Title |
|---|---|
| 3.2-1 | EQUIPMENT AND STRUCTURE CLASSIFICATION |
| 3.2-2 | CODE GROUP DESIGNATIONS, INDUSTRY CODES, AND STANDARDS FOR MECHANICAL COMPONENTS |
| 3.2-3 | SUMMARY OF SAFETY CLASS DESIGN REQUIREMENTS |
| 3.3-1 | DYNAMIC WIND PRESSURE FOR CATEGORY I STRUCTURES |
| 3.4-1 | FLOOD PROTECTION FOR SAFETY-RELATED STRUCTURES AND SYSTEMS |
| 3.4-2 | PENETRATIONS THROUGH EXTERIOR WALLS OF REACTOR BUILDING BELOW DBFL |
| 3.4-3 | PENETRATIONS THROUGH EXTERIOR WALLS OF CONTROL AND TURBINE BUILDINGS BELOW DBFL |
| 3.4-4 | PENETRATIONS THROUGH EXTERIOR WALLS OF RADWASTE BUILDING AND SCREENWELL BUILDING BELOW DBFL |
| 3.4-5 | PENETRATIONS THROUGH EXTERIOR WALLS OF PIPE TUNNELS BELOW DBFL |
| 3.4-6 | PENETRATIONS THROUGH EXTERIOR WALLS OF DIESEL GENERATOR BUILDING AND MAIN STACK BELOW DBFL |
| 5 3.4-7 | PERFORMANCE OF WATER STOP MATERIAL IN EXPECTED ENVIRONMENT |
| 3.5-1 | STRUCTURES, SYSTEMS, AND COMPONENTS - SAFETY-RELATED |
| 3.5-2 | SUMMARY OF FORCES AND STRESSES ACTING ON THERMOWELL WELDS IN THE VARIOUS HIGH ENERGY SYSTEMS |
| 3.5-3 | DAMAGE PROBABILITY DUE TO LOW TRAJECTORY TURBINE MISSILES FROM UNIT 2 STRIKING PLANT REGIONS AT UNIT 2 (Manufacturer's Probability) |

TABLE 3.2-1

EQUIPMENT AND STRUCTURE CLASSIFICATION

| | Scope of Supply | Location | Electrical Classification | Seismic Category | Quality Group Classification | Quality Assurance Requirement | Tornado Protection | Notes |
|---|---|---|---|---|---|---|---|---|
| **Reactor System** | | | | | | | | |
| Reactor vessel | GE | PC | NA | I | A | I | P | |
| Reactor vessel support skirt | GE | PC | NA | I | NA | I | P | |
| Reactor vessel appurtenances, pressure retaining portions | GE | PC | NA | I | A | I | P | |
| CRD housing supports | GE | PC | NA | I | NA | I | P | |
| Reactor internal structures, engineering safety features | GE | PC | NA | I | NA | I | P | (1) |
| Reactor internal structures, other | GE | PC | NA | NA | NA | NA | P | (2) |
| Control rods | GE | PC | NA | I | NA | I | P | |
| Control rod drives | GE | PC | NA | I | NA | I | P | |
| Core support structure | GE | PC | NA | I | NA | I | P | |
| Fuel assemblies | GE | PC | NA | I | NA | I | P | |
| Reactor vessel stabilizer | GE | PC | NA | I | NA | I | P | |
| Reactor vessel insulation | P | PC | NA | NA | NA | NA | P | |
| **Nuclear Boiler System** | | | | | | | | |
| Instrumentation condensing chambers | GE | PC | NA | I | A | I | P | |
| SRV air accumulators | P | PC | NA | I | B | I | P | |
| Piping, SRV discharge | P | PC | NA | I | C | I | P | |
| Piping, main steam within outermost isolation valve | P | PC | NA | I | A | I | P | (3) |
| Pipe supports, main steam within outermost isolation valve | P | PC | NA | I | A | I | P | |
| Pipe whip restraints, main steam, and feedwater | P | PC, RB | NA | I | NA | I | P | |
| Piping, feedwater within outermost isolation valve | P | PC | NA | I | A | I | P | |
| Piping, other RCPB piping within outermost isolation valve | P | PC | NA | I | A | I | P | (3) |
| Piping, instrumentation beyond outermost isolation valve | P | RB, TB | NA | I or NA | B or D | I or NA | P | |
| Safety/relief valves | GE | PC | 1E | I | A | I | P | |

TABLE 3.2-1 (Cont)

| | Scope of Supply | Location | Electrical Classification | Seismic Category | Quality Group Classification | Quality Assurance Requirement | Tornado Protection | Notes |
|---|---|---|---|---|---|---|---|---|
| Valves, main steam isolation valves (MSIV) | P | PC,RB | 1E | I | A | I | P | |
| Valves, feedwater isolation valves | P | PC,RB | 1E | I | A | I | P | |
| Valves, other isolation valves and within outermost isolation valve | P | PC,RB | 1E | I | A | I | P | |
| Valves, instrumentation beyond outermost isolation valve | P | RB | NA | NA | D | NA | P | |
| Instrumentation modules with safety function | GE | RB | 1E | I | NA | I | P | |
| Electrical modules with safety function | GE | RB | 1E | I | NA | I | P | |
| Cable, cable trays, and supports with safety function | P | C,RB,M | 1E | I | NA | I | P | |
| T-Quenchers | P | PC | NA | I | C | I | P | |
| **Recirculation System** | | | | | | | | |
| Piping, essential | GE,P | PC,RB | NA | I | A,B | I | P | (3) |
| Pipe suspension, recirculation line | GE | PC | NA | I | NA | I | P | |
| Pipe restraints, recirculation line | GE | PC | NA | I | NA | I | P | (4) |
| Pumps | GE | PC | NA | I | A | I | P | |
| Valves, essential | GE,P | PC,RB | 1E | I | A,B,C | I | P | |
| Piping and valves, nonessential | P | RB | NA | NA | D | NA | P | |
| Pump motors | GE | PC | Non-1E | I | NA | I | P | |
| Electrical modules with safety function | GE | RB | 1E | I | NA | I | P | |
| Cable, cable trays, and supports with safety function | P | C,RB,M | 1E | I | NA | I | P | |
| LMFG set | GE | N | Non-1E | NA | NA | NA | NR | |

TABLE 3.2-1 (Cont)

| | Scope of Supply | Location | Electrical Classification | Seismic Category | Quality Group Classification | Quality Assurance Requirement | Tornado Protection | Notes |
|---|---|---|---|---|---|---|---|---|
| **CRD Hydraulic System** | | | | | | | | |
| Valves, scram discharge volume lines | GE | RB | 1E | I | B | I | P | |
| Valves, insert and withdraw lines | P | RB | NA | I | B | I | P | (5) |
| Valves, other | GE,P | RB | Non-1E | NA | D | NA | P | |
| Piping, scram discharge volume lines | P | RB | NA | I | B | I | P | |
| Piping, insert and withdraw lines | P | PC,RB | NA | I | B | I | P | (5) |
| Piping, other | P | RB | NA | NA | D | NA | P | |
| Hydraulic control unit | GE | RB | NA | I | Special | I | P | (6) |
| CRD pumps, filters and strainers | GE | RB | Non-1E | NA | D | NA | P | |
| Electric modules with safety function | GE | RB | 1E | I | NA | I | P | |
| Cable, cable trays, and supports with safety function | P | C,RB,M | 1E | I | NA | I | P | |
| **Standby Liquid Control System** | | | | | | | | |
| Standby liquid control storage tank | GE | RB | NA | I | B | I | P | |
| Pumps | GE | RB | NA | I | B | I | P | |
| Pump motors | GE | RB | 1E | I | NA | I | P | |
| Valves, explosive | GE | RB | 1E | I | A | I | P | |
| Valves, isolation and within primary containment | P | PC,RB | NA | I | A | I | P | |
| Valves, beyond isolation valves | P | RB | 1E | I | B | I | P | |
| Piping, downstream of explosive valves | P | PC,RB | NA | I | A | I | P | |
| Piping, upstream of explosive valves | P | RB | NA | I | B | I | P | |
| Electrical modules with safety function | GE | RB | 1E | I | NA | I | P | |
| Cable, cable trays, and supports with safety function | P | C,RB,M | 1E | I | NA | I | P | |
| Test tank | P | RB | NA | NA | D | NA | P | |
| Piping and valves, other | P | RB | NA | NA | D | NA | P | |

TABLE 3.2-1 (Cont)

| | Scope of Supply | Location | Electrical Classification | Seismic Category | Quality Group Classification | Quality Assurance Requirement | Tornado Protection | Notes |
|---|---|---|---|---|---|---|---|---|
| Condensate Storage and Transfer System | | | | | | | | |
| Condensate storage tank | P | M | NA | NA | D | NA | NR | (19) |
| Piping | P | M,P,RB,T,W | NA | NA | D | NA | NR | |
| Valves and other components | P | M,P,RB,T,W | Non-1E | NA | D | NA | NR | |
| Standby Gas Treatment System | | | | | | | | |
| Filter units | P | RB | 1E | I | C | I | P | |
| Automatic valves | P | RB | 1E | I | C | I | P | |
| Piping and manual valves, essential | P | RB | NA | I | C | I | P | |
| Piping and manual valves, nonessential | P | RB | NA | I | D | I | P | |
| All other components | P | RB | Non-1E | I | C | I | P | |
| Primary Containment Purge System | | | | | | | | |
| Automatic isolation valves | P | RB | 1E | I | C | I | P | |
| Piping and manual valves, essential | P | RB | NA | I | C | I | P | |
| All other components, essential | P | RB | Non-1E | I | C | I | P | |
| All other components, nonessential | P | RB | NA | NA | D | NA | P | |
| Diesel Generator Systems | | | | | | | | |
| Piping, fuel oil | P | O,S | NA | I | C | I | P | |
| Valves, fuel oil | P | O,S | 1E | I | C | I | P | |
| Pumps, fuel oil | P | S | NA | I | C | I | P | |
| Pump motors, fuel oil system | P | S | 1E | I | NA | I | P | |
| Day tanks | P | S | NA | I | C | I | P | |
| Diesel fuel storage tanks | P | S | NA | I | C | I | P | |
| Piping, air startup, essential | P | S | NA | I | C | I | P | |
| Valves, air startup, essential | P | S | 1E | I | C | I | P | |
| Piping, air startup, nonessential | P | S | NA | NA | D | NA | P | |
| Compressors, air startup | P | S | Non-1E | NA | D | NA | P | |
| Receivers, air startup | P | S | NA | I | C | I | P | |
| HPCS diesel-generator | GE | S | 1E | I | B | I | P | |
| Standby diesel-generators | P,GE | S | 1E | I | B | I | P | |

TABLE 3.2-1 (Cont)

the process shutoff valve (root valve) to the sensing instrumentation.

d. All other instrument lines:

1) through the root valve are of the same classification as the system to which they are attached.
2) beyond the root valve, if used to actuate a safety system, are of the same classification as the system to which they are attached.
3) beyond the root valve, if not used to actuate a safety system, may be Quality Group D.

e. All sample lines from the outer isolation valve or the process root valve through the remainder of the sampling system are Quality Group D.

(4) Recirculation system pipe restraints are not required to function (i.e., restrain a pipe) during an earthquake. These restraints are designed to withstand an SSE without loss of functional capability.

(5) The CRD insert and withdraw lines from the drive flange up to and including the first valve on the hydraulic control unit (HCU) are Safety Class 2.

(6) The HCU is a GE factory-assembled engineered module of valves, tubing, piping, and stored water which controls a single CRD by the application of precisely timed sequences of pressures and flows to accomplish slow insertion or withdrawal of the control rods for power control and rapid insertion for reactor scram.

Although the HCU, as a unit, is field installed and connected to process piping, many of its internal parts differ markedly from process piping components because of the more complex functions they must provide. Thus, although the codes and standards invoked by Group A, B, C, and D pressure integrity quality levels clearly apply at all levels to the interfaces between the HCU and the connecting conventional piping components (e.g., pipe nipples, fittings, simple hand valves), it is considered that they do not apply to the specialty parts (e.g., solenoid valves, pneumatic components, and instruments).

The design and construction specifications for the HCU do invoke such codes and standards as can be reasonably

TABLE 3.2-1 (Cont)

examination may be substituted. Examination procedures and acceptance standards are at least equivalent to those specified in ANSI B31.1.0.

b. All fillet and socket welds are examined by either magnetic particle or liquid penetrant methods. All structural attachment welds to pressure-retaining materials are examined by either magnetic particle or liquid penetrant methods. Examination procedures and acceptance standards are at least equivalent to those specified in ANSI B31.1.0.

c. The main steam line (MSL) from its outer isolation valve up to and including the turbine stop valve and all branch lines 2 1/2 inches in diameter and larger, up to and including the first valve (including restraints) is designed by the use of an appropriate dynamic seismic-system analysis to withstand OBE and DBE design loads in combination with other appropriate loads within the limits specified for Safety Class 2 pipe in ASME Section III. The mathematical model for the dynamic seismic analyses of the MSL and branch line piping includes the turbine stop valves and piping beyond the stop valves including the piping to the turbine casing. The dynamic input loads for design of the MSL are derived from a time history model analysis (or an equivalent method) of the reactor and applicable portions of the turbine building. The turbine building, housing the MSLs, may undergo some plastic deformation under the DBE, however, the plastic deformation will be limited to a ductility factor (defined as the ratio between the maximum displacement and the yield displacement) of 2 and an elastic multi-degree-of-freedom system analysis will be used to determine the input to the MSL. The stress allowable and associated deformation limits for piping will be in accordance with Quality Group B requirements for the OBE and DBE loading combinations. The MSL supporting structures (those portions of the turbine building) are such that the MSL and its supports can maintain their integrity within the Quality Group B requirements under the Category I seismic loading condition.

TABLE 3.2-1 (Cont)

operated from the control room using signals that indicate loss of feedwater flow. The classification of the feedwater lines from the reactor vessel to and including the third isolation valve will be Quality Group A; beyond the third valve will be Quality Group D.

[19]The condensate storage tank is designed, fabricated, and tested in accordance with the requirements of ASTM D 3299-74 or NBS PS 15-69.

[20]The radwaste building is designed and constructed in full compliance with Regulatory Guide 1.143.

[21]The standby gas treatment building is designed and constructed in accordance with QA Category I requirements up to el 286 ft only.

[22]The reactor building polar crane (RBPC) is designed to withstand the spectrum of tornado-generated missiles (Section 3.5.1.4). The metal siding above the refueling floor is designed to withstand the wind loading generated by a tornadic event. This precludes RBPC from exposure to tornadic wind loading.

[23]The revetment ditch system has been analyzed for the combination of (1) the instantaneous lake level at el 248.8 ft due to 25-year flood and an SSE, and (2) the 5
instantaneous lake level at el 249.5 ft due to 100-year flood and an OBE, and the revetment ditch system is found sufficiently stable.

of missiles, is not considered credible. Massive and rapid failure of these components is not considered credible because of the material characteristics; inspections; quality control during fabrication, erection, and operation; conservative design; and prudent operation as applied to the particular component.

The most substantial piece of nuclear steam supply system (NSSS) rotating equipment is the recirculation pump and motor. The potential for missiles from this source has been evaluated and it has been concluded that destructive pump overspeed cannot result in the generation of missiles[1].

Motors will not become missiles because the rotation speed is limited to within design speed. The pump shaft failure decouples the rotor for the overspeed driving blowdown force. Only those cases with peak torques less than those required to fail the pump shaft (five times rated) will have the capability to drive the motor to overspeed. When missile generation probabilities are considered along with a discussion of the actual load-bearing capabilities of the system, it is evident that these considerations support the conclusion that it is unrealistic that the motors would become missiles.

The pump impeller or fan blades will not become missiles during coupling failures because braking forces applied by the process fluids will limit the rotational speed to less than the normal operating speed. The coupling will remain inside the pump coupling guard or fan housing.

Redundant overspeed tripping devices ensure that the turbine does not reach runaway speed where possible component failure could take place.

THIS PAGE INTENTIONALLY BLANK

3.9.2.2.2B Seismic and Hydrodynamic Load Qualification of Specific NSSS Mechanical Components

The following sections discuss the testing or analytical qualification of NSSS equipment. Seismic qualification is also described in Sections 3.9.1.4B, 3.9.3.1B, and 3.9.3.2B.

Jet Pumps

A dynamic analysis of the jet pumps is performed and stresses from the analysis are below the design allowables.

CRD and CRD Housing

The dynamic qualification of the CRD housing (with enclosed CRD) is done analytically, and the stress results of their analysis established the structural integrity of these components. Preliminary dynamic tests have been conducted to verify the operability of the CRD during a dynamic event. A simulated test, imposing a static bow in the fuel channels, is performed with the CRD functioning satisfactorily.

Core Support (Fuel Support and Control Rod Guide Tube)

A detailed analysis imposing dynamic effects due to seismic and hydrodynamic events showed that the maximum stresses developed during these events are much lower than the maximum allowed for the component material.

Hydraulic Control Unit

The seismic and hydrodynamic load adequacy of the HCU for the faulted condition was determined by test and analysis with the HCUs mounted on a seismic support structure. The dynamic loads were 1.7 g horizontal at 10 to 23 Hz natural frequency and 0.5 g vertical at 23 Hz. At these frequencies, the maximum HCU capabilities by test for seismic and hydrodynamic loads were 6 to 12 g horizontal and 23 g vertical.

Fuel Assembly (Including Channels)

GE BWR fuel channel design bases, analytical methods, and evaluation results, including seismic and hydrodynamic considerations, are contained in NEDE 24011[6] and NEDE 24011-US[7]. See Section 3.9.1.4.10B.

Recirculation Pump and Motor Assembly

Calculations were made to assure that the recirculation pump and motor assembly is designed to withstand the specific static equivalent seismic and hydrodynamic loads. The flooded assembly was analyzed as a free body supported by constant support hangers from the brackets on the motor mounting member with hydraulic snubbers attached to brackets located on the pump case and the top of the motor frame.

Primary stresses due to horizontal and vertical seismic (including hydrodynamic) forces are considered to act simultaneously and are conservatively added directly. Horizontal and vertical dynamic forces are applied to mass centers, and equilibrium reactions are determined for motor and pump brackets.

ECCS Pump and Motor Assembly

The qualification of the ECCS pump and motor assemblies as a unit while operating under faulted conditions was provided in the form of a static earthquake-acceleration analysis. The maximum specified vertical and horizontal accelerations were constantly applied simultaneously in the worst-case combination and the results of the analysis indicate the pump is capable of sustaining these loadings without overstressing the pump components.

A motor of similar design has been seismically qualified via a combination of static analysis and dynamic testing. The complete motor assembly has been seismically qualified via dynamic testing, in accordance with IEEE-344-1975. The qualification test program included demonstration of startup and shutdown capabilities, as well as no-load operability during seismic and hydrodynamic loading conditions.

RCIC Pump Assembly

The RCIC pump construction is a barrel-type on a large cross-section pedestal. The RCIC pump assembly is analytically qualified by static analysis for seismic and hydrodynamic loading as well as the design operating loads of pressure, temperature, and external piping loads. The results of this analysis confirm that the stresses are substantially less than the allowables.

RCIC Turbine Assembly

The RCIC turbine is qualified for seismic and hydrodynamic loads via a combination of static analysis and dynamic

equipment must perform its safety function have been specified and used as the basis for environmental qualification.

Qualification by Type Testing or Combination of Type Test/ Analysis

Testing is the preferred method of qualification. Analysis is used to verify or supplement test results and operating experience. Qualification by analysis alone is used only for equipment for which qualification by test is precluded by physical size or application.

Conditions simulated during the test are reviewed to assure that they envelop the full range of environmental and service conditions that can be experienced. The test duration and environmental profiles used in the test are reviewed to ensure that they equal or exceed values specified for the equipment. The test specimen model, design, and material construction are reviewed against the equipment being supplied to verify applicability of qualification test results. The test methods and procedures are reviewed for conformance with the specified requirements.

Operational modes tested are reviewed to assure that they represent the actual application requirements as defined in the procurement documents.

Where seals, connectors, and mounting devices are included as part of the component, the test results and conclusions address them and they are part of the qualification. Materials used for terminating cables and similar components are addressed separately.

Methods (test, evaluation, analysis) used to qualify various Class 1E equipment and components are reviewed and a determination of their adequacy is made on a case-by-case basis.

Aging

During test procedures, prior to simulating seismic events and DBAs, equipment or its age-sensitive components are preconditioned to their end-of-qualified-life condition. As applicable, preconditioning stress methods include elevating temperature, irradiation, operational cycling, power switching, pressure tests, and vibration. At all times stress levels are limited to values that will not induce a material phase change in the equipment.

Arrhenius aging methodology is the preferred method of thermally aging equipment and in general is used as a basis for determining qualified life. When other methods are used, proper justification is provided. In general, a gamma radiation source is used to simulate expected radiation exposure. Where beta and gamma radiation exposure is expected, beta radiation is taken into account either during simulation or during evaluation of the results. Plant operating cycles, typical for the equipment type and location, are simulated during testing.

Margin

Qualification type test results are reviewed to verify that adequate margin exists between the most severe specified service conditions for the equipment and the conditions used in type testing. This accounts for normal variations in commercial production of equipment and reasonable errors in defining satisfactory performance. Increased levels of testing, number of test cycles, and test duration are among methods used for assuring adequate margin.

### 3.11.3 Qualification Test Results

Qualification documentation is reviewed for methodology and content to assure that the requirements of Category II of NUREG-0588 are met or exceeded. The documentation acceptance criteria are such that auditable engineering details of the qualification procedures and conclusions, that the conclusions were justified, that each specimen qualified is applicable to the equipment installed in the plant, and that the qualification test parameters envelop those specified for the equipment.

The status of the qualification documentation will be contained in the EQD.

Equipment tested was exposed to a temperature, pressure, humidity, and radiation environment applicable to the location. The equipment tested in each case performed its required safety function under the extreme environmental conditions specified. Qualification test results and supporting documentation are maintained in an auditable file for review and use during plant operation.

### 3.11.4 Loss of Heating, Ventilating, and Air Conditioning

To ensure that loss of heating, ventilating, and air conditioning (HVAC) systems does not adversely affect the operability of safety-related controls and electrical

# CHAPTER 4

# REACTOR

## TABLE OF CONTENTS


| Section | Title | Page |
|---|---|---|
| 4.1 | SUMMARY DESCRIPTION | 4.1-1 |
| 4.1.1 | Reactor Vessel | 4.1-1 |
| 4.1.2 | Reactor Internal Components | 4.1-1 |
| 4.1.2.1 | Reactor Core | 4.1-1 |
| 4.1.2.2 | Shroud | 4.1-4 |
| 4.1.2.3 | Shroud Head and Steam Separators | 4.1-5 |
| 4.1.2.4 | Steam Dryer Assembly | 4.1-5 |
| 4.1.3 | Reactivity Control Systems | 4.1-5 |
| 4.1.3.1 | Operation | 4.1-5 |
| 4.1.3.2 | Description of Control Rods | 4.1-5 |
| 4.1.3.3 | Supplementary Reactivity Control | 4.1-5 |
| 4.1.4 | Analysis Techniques | 4.1-6 |
| 4.1.4.1 | Reactor Internal Components | 4.1-6 |
| 4.1.4.1.1 | MASS (Mechanical Analysis of Space Structure) | 4.1-6 |
| 4.1.4.1.2 | SNAP (MULTISHELL) | 4.1-7 |
| 4.1.4.1.3 | GASP | 4.1-7 |
| 4.1.4.1.4 | NOHEAT | 4.1-8 |
| 4.1.4.1.5 | FINITE | 4.1-9 |
| 4.1.4.1.6 | DYSEA (Dynamic and Seismic Analysis) | 4.1-9 |
| 4.1.4.1.7 | SHELL 5 | 4.1-10 |
| 4.1.4.1.8 | HEATER | 4.1-11 |
| 4.1.4.1.9 | FAP-71 (Fatigue Analysis Program) | 4.1-12 |
| 4.1.4.1.10 | CREEP/PLAST | 4.1-12 |
| 4.1.4.1.11 | ANSYS | 4.1-13 |
| 4.1.4.2 | Fuel Rod Thermal Analysis | 4.1-14 |
| 4.1.4.3 | Reactor Systems Dynamics | 4.1-14 |
| 4.1.4.4 | Nuclear Engineering Analysis | 4.1-15 |
| 4.1.4.5 | Neutron Fluence Calculations | 4.1-15 |
| 4.1.4.6 | Thermal-Hydraulic Calculations | 4.1-15 |
| 4.1.5 | References | 4.1-16 |
| 4.2 | FUEL SYSTEM DESIGN | 4.2-1 |
| 4.2.1 | Design Bases | 4.2-1 |
| 4.2.2 | Description and Design Drawings | 4.2-1 |
| 4.2.2.1 | Reactivity Control Assembly (Control Rods) | 4.2-1 |
| 4.2.2.2 | Reactivity Control Assembly Evaluation | 4.2-1 |
| 4.2.3 | Design Evaluation | 4.2-1 |

CHAPTER 4

TABLE OF CONTENTS (Cont)


| Section | Title | Page |
|---|---|---|
| 4.2.4 | Testing, Inspection, and Surveillance Plans | 4.2-1 |
| 4.2.5 | References | 4.2-2 |
| 4.3 | NUCLEAR DESIGN | 4.3-1 |
| 4.3.1 | Design Bases | 4.3-1 |
| 4.3.2 | Description | 4.3-1 |
| 4.3.2.1 | Nuclear Design Description | 4.3-1 |
| 4.3.2.2 | Power Distribution | 4.3-1 |
| 4.3.2.2.1 | Power Distribution Calculations | 4.3-1 |
| 4.3.2.2.2 | Power Distribution Measurements | 4.3-1 |
| 4.3.2.2.3 | Power Distribution Accuracy | 4.3-1 |
| 4.3.2.2.4 | Power Distribution Anomalies | 4.3-1 |
| 4.3.2.3 | Reactivity Coefficients | 4.3-1 |
| 4.3.2.4 | Control Requirements | 4.3-2 |
| 4.3.2.4.1 | Shutdown Reactivity | 4.3-2 |
| 4.3.2.4.2 | Reactivity Variations | 4.3-2 |
| 4.3.2.5 | Control Rod Patterns and Reactivity Worths | 4.3-2 |
| 4.3.2.5.1 | Scram Reactivity | 4.3-2 |
| 4.3.2.6 | Criticality of Reactor During Refueling | 4.3-2 |
| 4.3.2.7 | Stability | 4.3-2 |
| 4.3.2.7.1 | Xenon Transients | 4.3-2 |
| 4.3.2.7.2 | Thermal-Hydraulic Stability | 4.3-2 |
| 4.3.2.8 | Vessel Irradiations | 4.3-3 |
| 4.3.3 | Analytical Methods | 4.3-3 |
| 4.3.4 | Changes | 4.3-3 |
| 4.3.5 | References | 4.3-4 |
| 4.4 | THERMAL-HYDRAULIC DESIGN | 4.4-1 |
| 4.4.1 | Design Bases | 4.4-1 |
| 4.4.2 | Description of Thermal-Hydraulic Design of the Reactor Core | 4.4-1 |
| 4.4.2.1 | Summary Comparison | 4.4-1 |
| 4.4.2.2 | Critical Power Ratio | 4.4-1 |
| 4.4.2.3 | Linear Heat Generation Rate | 4.4-1 |
| 4.4.2.4 | Void Fraction Distribution | 4.4-1 |
| 4.4.2.5 | Core Coolant Flow Distribution and Orificing Pattern | 4.4-2 |
| 4.4.2.6 | Core Pressure Drop and Hydraulic Loads | 4.4-2 |
| 4.4.2.7 | Correlation and Physical Data | 4.4-2 |

## 4.2 FUEL SYSTEM DESIGN

The format of this section corresponds to Standard Review Plan 4.2 in NUREG-0800. Most of the information presented will be by reference to the licensing topical report, General Electric Standard Application for Reactor Fuel, GESTAR II[1].

### 4.2.1 Design Bases

See Section A.4.2.1 of GESTAR II[1].

### 4.2.2 Description and Design Drawings

See Section A.4.2.2 of GESTAR II[1].

#### 4.2.2.1 Reactivity Control Assembly (Control Rods)

The control rod description is given in Section 2.2.4 and shown on Figures 2.6a, 2.6b, and 2.7 of NEDE 20944-P-1[2].

#### 4.2.2.2 Reactivity Control Assembly Evaluation

The control rod evaluation is given in Section 2.3.3 of NEDE-20944-P-1[2].

### 4.2.3 Design Evaluation

See Section A.4.2.3 of GESTAR II[1].

### 4.2.4 Testing, Inspection, and Surveillance Plans

See Section A.4.2.4 of GESTAR II[1].

### 4.2.5 References

1. General Electric Standard Application for Reactor Fuel, including United States Supplement, NEDE-24011-P-A and NEDE-24011-P-A-US (latest approved revision).

2. BWR/4 and BWR/5 Fuel Design, NEDE-20944-P-1 (proprietary) and NEDO-20944-1, October 1976, and Amendment 1, January 1977.

# 4.4 THERMAL-HYDRAULIC DESIGN

## 4.4.1 Design Bases

The design basis is given in Section A.4.4.1 of GESTAR II[1].

The design steady-state minimum critical power ratio (MCPR) limit and the peak linear heat generation rate (LHGR) are given in Table 4.4-1.

## 4.4.2 Description of Thermal-Hydraulic Design of the Reactor Core

Information pertaining to Section 4.4.2 is given in Section A.4.4.2 of GESTAR II[1]. Additions or differences are provided below for each applicable subsection.

### 4.4.2.1 Summary Comparison

An evaluation of plant performance from a thermal-hydraulic standpoint is provided in Section 4.4.3. A tabulation of thermal-hydraulic parameters of the core and a comparison of this reactor with others of similar design are given in Table 4.4-1.

### 4.4.2.2 Critical Power Ratio

See Section A.4.4.2.2 of GESTAR II[1].

### 4.4.2.3 Linear Heat Generation Rate

See Section A.4.4.2.3 of GESTAR II[1].

### 4.4.2.4 Void Fraction Distribution

See Section A.4.4.2.4 of GESTAR II[1].

The core average and maximum exit void fractions in the core at rated condition are given in Table 4.4-1. The axial distribution of core void fractions for the average radial channel and the maximum radial channel (end of node value) for the core are given in Table 4.4-2. Similar distributions for steam quality are provided in Table 4.4-3. The core average axial power distribution used to produce these tables is given in Table 4.4-4.

### 4.4.2.5 Core Coolant Flow Distribution and Orificing Pattern

See Section A.4.4.2.5 of GESTAR II[1].

### 4.4.2.6 Core Pressure Drop and Hydraulic Loads

See Section A.4.4.2.6 of GESTAR II[1].

### 4.4.2.7 Correlation and Physical Data

Substantial amounts of physical data have been obtained in support of the pressure drop and thermal-hydraulic loads. This information is given in Appendix B of GESTAR II[1] which responds to NRC questions to Section 4 of GESTAR II[1].

### 4.4.2.8 Thermal Effects of Operational Transients

See Section A.4.4.2.8 of GESTAR II[1].

### 4.4.2.9 Uncertainties in Estimates

See Section A.4.4.2.9 of GESTAR II[1].

### 4.4.2.10 Flux Tilt Considerations

The inherent design characteristics of the BWR are particularly well suited to handling perturbations due to flux tilt. The stablizing nature of the moderator void coefficient effectively damps oscillations in the power distribution. In addition to this damping, the incore instrumentation system and associated online computer provide the operator with prompt and reliable power distribute information. Thus, the operator can readily use control rods or other means to effectively limit undesirable effects of flux tilting. Because of these features and capabilities, it is not necessary to allocate a specific peaking factor margin to account for flux tilt. If for some reason, the power distribution could not be maintained within normal limits using control rods, then the operating power limits would have to be reduced as described in Chapter 16.

i. Design Criterion 9

Instrumentation shall be provided to aid the operator in the detection of water accumulation in the instrumented volume(s) prior to scram initiation.

Nine Mile Point Unit 2 Compliance

The present alarm and rod block instrumentation meets this criterion.

j. Design Criterion 10

Vent and drain line valves shall be provided to contain the scram discharge water, with a single active failure, and to minimize operational exposure.

Nine Mile Point Unit 2 Compliance

See response to Safety Criterion 2 and Operational Criterion 3.

5. Surveillance Criteria 5

a. Surveillance Criterion 1

Vent and drain valves shall be periodically tested.

b. Surveillance Criterion 2

Verifying level detection instrumentation shall be periodically tested in place.

c. Surveillance Criterion 3

The operability of the entire system as an integrated whole shall be demonstrated periodically and during each operating cycle, by demonstrating scram instrument response and valve function at pressure and temperature at approximately 50 percent control-rod density.

Nine Mile Point Unit 2 Compliance

The Unit 2 technical specifications and periodic testing requirements will address these criteria.

Hydraulic Control Units Each HCU furnishes pressurized water, on signal, to a drive unit. The drive then positions its control rod as required. Operation of the electrical system that supplies scram and normal control rod positioning signals to the HCU is described in Section 7.7.1.1.

The basic components in each HCU are manual, pneumatic, and electrical valves; an accumulator; related piping; electrical connections; filters; and instrumentation (Figures 4.6-5 and 4.6-8). The components and their functions are described as follows:

Insert Drive Valve The insert drive valve is solenoid operated and opens on an insert signal. The valve supplies drive water to the bottom side of the main drive piston.

Insert Exhaust Valve The insert exhaust solenoid valve also opens on an insert signal. The valve discharges water from above the drive piston to the exhaust water header.

Withdraw Drive Valve The withdraw drive valve is solenoid operated and opens on a withdraw signal. The valve supplies drive water to the top of the drive piston.

Withdraw Exhaust Valve The solenoid-operated withdraw exhaust valve opens on a withdraw signal and discharges water from below the main drive piston to the exhaust header. It also serves as the settle valve, which opens, following any normal drive movement (insert or withdraw), to allow the control rod and its drive to settle back into the nearest latch position.

# CHAPTER 5

## REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS

## TABLE OF CONTENTS


| Section | Title | Page |
|---|---|---|
| 5.1 | SUMMARY DESCRIPTION | 5.1-1 |
| 5.1.1 | Schematic Flow Diagram | 5.1-3 |
| 5.1.2 | Piping and Instrumentation Diagram | 5.1-3 |
| 5.1.3 | Elevation Drawing | 5.1-4 |
| 5.2 | INTEGRITY OF REACTOR COOLANT PRESSURE BOUNDARY | 5.2-1 |
| 5.2.1 | Compliance with Codes and Code Cases | 5.2-1 |
| 5.2.1.1 | Compliance with 10CFR50, Section 50.55a | 5.2-1 |
| 5.2.1.2 | Applicable Code Cases | 5.2-1 |
| 5.2.2 | Overpressure Protection | 5.2-1 |
| 5.2.2.1 | Design Basis | 5.2-1 |
| 5.2.2.1.1 | Safety Design Bases | 5.2-1 |
| 5.2.2.1.2 | Power Generation Design Bases | 5.2-2 |
| 5.2.2.1.3 | Discussion | 5.2-2 |
| 5.2.2.1.4 | Safety/Relief Valve Capacity | 5.2-3 |
| 5.2.2.2 | Design Evaluation | 5.2-4 |
| 5.2.2.2.1 | Method of Analysis | 5.2-4 |
| 5.2.2.2.2 | System Design | 5.2-4 |
| 5.2.2.2.3 | Evaluation of Results | 5.2-5 |
| 5.2.2.3 | Piping and Instrument Diagrams | 5.2-6 |
| 5.2.2.4 | Equipment and Component Description | 5.2-6 |
| 5.2.2.4.1 | Description | 5.2-6 |
| 5.2.2.4.2 | Design Parameters | 5.2-9a |6 |
| 5.2.2.4.3 | Safety/Relief Valve | 5.2-10 |
| 5.2.2.5 | Mounting of Pressure Relief Devices | 5.2-10 |
| 5.2.2.6 | Applicable Codes and Classification | 5.2-11 |
| 5.2.2.7 | Material Specification | 5.2-11 |
| 5.2.2.8 | Process Instrumentation | 5.2-11 |
| 5.2.2.9 | System Reliability | 5.2-11 |
| 5.2.2.10 | Inspection and Testing | 5.2-11 |
| 5.2.3 | Reactor Coolant Pressure Boundary Materials | 5.2-12 |
| 5.2.3.1 | Material Specifications | 5.2-12 |
| 5.2.3.2 | Compatibility with Reactor Coolant | 5.2-12 |
| 5.2.3.2.1 | PWR Chemistry of Reactor Coolant | 5.2-12 |
| 5.2.3.2.2 | BWR Chemistry of Reactor Coolant | 5.2-12 |

CHAPTER 5

TABLE OF CONTENTS (Cont)


| Section | Title | Page |
|---|---|---|
| 5.2.3.2.3 | Compatibility of Construction Materials with Reactor Coolant | 5.2-18 |
| 5.2.3.2.4 | Compatibility of Construction Materials with External Insulation and Reactor Coolant | 5.2-18 |
| 5.2.3.3 | Fabrication and Processing of Ferritic Materials | 5.2-19 |
| 5.2.3.3.1 | Fracture Toughness | 5.2-19 |
| 5.2.3.3.2 | Control of Welding | 5.2-20 |
| 5.2.3.3.3 | Nondestructive Examination of Ferritic Tubular Products | 5.2-20 |
| 5.2.3.3.4 | Moisture Control For Low Hydrogen Covered Arc Welding Electrodes | 5.2-21 |
| 5.2.3.4 | Fabrication and Processing of Austenitic Stainless Steels | 5.2-21 |
| 5.2.3.4.1 | Avoidance of Stress Corrosion Cracking | 5.2-21 |
| 5.2.3.4.2 | Control of Welding | 5.2-22 |
| 5.2.4 | Inservice Inspection and Testing of Reactor Coolant Pressure Boundary | 5.2-24 |
| 5.2.4.1 | System Boundary Subject to Inspection | 5.2-24 |
| 5.2.4.2 | Provisions for Access to the Reactor Coolant Pressure Boundary | 5.2-25 |
| 5.2.4.2.1 | Reactor Vessel Access | 5.2-25 |
| 5.2.4.2.2 | Pipe, Pumps, and Valves | 5.2-27 |
| 5.2.4.3 | Examination Techniques and Procedures | 5.2-27 |
| 5.2.4.3.1 | Equipment for Inservice Inspection | 5.2-27 |
| 5.2.4.3.2 | Coordination of Inspection Equipment with Access Provisions | 5.2-27 |
| 5.2.4.3.3 | Recording and Comparing Data | |
| 5.2.4.4 | Inspection Intervals | 5.2-28 |
| 5.2.4.5 | Inservice Inspection Program Categories and Requirements | 5.2-28 |
| 5.2.4.6 | Evaluation of Examination Results | 5.2-28 |
| 5.2.4.7 | System Leakage and Hydrostatic Pressure Tests | 5.2-28 |
| 5.2.4.8 | Inservice Inspection Commitment | 5.2-28 |
| 5.2.5 | Reactor Coolant Pressure Boundary and ECCS Leakage Detection System | 5.2-29 |
| 5.2.5.1 | Leakage Detection Methods | 5.2-29 |

CHAPTER 5

LIST OF FIGURES


| Figure Number | Title |
|---|---|
| 5.1-1 | RATED OPERATING CONDITIONS OF THE BOILING WATER REACTOR |
| 5.1-2 | NUCLEAR BOILER SYSTEM REACTOR |
| 5.2-1 | SAFETY RELIEF VALVE CAPACITY SIZING TRANSIENT "MSIV CLOSURE WITH HIGH FLUX TRIP" |
| 5.2-2 | SAFETY RELIEF VALVE SCHEMATIC ELEVATION |
| 5.2-3 | SAFETY RELIEF VALVE AND STEAM LINE SCHEMATIC |
| 5.2-4 | NUCLEAR BOILER SYSTEM P&ID |
| 5.2-5 | SCHEMATIC OF SAFETY RELIEF VALVE WITH AUXILIARY ACTUATING DEVICE |
| 5.2-6 | TYPICAL BWR FLOW DIAGRAM |
| 5.2-7 | CONDUCTIVITY, pH, CHLORIDE CONCENTRATION OF AQUEOUS SOLUTIONS AT 77°F (25°C) |
| 5.2-8 | CALCULATED LEAK RATE VS CRACK LENGTH AS A FUNCTION OF APPLIED HOOP STRESS |
| 5.2-9 | AXIAL THROUGHWALL CRACK LENGTH DATA CORRELATION |
| 5.3-1 | BRACKET FOR HOLDING SURVEILLANCE CAPSULE |
| 5.3-2 | MINIMUM TEMPERATURES REQUIRED VERSUS REACTOR PRESSURE |
| 5.3-3 | PREDICTED ADJUSTMENT OF REFERENCE TEMPERATURE "A," AS A FUNCTION OF FLUENCE AND COPPER CONTENT |
| 5.3-4 | REACTOR VESSEL |
| 5.3-5 | NOMINAL REACTOR VESSEL WATER LEVEL TRIP AND ALARM ELEVATION SETTINGS |

CHAPTER 5

LIST OF FIGURES (Cont)


| Figure Number | Title |
|---|---|
| 5.4-1 | RECIRCULATION SYSTEM ELEVATION AND ISOMETRIC |
| 5.4-2 | REACTOR RECIRCULATION SYSTEM P&ID |
| 5.4-3 | RECIRCULATION PUMP HEAD, NPSH, FLOW, AND EFFICIENCY CURVES |
| 5.4-4 | OPERATING PRINCIPLE OF JET PUMP |
| 5.4-5 | CORE FLOODING CAPABILITY OF RECIRCULATION SYSTEM |
| 5.4-6 | MAIN STEAMLINE FLOW RESTRICTOR |
| 5.4-7 | MAIN STEAM ISOLATION VALVE CUTAWAY VIEW |
| 5.4-8 | ACTUATOR ASSEMBLY EXPLODED VIEW |
| 5.4-9 | RCIC SYSTEM P&ID |
| 5.4-10 | REACTOR CORE ISOLATION COOLANT SYSTEM PROCESS DIAGRAM |
| 5.4-11 | VESSEL COOLANT TEMPERATURE VERSUS TIME (TWO HEAT EXCHANGERS AVAILABLE) |
| 5.4-12 | VESSEL COOLANT TEMPERATURE VERSUS TIME (ONE HEAT EXCHANGER AVAILABLE) |
| 5.4-13 | RESIDUAL HEAT REMOVAL SYSTEM P&ID |
| 5.4-14 | RESIDUAL HEAT REMOVAL SYSTEM PROCESS DIAGRAM AND DATA |
| 5.4-15 | RHR PUMP CHARACTERISTIC CURVES |
| 5.4-16 | REACTOR WATER CLEANUP SYSTEM P&ID |
| 5.4-17 | REACTOR WATER CLEANUP SYSTEM |
| 5.4-18 | FILTER DEMINERALIZER SYSTEM P&ID |

2. Qualify for the rated nameplate capacity credit for the overpressure protection function.

3. Meet other performance requirements, such as response time, necessary to provide relief functions.

The SRV discharge piping is designed, installed, and tested in accordance with ASME Section III.

5.2.2.1.4 Safety/Relief Valve Capacity

The SRV capacity is adequate to limit the primary system pressure, including transients, to the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1971 Edition up to and including Winter 1972 Addenda. The essential ASME requirements which are all met by this analysis are discussed as follows.

It is recognized that the protection of vessels in a nuclear power plant is dependent upon many protective systems to relieve or terminate pressure transients. Installation of pressure-relieving devices may not independently provide complete protection. The safety valve sizing evaluation assumes credit for operation of the scram protective system which may be tripped by either one of two sources, i.e., a direct or flux trip signal. The direct scram trip signal is derived from position switches mounted on the main steam line isolation valves (MSIVs) or the turbine stop valves or from pressure switches mounted on the dump valve of the turbine control valve hydraulic actuation system. The position switches are actuated when the respective valves are less than or equal to 90-percent fully open. The pressure switches are actuated when a fast closure of the turbine control valves is initiated. Further, no credit is taken for power operation of the pressure-relieving devices. Credit is taken for the dual-purpose SRVs in their ASME Code qualified mode (spring lift) of safety operation.

The rated capacity of the SRVs is sufficient to prevent a rise in pressure within the protected vessel of more than 110 percent of the design pressure (1.10 x 1,250 psig = 1,375 psig) for events defined in Section 15.2.

Full account is taken of the pressure drop on both the inlet and discharge sides of the valves. All SRVs discharge into the suppression pool through a discharge pipe from each valve which is designed to achieve sonic flow conditions through the valve, thus providing flow independence to discharge piping losses. Additional measures to counteract 5

the effects of backpressure in the SRV discharge lines are
5 discussed in Sections 5.2.2.2.3 and 5.2.2.4.1.

Table 5.2-3 lists the systems that could initiate during the design basis overpressure event.

5.2.2.2 Design Evaluation

5.2.2.2.1 Method of Analysis

The model used to analyze overpressurization is provided in Section S.2.3 of GESTAR II[1].

5.2.2.2.2 System Design

A parametric study was conducted to determine the required steam flow capacity of the SRVs based on the following assumptions.

Operating Conditions

The operating conditions are:

1. Operating power = 3,466 MWt (104.3 percent of nuclear boiler rated power).

2. Vessel dome pressure <1,020 psig.

3. Steam flow = 15.013 x $10^6$ lb/hr (105 percent of nuclear boiler rated steam flow).

These conditions are the most severe because maximum stored energy exists at these conditions. At lower power conditions, the transients would be less severe.

Transients

The overpressure protection system must accommodate the most severe pressurization event described in Section S.2.3 of GESTAR II[1]. Table 5.2-4 lists the sequence of events for this worst-case transit, the MSIV closure with flux scram, based on the installed SRV capacity.

expected that the lowest set SRV will reopen and reclose as generated heat drops into the decay heat characteristics. The pressure increase and relief cycle continues with lower frequency and shorter relief discharges as the decay heat drops off and until such time as the residual heat removal (RHR) system can dissipate this heat. Remote manual actuation of the valves from the main control room is recommended to minimize the total number of these discharges, with the intent of achieving extended valve seat life. The design and position indication of the SRVs comply with the requirements of NUREG-0737, as discussed in Section 1.10.

A schematic of the SRV is shown on Figure 5.2-5. It is opened by either of two modes of operation:

1. The spring (safety) mode of operation which consists of direct action of the steam pressure against a spring-loaded disk that will pop open when the valve inlet pressure force exceeds the spring force.

2. The power-actuated (relief) mode of operation which consists of using an auxiliary actuating device consisting of a pneumatic piston/cylinder and mechanical linkage assembly which opens the valve by overcoming the spring force, even with valve inlet pressure equal to 0 psig.

The pneumatic operator is arranged so that if it malfunctions it does not prevent the valve disk from lifting if steam inlet pressure reaches the spring lift set pressure.

For overpressure SRV operation (self-actuated or spring lift mode), the spring load establishes the SRV opening set point pressure and is set to open at set points designated in Table 5.2-2. In accordance with the ASME code, the full lift of this mode of operation is attained at a pressure no greater than 3 percent above the set point.

The safety function of the SRV is a backup to the relief function described in the following paragraph. The spring-loaded valves are designed and constructed in accordance with ASME Section III, Subsubarticle NB-7640, as safety valves with auxiliary actuating devices.

For overpressure relief valve operation (power-actuated mode), each valve is provided with a pressure-sensing device that operates at the set points designated in Table 5.2-2.

When the set pressure is reached, it operates a solenoid air valve which in turn actuates the pneumatic piston/cylinder and linkage assembly to open the valve. When the piston is actuated, the delay time (maximum elapsed time between receiving the overpressure signal at the valve actuator and the actual start of valve motion) does not exceed 0.1 sec. The maximum elapsed time between signal to actuator and full open position of valve does not exceed 0.2 sec.

The SRVs can be operated in the power-actuated mode by remote-manual controls from the main control room.

Each SRV has its own pneumatic accumulator and inlet check valve. The accumulator capacity is sufficient to provide one SRV actuation, which is all that is required for overpressure protection. Subsequent actuations for an overpressure event can be spring actuations to limit reactor pressure to acceptable levels.

The SRVs are designed to operate to the extent required for overpressure protection in the following accident environments:

1. 340°F for 3 hr, at drywell pressure ≤45 psig.

2. 320°F for an additional 3-hr period, at drywell pressure ≤45 psig.

3. 250°F for an additional 18-hr period, at 25 psig.

4. Duration of operability is 2 days at 200°F and 20 psig, following which the valves remain fully open or closed for 97 days, provided air and power supply is available. No power/air supply is required to keep the valve closed.

The ADS utilizes seven selected SRVs for depressurization of the reactor (Section 6.3). Each of the SRVs used for automatic depressurization is equipped with an air accumulator and check valve arrangement. These accumulators assure that the valves can be held open following failure of the air supply to the accumulators. They are sized to be capable of opening the valves and holding them open against the maximum drywell pressure of 45 psig. The accumulator capacity is sufficient for each ADS valve to provide two actuations against the maximum drywell design pressure with the reactor pressure of 0 psig.

Each SRV discharges steam through a discharge line to a point below the minimum water level in the suppression pool.

THIS PAGE INTENTIONALLY BLANK

#### 5.2.2.4.3 Safety/Relief Valve

The discharge area of the valve is 18.4 sq in and the coefficient of discharge K(D) is equal to 0.873 (K=0.9 K(D)).

The design pressure and temperature of the valve inlet and outlet are 1,375 psig at 585°F and 625 psig at 500°F, respectively. The valves have been designed to achieve the maximum practical number of actuations consistent with state-of-the-art technology. The design pressure and temperature for the SRV discharge piping are 570 psig and 485°F.

SRV cyclic testing has demonstrated an expected service life of at least 60 actuation cycles between required maintenance. Discharge of pipeline debris through the valve will, however, adversely affect seat leakage. For a schematic cross section of the valve, see Figure 5.2-5.

### 5.2.2.5 Mounting of Pressure Relief Devices

The SRVs are located on the main steam piping header. The mounting consists of a special, forged-contoured nozzle and an oversized flange connection. This provides a high-integrity connection that withstands the thrust, bending, and torsional loadings to which the main steam pipe and relief valve discharge pipe are subjected, including:

1. Thermal expansion effects of the connecting piping.

2. Dynamic effects of the piping due to SSE and suppression pool loads.

3. Reactions due to transient unbalanced wave forces exerted on the SRVs during the first few seconds after the valve is opened and prior to the time steady-state flow has been established. (With steady-state flow, the dynamic flow reaction forces are self-equilibrated by the valve discharge piping.)

4. Dynamic effects of the piping and branch connection due to the turbine stop valve closure.

In no case are allowable valve flange loads exceeded nor does the stress at any point in the piping exceed code allowables for any specified combination of loads.

### 5.2.2.6 Applicable Codes and Classification

The vessel overpressure protection system is designed to satisfy the requirements of ASME Section III. The general requirements for protection against overpressure of ASME Section III recognize that reactor vessel overpressure protection is one function of the reactor protective systems and allows the integration of pressure relief devices with the protective systems of the nuclear reactor. Hence, credit is taken for the scram protective system as a complementary pressure protection device. The NRC has also adopted the ASME codes as part of their requirements in 10CFR50.55a.

### 5.2.2.7 Material Specification

Material specifications of pressure-retaining components of SRVs are reported in Table 5.2-5.

### 5.2.2.8 Process Instrumentation

Overpressure protection process instrumentation is listed in Table 1.7-1, Figure 5.2-2 and shown on P&ID, Figure 5.1-2.

### 5.2.2.9 System Reliability

The SRVs have a high reliability as they are designed to satisfy the requirements of ASME Section III. The consequences of failure are discussed in Sections 15.1.4 and 15.6.1.

### 5.2.2.10 Inspection and Testing

The inspection and testing applicable to SRVs uses a quality assurance program that complies with Appendix B of 10CFR50. The SRVs were tested at the vendor's shop in accordance with quality control procedures to detect defects and to prove operability prior to installation. The following tests were conducted:

1. Hydrostatic test at ASME-specified test conditions.

2. Seat leakage measurements are made with steam during the set pressure test.

3. Set pressure test: Each valve is pressurized with saturated steam, with the pressure rising to the valve set pressure. The valve must open at the nameplate set pressure ±1 percent.

4. Response time test: Each SRV is tested to demonstrate acceptable response time.

The GE equipment specification requires certification from the valve manufacturer that design and performance requirements have been met, including capacity and blowdown requirements. The set points are adjusted, verified, and indicated on the valves by the vendor. Specified manual and automatic actuation relief mode of each SRV is verified during the preoperational test program.

It is not feasible to test the SRV set points while the valves are in place. The valves are mounted on 1,500-lb primary service rating flanges. They can be removed for maintenance or bench checks and reinstalled during normal plant shutdowns. The valves will be tested to check set pressure in accordance with the requirements of the plant technical specifications. The external surface and seating of all SRVs are 100 percent visually inspected when the valves are removed for maintenance or bench checks. Valve operability is verified during the preoperational test program as discussed in Chapter 14.

A discussion of SRV operability testing for two-phase flow in accordance with NUREG-737 is provided in Section 1.10, Task II.D.1.

5.2.3 Reactor Coolant Pressure Boundary Materials

5.2.3.1 Material Specifications

Table 5.2-5 lists the principal pressure-retaining components and materials and the appropriate material specifications for the RCPB components.

5.2.3.2 Compatibility with Reactor Coolant

5.2.3.2.1 PWR Chemistry of Reactor Coolant

Not applicable to BWRs.

5.2.3.2.2 BWR Chemistry of Reactor Coolant

Materials in the reactor coolant system are primarily austenitic stainless steel, carbon steel, and Zircaloy cladding. The reactor water chemistry limits are established to provide an environment favorable to these materials. Limits are placed on conductivity and chloride concentrations. Conductivity is limited because it can be continuously and reliably measured and gives an indication

Leak detection indicators and alarms are provided in the main control room as detailed in Tables 5.2-9 and 5.2-10. This satisfies position c.7.

Procedures and graphs are provided to plant operators for converting the various indicators to a common leakage equivalent to satisfy the remainder of position c.7.

Leak detection complies with IEEE 338. All active components associated with isolation signals can be tested during plant operation. Indication is provided in the main control room that a logic channel is tripped. 5

The leakage detection systems are equipped with provisions to permit testing for operability and calibration during the plant operation using the following methods:

1. Simulation of signals into trip units.

2. Comparing channel A to channel B of the same leak detection method (i.e., area temperature monitoring).

3. Operability checked by comparing one method versus another (i.e., tank fill up versus pump out and particulate monitoring).

4. Continuous monitoring of floor drain sump level is provided.

These satisfy position c.8.

Plant Technical Specifications comply with position c.9 by specifying limiting conditions for identified and unidentified leakage and by addressing the availability of various types of instruments to assure adequate coverage. 5

Regulatory Guide 1.22 Assessment

The proper operation of the LDS sensors and logic is verified during the preoperational tests and during plant operation. Each temperature switch (both ambient and differential types) that provides isolation signals is connected to one element of a dual thermocouple. A light illuminates when the temperature exceeds the set point. Verification of the thermocouple input is accomplished by comparing the reading from the trip channel with the recorder channel which is connected to the other element of the dual thermocouple. The trip logics are tested by applying a simulated trip signal from an external source to

the LDS channel. Keylock test switches are used to prevent the isolation signal from performing its isolating function.

5.4.6.1.4 Physical Damage

The system is designed to the requirements of Table 3.2-1 commensurate with the safety importance of the system and its equipment. The RCIC turbine and pump are located in a different quadrant of the reactor building and utilize different divisional power (and separate electrical routings) than that of its redundant system HPCS (Sections 5.4.6.1.1 and 5.4.6.2.4).

5.4.6.1.5 Environment

The system operates for the time intervals and the environmental conditions specified in Section 3.11.

The RCIC system takes suction from the condensate storage tanks during normal modes of operation. The condensate storage tanks are located within the condensate storage building which is maintained at a minimum temperature of 65°F, as described in Section 9.4.7.2.5.

All interconnecting piping is located within piping tunnels which are beneath heated structures and below the frost line. To provide a Category I source of cooling water for 5
the RCIC system, automatic transfer circuitry has been provided to transfer suction from the condensate storage tanks to the suppression pool, which is inside the reactor building and protected from cold weather. All other RCIC piping is located within the reactor building and is protected from cold weather.

5.4.6.2 System Design

5.4.6.2.1 General

<u>Description</u>

A summary description of the RCIC system is presented in Section 5.4.6.1, which defines in general the system functions and components. The detailed description of the system, its components, and operation is presented in the following sections.

<u>Diagrams</u>

The following diagrams are included for the RCIC systems:

1. A schematic piping and instrumentation diagram (Figure 5.4-9) shows all components, piping, points where interface system and subsystems tie together,

and instrumentation and controls associated with subsystem and component actuation.

2. A schematic process diagram (Figure 5.4-10) shows temperature, pressures, and flows for RCIC operation and system process data hydraulic requirements.

Interlocks

The following defines the various electrical interlocks:

1. There are three keylocked switches controlling valves F063, F064, F068 (2ICS-MOV128, -MOV121,

# CHAPTER 6

# ENGINEERED SAFETY FEATURES

## TABLE OF CONTENTS


| Section | Title | Page |
|---|---|---|
| 6.1 | ENGINEERED SAFETY FEATURE MATERIALS | 6.1-1 |
| 6.1.1 | Metallic Materials | 6.1-1 |
| 6.1.1.1 | Materials Selection and Fabrication | 6.1-1 |
| 6.1.1.1.1 | Specifications for Principal ESF Pressure-Retaining Materials | 6.1-1 |
| 6.1.1.1.2 | ESF Construction Material | 6.1-1 |
| 6.1.1.1.3 | Integrity of ESF Components During Manufacturing and Construction | 6.1-2 |
| 6.1.1.1.4 | Weld Fabrication and Assembly of Stainless Steel ESF Components (Non-NSSS Supplied Components) | 6.1-3 |
| 6.1.1.2 | Composition, Compatibility, and Stability of Containment and Core Spray Coolants | 6.1-4 |
| 6.1.2 | Organic Materials | 6.1-4 |
| 6.1.2.1 | Protective Coatings in the Suppression Pool | 6.1-4 |
| 6.1.2.2 | Protective Coatings in the Drywell | 6.1-5 |
| 6.2 | CONTAINMENT SYSTEMS | 6.2-1 |
| 6.2.1 | Containment Functional Design | 6.2-1 |
| 6.2.1.1 | Containment Structure | 6.2-1 |
| 6.2.1.1.1 | Design Basis | 6.2-1 |
| 6.2.1.1.2 | Design Features | 6.2-4 |
| 6.2.1.1.3 | Design Evaluation | 6.2-7 |
| 6.2.1.2 | Containment Subcompartments | 6.2-33 |
| 6.2.1.2.1 | Design Bases | 6.2-33 |
| 6.2.1.2.2 | Design Features | 6.2-34 |
| 6.2.1.2.3 | Design Evaluation | 6.2-35 |
| 6.2.1.3 | Mass and Energy Release Analysis for Postulated Loss-of-Coolant Accidents | 6.2-37 |
| 6.2.1.3.1 | Mass and Energy Release Data | 6.2-38 |
| 6.2.1.3.2 | Energy Source | 6.2-38 |
| 6.2.1.3.3 | Effects of Metal-Water Reaction | 6.2-38 |
| 6.2.1.4 | Mass and Energy Release Analysis for Postulated Secondary System Pipe Rupture Inside Containment (PWR) | 6.2-38 |
| 6.2.1.5 | Minimum Containment Pressure Analysis for Performance Capability Studies on Emergency Core Cooling System (PWR) | 6.2-39 |

# CHAPTER 6

## TABLE OF CONTENTS (Cont)


| | Section | Title | Page |
|---|---|---|---|
| | 6.2.1.6 | Testing and Inspection | 6.2-39 |
| | 6.2.1.7 | Instrumentation Requirements | 6.2-39 |
| | 6.2.2 | Containment Heat Removal System | 6.2-41 |
| | 6.2.2.1 | Design Bases | 6.2-41 |
| | 6.2.2.2 | System Design | 6.2-42 |
| | 6.2.2.3 | Design Evaluation | 6.2-45 |
| | 6.2.2.3.1 | Containment Sprays | 6.2-47 |
| | 6.2.2.3.2 | NPSH Availability | 6.2-47 |
| 5 | 6.2.2.3.3 | Heat Removal | 6.2-47a |
| | 6.2.2.4 | Tests and Inspections | 6.2-49 |
| | 6.2.2.5 | Instrumentation Requirements | 6.2-49 |
| | 6.2.3 | Secondary Containment Functional Design | 6.2-49 |
| | 6.2.3.1 | Design Bases | 6.2-49 |
| 5 | 6.2.3.2 | System Design | 6.2-51a |
| | 6.2.3.2.1 | Reactor Building Ventilation System | 6.2-52 |
| | 6.2.3.2.2 | Post-Accident Design Provisions | 6.2-53 |
| | 6.2.3.2.3 | Bypass Leakage Paths | 6.2-54 |
| | 6.2.3.2.4 | Bypass Leakage Rates | 6.2-56 |
| | 6.2.3.3 | Design Evaluation | 6.2-57 |
| | 6.2.3.4 | Tests and Inspections | 6.2-57 |
| | 6.2.3.5 | Instrumentation Requirements | 6.2-57 |
| | 6.2.4 | Primary Containment Isolation System | 6.2-58 |
| | 6.2.4.1 | Design Bases | 6.2-58 |
| | 6.2.4.1.1 | Safety Design Bases | 6.2-58 |
| | 6.2.4.2 | System Design | 6.2-59 |
| | 6.2.4.3 | Design Evaluation | 6.2-61 |
| | 6.2.4.3.1 | Introduction | 6.2-61 |
| | 6.2.4.3.2 | Evaluation Against General Design Criteria | 6.2-62 |
| | 6.2.4.3.3 | Failure Modes and Effects Analysis | 6.2-70 |
| | 6.2.4.3.4 | Operator Actions | 6.2-71 |
| 5 | 6.2.4.4 | Tests and Inspections | 6.2-71a |
| | 6.2.5 | Combustible Gas Control in Containment | 6.2-72 |
| | 6.2.5.1 | Design Bases | 6.2-72 |
| | 6.2.5.2 | System Design | 6.2-74 |
| | 6.2.5.2.1 | Atmospheric Mixing | 6.2-75 |
| | 6.2.5.2.2 | Hydrogen Recombiner System | 6.2-76 |
| | 6.2.5.2.3 | Primary Containment Nitrogen Inerting System | 6.2-77 |
| | 6.2.5.2.4 | Primary Containment Purge | 6.2-77 |
| | 6.2.5.2.5 | Hydrogen and Oxygen Monitoring System | 6.2-78 |
| | 6.2.5.3 | Design Evaluation | 6.2-78 |
| | 6.2.5.3.1 | Sources of Oxygen and Hydrogen | 6.2-79 |

# CHAPTER 6

## TABLE OF CONTENTS (Cont)


| Section | Title | Page |
|---|---|---|
| 6.2.5.3.2 | Accident Description | 6.2-80 |
| 6.2.5.3.3 | Analysis | 6.2-81 |
| 6.2.5.3.4 | Failure Modes and Effects Analysis | 6.2-82 |
| 6.2.5.4 | Tests and Inspections | 6.2-82 |
| 6.2.5.5 | Instrumentation Requirements | 6.2-82 |
| 6.2.6 | Containment Leakage Testing | 6.2-84 |
| 6.2.6.1 | Containment Integrated Leakage Rate Test (ILRT) (Type A Test) | 6.2-84 |
| 6.2.6.2 | Containment Penetration Leakage Rate Tests (Type B Tests) | 6.2-87 |
| 6.2.6.3 | Primary Containment Isolation Valve Leakage Rate Tests (Type C Tests) | 6.2-88 |
| 6.2.6.4 | Scheduling and Reporting of Periodic Tests | 6.2-88 |
| 6.2.6.5 | Special Testing Requirements | 6.2-88 |
| 6.2.7 | References | 6.2-89 |
| 6.3 | EMERGENCY CORE COOLING SYSTEMS | 6.3-1 |
| 6.3.1 | Design Bases and Summary Description | 6.3-1 |
| 6.3.1.1 | Design Bases | 6.3-1 |
| 6.3.1.1.1 | Performance and Functional Requirements | 6.3-1 |
| 6.3.1.1.2 | Reliability Requirements | 6.3-2 |
| 6.3.1.1.3 | ECCS Requirements for Protection from Physical Damage | 6.3-4 |
| 6.3.1.1.4 | ECCS Environmental Design Basis | 6.3-5 |
| 6.3.1.2 | Summary Descriptions of ECCS | 6.3-6 |
| 6.3.1.2.1 | High Pressure Core Spray | 6.3-6a \| 6 |
| 6.3.1.2.2 | Low Pressure Core Spray | 6.3-6a |
| 6.3.1.2.3 | Low Pressure Coolant Injection | 6.3-6a |
| 6.3.1.2.4 | Automatic Depressurization System | 6.3-7 |
| 6.3.2 | System Design | 6.3-7 |
| 6.3.2.1 | Schematic Piping and Instrumentation Diagrams | 6.3-7 |
| 6.3.2.2 | Equipment and Component Descriptions | 6.3-7 |
| 6.3.2.2.1 | High Pressure Core Spray System | 6.3-8c |
| 6.3.2.2.2 | Automatic Depressurization System | 6.3-12 |
| 6.3.2.2.3 | Low Pressure Core Spray System | 6.3-12 |
| 6.3.2.2.4 | Low Pressure Coolant Injection | 6.3-15 |
| 6.3.2.2.5 | ECCS Discharge Line Fill System | 6.3-18 |
| 6.3.2.3 | Applicable Codes and Classifications | 6.3-19 |
| 6.3.2.4 | Materials Specifications and Compatibility | 6.3-19 |

CHAPTER 6

TABLE OF CONTENTS (Cont)


| | | |
|---|---|---|
| 6.3.2.5 | System Reliability | 6.3-19 |
| 5 6.3.2.6 | Protection Provisions | 6.3-20a |
| 6.3.2.7 | Provisions for Performance Testing | 6.3-20b |
| 6.3.2.8 | Manual Actions | 6.3-21 |
| 6.3.3 | ECCS Performance Evaluation | 6.3-21 |
| 6.3.3.1 | ECCS Bases for Technical Specifications | 6.3-22 |
| 6.3.3.2 | Acceptance Criteria for ECCS Performance | 6.3-22 |
| 6.3.3.3 | Single-Failure Considerations | 6.3-23 |
| 6.3.3.4 | System Performance During the Accident | 6.3-23 |
| 6.3.3.5 | Use of Dual Function Components for ECCS | 6.3-24 |
| 6.3.3.6 | Limits on ECCS Parameters | 6.3-24 |
| 6.3.3.7 | ECCS Analyses for LOCA | 6.3-25 |
| 6.3.3.7.1 | LOCA Analysis Procedures and Input Variables | 6.3-25 |
| 6.3.3.7.2 | Accident Description | 6.3-25 |
| 6.3.3.7.3 | Break Spectrum Calculations | 6.3-25 |
| 6.3.3.7.4 | Large Recirculation Line Break Calculations | 6.3-25 |
| 6.3.3.7.5 | Transition Recirculation Line Break Calculations | 6.3-27 |
| 6.3.3.7.6 | Small Recirculation Line Break Calculations | 6.3-28 |
| 6.3.3.7.7 | Calculations for Other Break Locations | 6.3-28 |
| 6.3.3.8 | LOCA Analysis Conclusions | 6.3-28 |
| 6.3.4 | Tests and Inspections | 6.3-28 |
| 6.3.4.1 | ECCS Performance Tests | 6.3-28 |
| 6.3.4.2 | Reliability Tests and Inspections | 6.3-29 |
| 6.3.4.2.1 | HPCS Testing | 6.3-30 |
| 6.3.4.2.2 | ADS Testing | 6.3-30 |
| 6.3.4.2.3 | LPCS Testing | 6.3-31 |
| 6.3.4.2.4 | LPCI Testing | 6.3-31 |
| 6.3.5 | Instrumentation Requirements | 6.3-31 |
| 6.3.6 | References | 6.3-33 |
| 6.4 | HABITABILITY SYSTEMS | 6.4-1 |
| 6.4.1 | Design Basis | 6.4-2 |
| 6.4.2 | System Design | 6.4-4 |
| 6.4.2.1 | Definition of Main Control Room Envelope | 6.4-4 |
| 6.4.2.2 | Ventilation System Design | 6.4-4 |
| 6.4.2.3 | Leaktightness | 6.4-5 |

CHAPTER 6

LIST OF TABLES (Cont)


| Table Number | Title |
|---|---|
| 6.2-31 | BLOWDOWN DATA, 24-IN RECIRCULATION SUCTION LINE BREAK |
| 6.2-32 | SUBCOMPARTMENT NODAL DESCRIPTION, 12-IN RECIRCULATION INLET LINE BREAK |
| 6.2-33 | SUBCOMPARTMENT VENT PATH DESCRIPTION, 12-IN RECIRCULATION INLET LINE BREAK |
| 6.2-34 | BLOWDOWN DATA, 12-IN RECIRCULATION INLET LINE BREAK |
| 6.2-35 | SUBCOMPARTMENT NODAL DESCRIPTION, 12-IN LPCI LINE BREAK |
| 6.2-36 | SUBCOMPARTMENT VENT PATH DESCRIPTION, 12-IN LPCI LINE BREAK |
| 6.2-37 | BLOWDOWN DATA, 12-IN LPCI LINE BREAK |
| 6.2-38 | SUBCOMPARTMENT NODAL DESCRIPTION, 12-IN FEEDWATER LINE BREAK |
| 6.2-39 | SUBCOMPARTMENT VENT PATH DESCRIPTION, 12-IN FEEDWATER LINE BREAK |
| 6.2-40 | BLOWDOWN DATA, 12-IN FEEDWATER LINE BREAK |
| 6.2-41 | SUBCOMPARTMENT NODAL DESCRIPTION, 10-IN LPCS LINE BREAK |
| 6.2-42 | SUBCOMPARTMENT VENT PATH DESCRIPTION, 10-IN LPCS LINE BREAK |
| 6.2-43 | BLOWDOWN DATA, 10-IN LPCS LINE BREAK |
| 6.2-44 | SUBCOMPARTMENT NODAL DESCRIPTION, 6-IN RCIC HEAD SPRAY LINE BREAK |
| 6.2-45 | SUBCOMPARTMENT VENT PATH DESCRIPTION, 6-IN RCIC HEAD SPRAY LINE BREAK |
| 6.2-46 | BLOWDOWN DATA, 6-IN RCIC HEAD SPRAY LINE BREAK |

CHAPTER 6

LIST OF TABLES (Cont)


| | Table Number | Title |
|---|---|---|
| | 6.2-47 | SUBCOMPARTMENT NODAL DESCRIPTION, 24-IN RECIRCULATION SUCTION LINE BREAK |
| | 6.2-48 | SUBCOMPARTMENT VENT PATH DESCRIPTION, 24-IN RECIRCULATION SUCTION LINE BREAK |
| | 6.2-49 | BLOWDOWN DATA, 24-IN RECIRCULATION SUCTION LINE BREAK |
| | 6.2-50 | MASS AND ENERGY RELEASE DATA |
| | 6.2-51 | CONTAINMENT SPRAY PARAMETERS |
| | 6.2-52 | ACCIDENT ANALYSIS PARAMETERS USED FOR DBA OF CONTAINMENT HEAT REMOVAL |
| | 6.2-53 | ENERGY/MASS BALANCE |
| | 6.2-54 | REACTOR BUILDING DESIGN AND PERFORMANCE DATA |
| | 6.2-55 | EVALUATION OF POTENTIAL BYPASS LEAKAGE PATHS FOR MAIN STEAM SYSTEM |
| | 6.2-56 | CONTAINMENT ISOLATION PROVISIONS FOR FLUID LINES |
| | 6.2-57 | COMBUSTIBLE GAS CONTROL SYSTEM COMPONENT DESCRIPTION |
| | 6.2-58 | GENERAL PARAMETERS USED IN CALCULATING POST-DBA OXYGEN/HYDROGEN CONCENTRATIONS |
| | 6.2-59 | PLANT PARAMETERS USED IN POST-DBA COMBUSTIBLE GAS CONCENTRATION ANALYSIS |
| | 6.2-60 | PRIMARY CONTAINMENT LEAKAGE TESTING |
| | 6.2-61 | DRYWELL BYPASS LEAKAGE TEST |
| 5 | 6.2-62 | SECONDARY CONTAINMENT ACCESS DOORS |
| | 6.3-1 | SIGNIFICANT INPUT VARIABLES USED IN THE LOSS-OF-COOLANT ACCIDENT ANALYSIS |

CHAPTER 6

LIST OF TABLES (Cont)


| Table Number | Title |
|---|---|
| 6.3-2 | OPERATIONAL SEQUENCE OF EMERGENCY CORE COOLING SYSTEMS FOR DESIGN BASIS ACCIDENT |
| 6.3-3 | SINGLE ACTIVE FAILURES CONSIDERED IN THE ECCS PERFORMANCE EVALUATION |
| 6.3-4 | MAPLHGR, MAXIMUM LOCAL OXIDATION, AND PEAK CLAD TEMPERATURE VERSUS EXPOSURE |
| 6.3-5 | SUMMARY OF RESULTS OF LOCA ANALYSIS |
| 6.3-6 | KEY TO FIGURE NUMBERS |
| 6.5-1 | DESIGN DATA OF PRINCIPAL EQUIPMENT STANDBY GAS TREATMENT SYSTEM |

# CHAPTER 6

## LIST OF FIGURES


| Figure Number | Title |
|---|---|
| 6.2-1 | RECIRCULATION PUMP SUCTION LINE BREAK SCHEMATIC |
| 6.2-2 | PRIMARY CONTAINMENT PRESSURE, PUMP SUCTION LINE BREAK WITHOUT FEEDWATER, CASE C |
| 6.2-3 | PRIMARY CONTAINMENT PRESSURE, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER, CASE B |
| 6.2-4 | PRIMARY CONTAINMENT PRESSURE, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER, CASE C |
| 6.2-5 | PRIMARY CONTAINMENT PRESSURE, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER, CASE A |
| 6.2-6 | PRIMARY CONTAINMENT TEMPERATURE, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER, CASE A |
| 6.2-7 | PRIMARY CONTAINMENT TEMPERATURE, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER, CASE B |
| 6.2-8 | PRIMARY CONTAINMENT TEMPERATURE, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER, CASE C |
| 6.2-9 | PRIMARY CONTAINMENT TEMPERATURE, RECIRCULATION PUMP SUCTION LINE BREAK WITHOUT FEEDWATER, CASE C |
| 6.2-10 | VENT SYSTEM MASS FLOW, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER, CASE C |
| 6.2-11 | SUPPRESSION POOL TEMPERATURE, RECIRCULATION PUMP SUCTION LINE BREAK WITH FEEDWATER |

CHAPTER 6

LIST OF FIGURES (Cont)


| Figure Number | Title |
|---|---|
| 6.2-47 | CONTAINMENT SPRAY FLOW RATE |
| 6.2-48 | HIGH PRESSURE CORE SPRAY FLOW RATE |
| 6.2-49 | LOW PRESSURE CORE SPRAY FLOW RATE |
| 6.2-50 | LOW PRESSURE COOLANT INJECTION FLOW RATE |
| 6.2-51 | RECIRCULATION PUMP SUCTION LINE BREAK AREA VS. TIME |
| 6.2-52 | NODAL PRESSURES, RECIRCULATION SUCTION LINE BREAK, RPV-BSW ANNULUS |
| 6.2-53 | NODAL PRESSURES, RECIRCULATION SUCTION LINE BREAK, RPV-BSW ANNULUS |
| 6.2-54 | NODAL PRESSURES, RECIRCULATION SUCTION LINE BREAK, RPV-BSW ANNULUS |
| 6.2-55 | NODAL PRESSURES, RECIRCULATION SUCTION LINE BREAK, RPV-BSW ANNULUS |
| 6.2-56 | NODAL PRESSURES, RECIRCULATION SUCTION LINE BREAK, RPV-BSW ANNULUS |
| 6.2-57 | NODAL PRESSURES, RECIRCULATION SUCTION LINE BREAK, RPV-BSW ANNULUS |
| 6.2-58 | NODAL PRESSURES, FEEDWATER LINE BREAK, RPV-BSW ANNULUS |
| 6.2-59 | NODAL PRESSURES, FEEDWATER LINE BREAK, RPV-BSW ANNULUS |
| 6.2-60 | NODAL PRESSURES, FEEDWATER LINE BREAK, RPV-BSW ANNULUS |
| 6.2-61 | NODAL PRESSURES, FEEDWATER LINE BREAK, RPV-BSW ANNULUS |

CHAPTER 6

LIST OF FIGURES (Cont)


| Figure Number | Title |
|---|---|
| 6.2-62 | NODAL PRESSURES, FEEDWATER LINE BREAK, RPV-BSW ANNULUS |
| 6.2-63 | NODAL PRESSURES, FEEDWATER LINE BREAK, RPV-BSW ANNULUS |
| 6.2-64 | NODALIZATION DIAGRAM, 6-IN RCIC HEAD SPRAY LINE BREAK, DRYWELL HEAD-DRYWELL SUBCOMPART MENT |
| 6.2-65 | NODAL PRESSURES, 6-IN RCIC HEAD SPRAY LINE BREAK, DRYWELL HEAD-DRYWELL SUBCOMPARTMENTS |
| 6.2-66 | NODAL PRESSURE DIFFERENTIALS, 6-IN RCIC HEAD SPRAY LINE BREAK, DRYWELL HEAD-DRYWELL SUB-COMPARTMENTS |
| 6.2-67 | NODALIZATION DIAGRAM, 24-IN RECIRCULATION SUCTION LINE BREAK, DRYWELL HEAD-DRYWELL SUB-COMPARTMENTS |
| 6.2-68 | NODAL PRESSURES, 24-IN RECIRCULATION SUCTION LINE BREAK, DRYWELL HEAD-DRYWELL SUBCOMPART-MENTS |
| 6.2-69 | NODAL PRESSURE DIFFERENTIALS, 24-IN RECIRCULA-TION SUCTION LINE BREAK, DRYWELL HEAD-DRYWELL SUBCOMPARTMENTS |
| 6.2-70 | ISOLATION VALVE ARRANGEMENT |
| 6.2-71a | CONTAINMENT ATMOSPHERE MONITORING SYSTEM P&ID |
| 6.2-72a & b | DBA HYDROGEN RECOMBINER SYSTEM P&ID |
| 6.2-72C | HYDROGEN/OXYGEN SAMPLING POINTS WITHIN PRIMARY CONTAINMENT |
| 6.2-72D | HYDROGEN GENERATION RATES FOLLOWING DBA |
| 6.2-72E | INTEGRATED HYDROGEN GENERATION FOLLOWING DBA |

CHAPTER 6

LIST OF FIGURES (Cont)


| Figure Number | Title |
|---|---|
| 6.2-72F | OXYGEN GENERATION RATE FOLLOWING DBA |
| 6.2-72G | INTEGRATED OXYGEN GENERATION FOLLOWING DBA |
| 6.2-72F | OXYGEN GENERATION RATE FOLLOWING DBA |
| 6.2-72H | OXYGEN CONCENTRATION FOLLOWING DBA |
| 6.2-72I | HYDROGEN CONCENTRATION FOLLOWING DBA |
| 6.2-72J | DELETED 5 |
| 6.2-72K | COMBUSTIBLE GAS CONTROL SYSTEM LOGIC DIAGRAM |
| 6.2-73 | CONTAINMENT LEAKAGE MONITORING SYSTEM P&ID |
| 6.2-74 | SPECTACLE FLANGES |
| 6.2-75 | TRANSVERSING IN-CORE PROBE PENETRATION |
| 6.3-1 | HIGH PRESSURE CORE SPRAY PROCESS DIAGRAM |
| 6.3-2 | LOW PRESSURE CORE SPRAY SYSTEM PROCESS DIAGRAM |
| 6.3-3A | HEAD VERSUS HIGH PRESSURE CORE SPRAY FLOW USED IN LOCA ANALYSIS |
| 6.3-3B | HIGH PRESSURE CORE SPRAY PUMP CHARACTERISTICS |
| 6.3-4A | HEAD VERSUS LOW PRESSURE CORE SPRAY FLOW USED IN LOCA ANALYSIS |
| 6.3-4B | LOW PRESSURE CORE SPRAY PUMP CHARACTERISTICS 5 |
| 6.3-5A | HEAD VERSUS LOW PRESSURE COOLANT INJECTION FLOW USED IN LOCA ANALYSIS |
| 6.3-5B | HIGH PRESSURE CORE SPRAY PUMP CHARACTERISTICS |
| 6.3-6 | HIGH PRESSURE CORE SPRAY SYSTEM P&ID |
| 6.3-7 | LOW PRESSURE CORE SPRAY SYSTEM P&ID |

# CHAPTER 6

## LIST OF FIGURES (Cont)


| Figure Number | Title |
|---|---|
| 6.3-8 | PEAK CLADDING TEMPERATURE AND PEAK LOCAL OXIDATION VERSUS BREAK AREA |
| 6.3-9 | NORMALIZED CORE POWER VERSUS TIME FOR LOCA ANALYSIS |

## 6.2 CONTAINMENT SYSTEMS

### 6.2.1 Containment Functional Design

This section establishes the design basis for the primary containment structure and provides the major design features and evaluation of the primary containment to perform the intended safety functions during all normal and postulated accident conditions throughout the operating life of the plant.

#### 6.2.1.1 Containment Structure

The primary containment structure of Unit 2 consists of the drywell, the pressure suppression chamber which stores a large volume of water, and the drywell floor which separates the drywell and suppression chamber. The drywell is a steel-lined reinforced concrete vessel in the shape of a frustum of a cone, closed by a dome with a torispherical head. The pressure suppression chamber is a cylindrical stainless steel clad steel-lined reinforced concrete vessel located below the drywell. The primary containment structure houses the reactor vessel, the reactor recirculation system, and other branch connections of the reactor coolant pressure boundary (RCPB).

##### 6.2.1.1.1 Design Bases

The primary containment structure, including subcompartments (Section 6.2.1.2), meets the following functional design bases.

<u>Containment Vessel Design</u>

The containment vessel design bases are:

1. The primary containment has the capability to maintain its functional integrity during and following the peak transient pressure and temperatures that would occur following any postulated loss-of-coolant accident (LOCA). The LOCA includes the worst single failure (which leads to the maximum primary containment pressure and temperature) and is further postulated to occur simultaneously with loss of offsite power and a safe shutdown earthquake (SSE).

2. The primary containment structure also withstands the peak environmental transient pressures and temperatures associated with the postulated spectrum of line breaks.

3. The primary containment has the capability to withstand jet forces associated with the flow from the postulated rupture of any pipe within it.

4. The primary containment system is protected from or designed to withstand missiles from internal sources and excessive motion of pipes that could directly or indirectly endanger the integrity of the containment.

5. The primary containment is designed for the hydrodynamic loads in the Design Assessment Report for Hydrodynamic Loads (DAR, Appendix 6A).

Containment Subcompartment Design

The effects of primary containment subcompartment pressurization (Section 6.2.1.2) on the postulated pipe ruptures have been evaluated.

Drywell Internal Pressure

The design basis accident (DBA) postulated for the calculation of the maximum pressure acting on the drywell walls is a double-ended rupture (DER) of a 24-in recirculation suction line. This event is more severe than a DER of the 26-in main steam line. The peak calculated drywell pressure is 39.75 psig following the recirculation pump suction line DER.

Suppression Chamber Internal Pressure

The DBA for the suppression chamber is a DER of a 24-in recirculation suction line. The peak pressure occurs shortly after the initial reactor blowdown. The maximum calculated suppression chamber pressure is 33.98 psig.

Drywell Floor Differential Pressure

The DBA for the drywell floor differential pressure is a DER of a 24-in recirculation suction line. The maximum differential pressure (drywell to suppression chamber) occurs at the time of downcomer vent clearing when steam and air begin to flow to the suppression chamber. The maximum drywell floor differential pressure is 16.89 psid.

Pipe whip restraints in the primary containment ensure that the feedwater lines will remain intact after a break in any one line. Sufficient water will remain in each unbroken feedwater line, even after flashing due to depressurization, to maintain a vertical water seal greater than 30 ft on the feedwater isolation valves. Water losses due to the backleakage through the two isolation check valves are minimal, and the radioactivity in the water is limited to the radioactivity in the feedwater prior to the LOCA. The water seals prevent containment atmosphere backleakage through the valves. Bypass leakage through one 24-in feedwater line would have to be considered only after a feedwater line break but not after any other breaks.

In addition to the two isolation check valves, each feedwater line has a remote-manual gate valve outboard of the isolation valves that may be shut subsequent to a LOCA anytime the operators determine that feedwater flow is unnecessary or unavailable. The gate valve provides further back leakage control.

During an accident the RWCU is isolated from the reactor pressure vessel and primary containment atmosphere. The RWCU is not expected to contain highly radioactive water or gases. The condenser and radwaste system are further isolated from the reactor pressure vessel and primary containment atmosphere by a 68-ft high water loop seal and two closed gate valves in the blowdown line.

The condensate makeup and drawoff system is used as the alternate fill source to the RHR, HPCS, LPCS, and RWCU systems. Each condensate fill connection to these systems is isolated by means of a normally closed globe valve. The main supply line into the secondary containment contains a check valve at the low point which, in case of a pipe break outside the containment, is sealed by a 70-ft leg of water. Although the condensate makeup and drawoff system is not of seismic design, any line break within the reactor building would provide a preferential flow path, for containment atmosphere leakage, into the reactor building atmosphere. Under this condition gaseous leakage would be collected by the SGTS and thus not be classified as bypass leakage.

6.2.3.2.4 Bypass Leakage Rates

The bypass leakage rate assumed following a design basis LOCA for 30 days is based on two sets of criteria. The first set involves determining the varying valve leakage rates for the main steam isolation valves (MSIV). The MSIVs are trunnion-type ball valves, and their allowable leakage

rates are based on MSIV Topical Report G&W-FSD 2538, Section 1.9. The valve design allows leakage of 0.1 scfh of air per inch of nominal seat diameter at 45 psid.

The sum of the nominal seat diameters for the MSIVs is 84 in. Assuming that only one valve per line is closed and that the seat on the closed valve acts as a turbulent rough passage in restricting flow, the instantaneous leakage rate is extrapolated from the allowable leakage at 45 psid by the following formula:

$$Q\ (\text{scfh}) = 84''\text{x}0.1\ \text{scfh/in} \left[\frac{P^2_{LOCA} - 216.09}{P^2_{test} - 216.09}\right]^{0.5} \left[\frac{T_{test}}{T_{LOCA}}\right]^{0.5} \qquad (6.2\text{-}12)$$

where T is measured in degrees Rankine and P in psia. Adjustments are then made to compensate for differences in test (air) and LOCA environment (steam/air) mediums and standard (scf) leak rates converted to drywell temperature and pressure conditions. The instantaneous leakage rate is then plotted against time for 30 days. The bypass leakage rate is determined by taking the area under this plot. A multiplier of 1.67 is then applied to account for limited operational wear. The maximum bypass leakage rate contributed by the MSIVs is 2,000 cf distributed over the first 30 days.

The second set of criteria involves determining the maximum bypass leakage rate for the isolation valves on the main steam drain line. The isolation valves maximum valve leakage rate allowed by periodic ISI tests on these valves (Section 6.2.6) is based on ASME Section XI, Table IWV3420-1. This table allows 7.5 scfd at functional (45 psid) pressure, per inch of nominal valve diameter. Assuming that only one valve is shut and that the seat on the shut valve acts as a turbulent rough passage in restricting flow, the instantaneous leakage rate is extrapolated from the allowable leakage at 45 psid by the following formula:

$$Q\ (\text{scfd}) = 6'\text{x}7.5\ \text{scfd/in} \left[\frac{P^2_{LOCA} - 216.09}{P^2_{test} - 216.09}\right]^{0.5} \left[\frac{T_{test}}{T_{LOCA}}\right]^{0.5} \qquad (6.2\text{-}13)$$

The design of the isolation valve as well as the associated system includes consideration of the possible adverse effects of sudden isolation valve closure when the plant systems are functioning under normal operation.

### 6.2.4.3 Design Evaluation

#### 6.2.4.3.1 Introduction

The primary objective of the primary containment isolation system is to provide protection by preventing releases of radioactive materials to the environment. This is accomplished by automatic isolation of system lines penetrating the primary containment. Redundancy is provided in all design aspects to satisfy the requirement that any active failure of a single valve or component does not prevent primary containment isolation.

Mechanical components, such as isolation valve arrangements, are redundant to provide backup in the event of accident conditions. The arrangements with appropriate instrumentation are described in Table 6.2-56 and Figure 6.2-70. The isolation valves have redundancy in mode initiation. Generally, the primary mode is automatic and the secondary mode is remote manual. A program of testing (Section 6.2.4.4) is maintained to ensure valve operability and leaktightness.

The design specifications require each isolation valve to be operable under the most severe operating conditions that it might experience. Each isolation valve is afforded protection, by separation and/or adequate barriers, from the consequences of potential missiles.

Electrical redundancy is provided in isolation valve arrangements; this eliminates dependency on one power source to attain isolation. Electrical cables for isolation valves in the same line have been routed separately. Cable selection is based on the specific environment (Section 3.11) to which they may be subjected, such as high radiation, high temperature, and high humidity.

Administrative control provisions ensure that the position of all nonpowered isolation valves is maintained and known. The position for all power-operated valves is indicated in the main control room. Discussion of instrumentation and controls for the isolation valves is included in Chapter 7.

6.2.4.3.2 Evaluation Against General Design Criteria

Evaluation Against Criterion 55

The RCPB, as defined in 10CFR50, Section 50.2 (v), consists of reactor pressure vessel (RPV), pressure retaining appurtenances attached to the vessel, and valves and pipes that extend from the RPV up to and including the outermost isolation valve. The lines of the RCPB that penetrate the primary containment include provisions for isolation of the primary containment, thereby precluding any significant release of radioactivity. Similarly, for lines that do not penetrate the primary containment but form a portion of the RCPB, the design ensures that isolation of the RCPB can be achieved.

Influent Lines Influent lines that penetrate the primary containment and connect directly to the RCPB are equipped with at least two isolation valves, one inside the drywell and the other as close to the external side of the primary containment as practical. Protection of the environment is provided by these isolation valves.

Table 6.2-56 contains those influent pipes that compose the RCPB and penetrate the primary containment.

1. Feedwater Lines The feedwater lines are part of the RCPB as they penetrate the drywell to connect with the RPV. The isolation valve inside the drywell is a Y-pattern check valve, located as close as practical to the primary containment wall. Outside the primary containment is another Y-pattern check valve located as close as practical to the primary containment wall, and farther away from the primary containment is a motor-operated gate valve. Should a break occur in the feedwater line, the check valves prevent significant loss of reactor coolant inventory and offer immediate isolation. However, in case a LOCA occurs without a seismic event, the design allows the condensate and feedwater pumps to supply feedwater to the vessel. For this reason, the outermost gate valve does not automatically isolate upon signal from the protection system. The gate valve does meet the same environmental and seismic qualifications as the outboard isolation valve. The valve can be remotely closed from the control room to provide long-term leakage protection upon operator judgment that feedwater makeup is unavailable or unnecessary. No credit is taken for feedwater flow

TABLE 6.2-40

BLOWDOWN DATA

12-Inch Feedwater Line Break
RPV-BSW Annulus

| Time (sec) | Blowdown Mass Flow Rate (lbm/sec) | Blowdown Enthalpy (Btu/lbm) | Blowdown Energy Release Rate (Btu/sec)[1] | Total Effective Break Area ($ft^2$) |
|---|---|---|---|---|
| 0.00000 | 13,301 | 402.0 | $5.348 \times 10^6$ | 1.352 |
| 0.01530 | 13,301 | 402.0 | $5.348 \times 10^6$ | 1.352 |
| 0.01541 | 9,436 | 402.0 | $3.794 \times 10^6$ | [2] |
| 0.02066 | 9,436 | 402.0 | $3.794 \times 10^6$ | [2] |
| 0.02067 | 15,962 | 402.0 | $6.418 \times 10^6$ | [2] |
| 1.00000 | 15,962 | 402.0 | $6.418 \times 10^6$ | [2] |

[1] Due to symmetry in the nodalization, the tabulated blowdown represents one-half of the total blowdown.
[2] To be provided in an amendment.

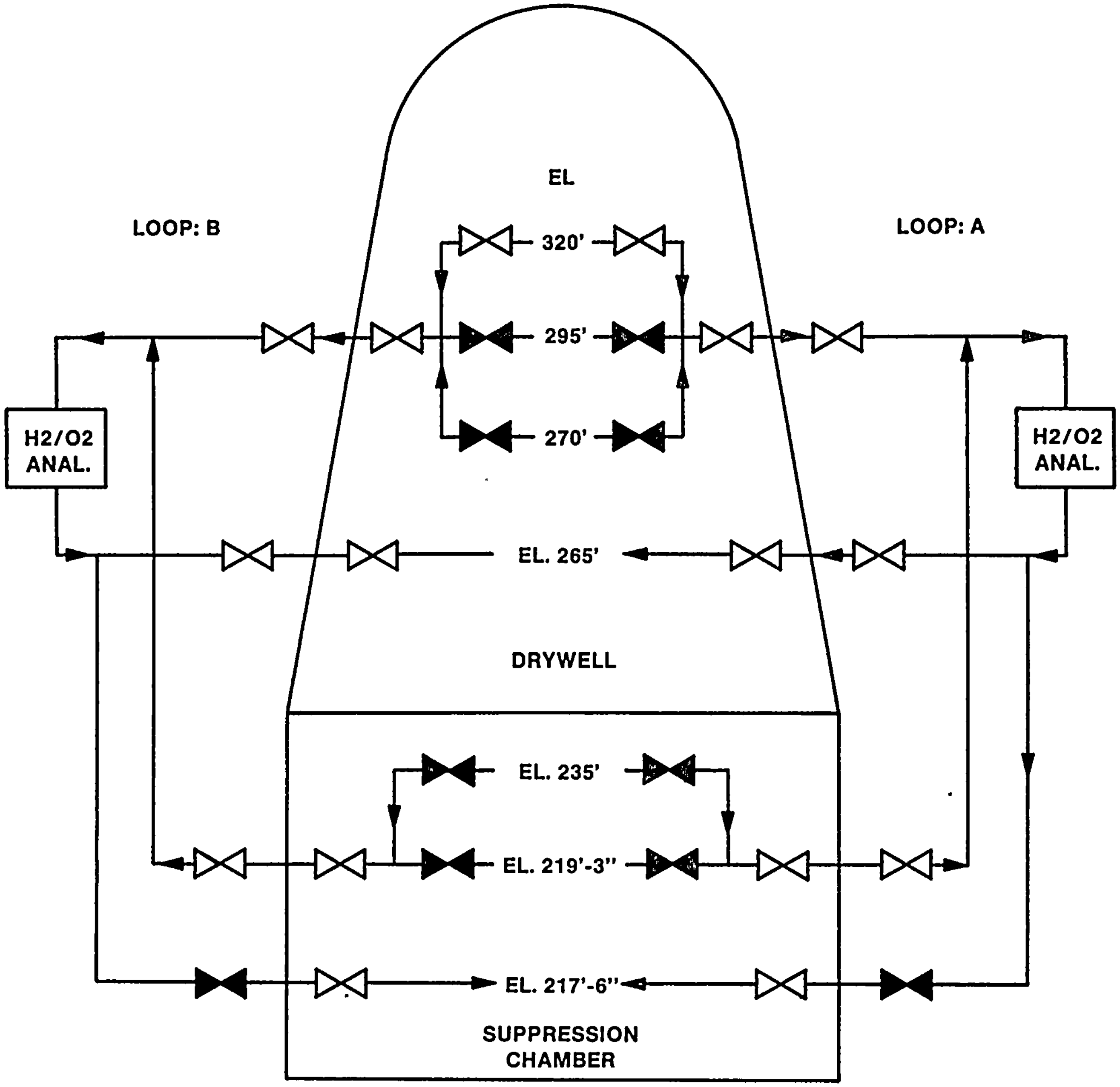



FIGURE 6.2-72C

HYDROGEN/OXYGEN SAMPLING POINTS WITHIN PRIMARY CONTAINMENT

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT

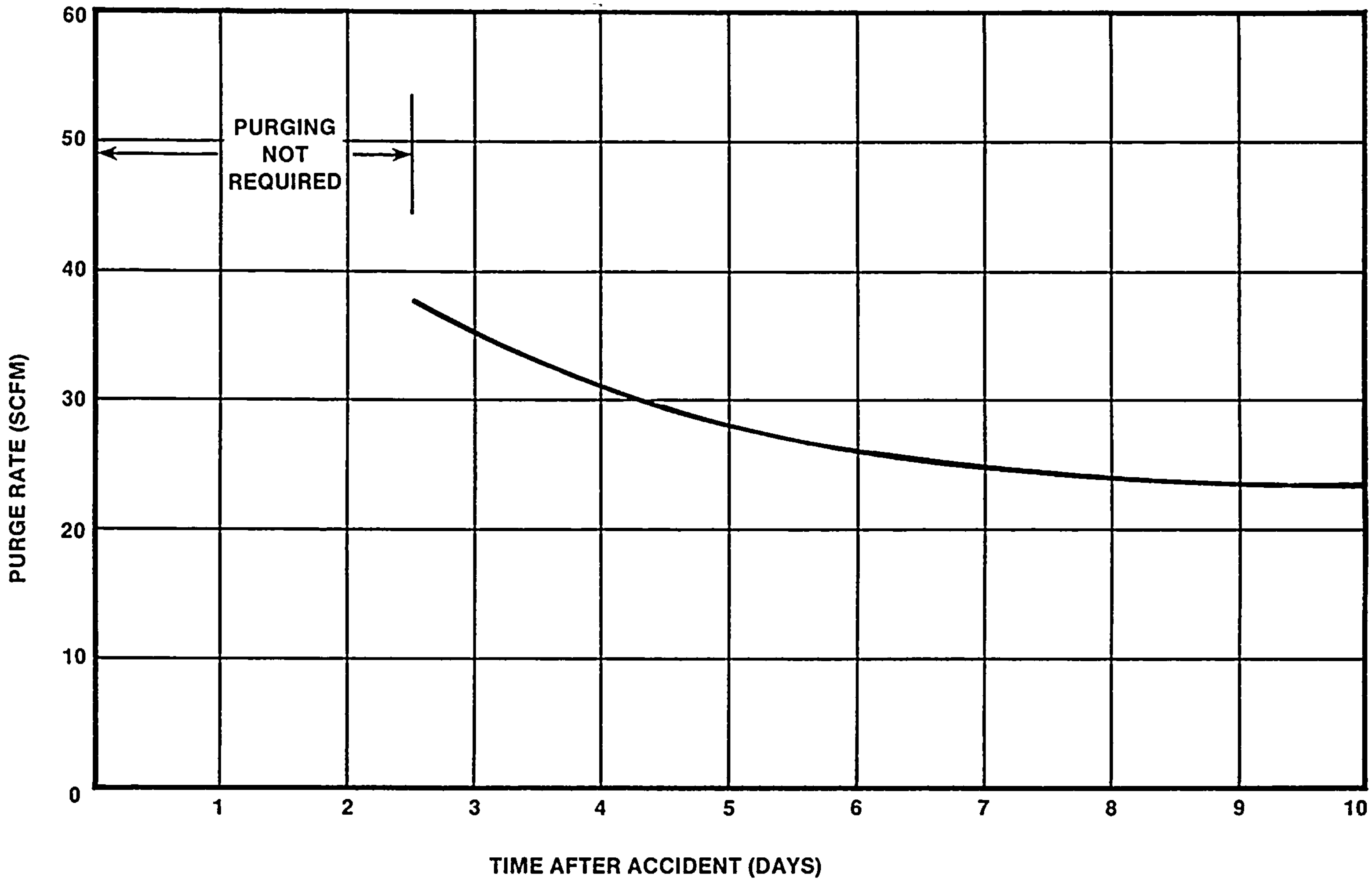



FIGURE 6.2-72J

PRIMARY CONTAINMENT
PURGE RATE FOLLOWING DBA

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT

pipe breaks. Following a small break and ADS initiation, LPCI provides coolant inventory makeup.

6.3.1.2.4 Automatic Depressurization System

The ADS utilizes 7 of the 18 safety/relief valves (SRV) to reduce reactor pressure following small breaks in the event of HPCS failure. When vessel pressure is reduced to within the capacity of the low-pressure systems (LPCS and LPCI), these systems provide inventory makeup to maintain acceptable post-accident temperatures.

6.3.2 System Design

A detailed description of the individual systems including individual design characteristics of the systems is provided in Sections 6.3.2.1 through 6.3.2.4. The following discussion provides details of the combined systems, in particular, those design features and characteristics which are common to all systems.

6.3.2.1 Schematic Piping and Instrumentation Diagrams

The P&IDs for the ECCS are identified in Section 6.3.2.2. The process diagrams that identify the various operating modes of each system are also identified in Section 6.3.2.2.

6.3.2.2 Equipment and Component Descriptions

The initiating signal for the ECCS comes from at least two independent and redundant sensors of drywell pressure and reactor water level. The ECCS is automatically actuated and requires no operator action during the first 10 min following the accident. A time sequence for starting of the systems is provided in Table 6.3-2.

Normally, electric power for operation of the ECCS is received from normal offsite ac power sources. Upon loss of normal power, operation is from onsite standby diesel generators. The diesel generators have sufficient independence, redundancy, and capacity that all ECCS requirements are satisfied. There are three independent divisions of the onsite emergency ac power system: Divisions I, II, and III. Each Division has its own diesel generator. The HPCS is powered from an independent ac supply bus (Division III). The LPCS and one LPCI are powered from a second (Division I) ac supply bus and the two remaining LPCIs are powered from a third and separate ac supply bus (Division II). The HPCS has its own diesel generator as its alternate power supply. The LPCS and one

LPCI loop switch to the Division I diesel generator supply and the other two LPCI loops switch to the Division II diesel generator power supply. Section 8.3 contains a more detailed description of the onsite emergency ac power system.

Regulatory Guide 1.1 prohibits design reliance on pressure and/or temperature transients expected during a LOCA for assuring adequate net positive suction head (NPSH). The requirements of this regulatory guide are met for the Unit 2 HPCS, LPCS, and LPCI pumps. The ECCS design conservatively assumes 0 psig containment pressure and maximum expected temperatures of the pumped fluids. Thus no reliance is placed on pressure and/or temperature transients to assure adequate NPSH. Requirements for NPSH for each pump are given on pump characteristic curves (Figures 6.3-3 [HPCS], 6.3-4 [LPCS]), and 6.3-5 [LPCI]).

All ECCS pressure relief valve discharge lines are designed to accommodate the effects of water hammer due to relief valve actuation. For a discussion of the analyses used to verify the design adequacy of piping systems subjected to occasional dynamic loads, including water hammer, see Section 3.9.1.5.2A.

The limiting condition for NPSH available occurs for all of the ECCS pumps when suction is taken from the suppression pool. In addition to the requirements of Regulatory Guide 1.1, the following design features/criteria were applied to calculations of NPSH available for ECCS suction piping from the suppression pool:

5 1. Suppression pool level is assumed to be at its minimum drawdown level of 197 ft and 8 in.

2. Assuming the suppression pool suction strainers are 50 percent clogged, the pressure drop across the CSH and CSL strainers is 1 psi and the drop across the RHR strainer is 0.65 psi. With the strainers 50 percent plugged, a 1 psi pressure drop across the high pressure core spray and low pressure core spray suppression pool strainers is assumed. A 0.65 pressure drop across the RHR suppression pool strainers is assumed.

3. Pumps are assumed to be operating at maximum runout flow with the suppression pool temperature at 212°F.

$$NPSH_{min} = P_B + L_H - V_p$$
$$= 35.39 + 20.34 - 35.39 - 8.44$$
$$= 11.90 \text{ ft}$$

LPCI

This ECCS mode of RHR system operation constitutes the limiting condition of NPSH available for the RHR pumps. With all other conditions equal the NPSH available for RHR pump A is the least of the three due to the greatest frictional losses in suction piping and fittings. The ECCS mode of operation is the worst case based upon the fluid velocity head. Accordingly, the following NPSH calculation is for this pump only while performing its ECCS function.

Evaluating all factors as defined above:

$$P_B = 14.7 \text{ psia } (144 \text{ in}^2/\text{ft}^2)/(0.016719) = 35.39 \text{ ft}$$

$$L_H = 197.67 - 177.29 = 20.38 \text{ ft}$$

$$V_p = (14.7 \text{ psia})\ (144 \text{ in}^2/\text{ft}^2)/(0.016719) = 35.39 \text{ ft}$$

$$h_f = 4.84 \text{ ft}$$

$$NPSH_{min} = 35.39 + 20.38 - 35.39 - 4.84$$
$$= 15.54 \text{ ft}$$

6.3.2.2.1 High Pressure Core Spray System

The system is designed to pump water into the reactor vessel over a wide range of pressures. For small breaks that do not result in rapid reactor depressurization, the system maintains reactor water level and reduced vessel pressure. For large breaks the HPCS system cools the core by a spray.

The HPCS system consists of a single motor-driven centrifugal pump located outside the primary containment, an independent spray sparger in the reactor vessel located above the core (separate from the LPCS sparger), and associated system piping, valves, controls, and instrumentation. The system is designed to operate from normal offsite auxiliary power or from the Division III diesel generator supply if offsite power is not available. The P&ID (Figure 6.3-6 for the HPCS) shows the system components and their arrangement. The HPCS system process diagram (Figure 6.3-1) shows the design operating modes of

the system. A simplified system flow diagram showing system injection into the reactor vessel is included on Figure 6.3-1.

The principal active HPCS equipment is located outside the primary containment. Suction piping is provided from the condensate storage tank and the suppression pool. Such an arrangement provides the capability to use reactor grade water from the condensate storage tank when the HPCS system functions to back up the RCIC system. The RCIC system is discussed in Section 5.4.6. In the event that the

available other than the LPCI injection line. However, the low water level or high drywell pressure signals which automatically initiate the LPCI mode are also used to isolate all other modes of operation and revert other system valves to the LPCI lineup. Inlet and outlet valves from the heat exchangers receive no automatic signals as the system is designed to provide rated flow to the vessel whether they are open or not.

A check valve in the pump discharge line is used together with a discharge line fill system (Section 6.3.2.2.5) to prevent water hammer resulting from pump start against a potential shutoff condition. A flow element in the pump discharge line is used to provide a measure of system flow and to originate automatic signals for control of the pump minimum flow valve. The minimum flow valve permits a small flow to the suppression pool in the event that either no discharge valve is open, or in the case of a LOCA, vessel pressure is higher than the pump shutoff head.

Using the suppression pool as the source of water for LPCI establishes a closed loop for recirculation for reactor water makeup.

The design pressures and temperatures, at various points in the system, during each of the several modes of operation of the RHR subsystems, can be obtained from the LPCI process diagram (Figure 5.4-15).

LPCI pumps and equipment are described in detail in Section 5.4.7, which also describes the other functions served by the same pumps if not needed for the LPCI function. The RHR heat exchangers are not associated with the emergency core cooling function. The heat exchangers are discussed in Section 6.2.2. The portions of the RHR required for accident protection including support structures are designed in accordance with Category I criteria (Chapter 3). The available NPSH for the LPCI pumps was calculated in accordance with Regulatory Guide 1.1. The LPCI pump characteristics are shown on Figure 6.3-5.

The LPCI system incorporates a relief valve on each of the pump discharge lines that protects the components and piping from inadvertent overpressure conditions. These valves are set to relieve pressure at 500 psig. Section 5.2.2 discusses relief valve settings and capacities.

The following provisions are included in the LPCI system to permit testing of the system:

1. All active LPCI components are designed to be testable during normal plant operation.

2. A discharge test line is provided for the three pumps to route suppression pool water back to the suppression pool without entering the RPV.

3. A suction test line, supplying reactor grade water, is provided to the test loop to discharge into the RPV during plant shutdown.

4. Instrumentation is provided to indicate system performance during normal and test operations.

5. All motor-operated valves and air-operated valves are capable of manual operation for test purposes.

6. All relief valves are removable for bench testing during plant shutdown.

6.3.2.2.5 ECCS Discharge Line Fill System

A requirement of the ECCS is that cooling water flow to the reactor vessel be initiated rapidly when the system is called on to perform its function. This quick-start system characteristic is provided by quick-opening valves, quick-start pumps, and the emergency ac power sources. The lag between the signal to start the pump and the initiation of flow into the RPV can be minimized by keeping the ECCS pump discharge lines full. Additionally, if these lines were empty when the systems were called for, large momentum forces associated with accelerating fluid into a dry pipe could cause physical damage to the piping. Therefore, the ECCS discharge line fill system is designed to maintain the pump discharge lines in a filled condition.

Since the ECCS discharge lines are elevated above the suppression pool, check or stop-check valves are provided near the pumps to prevent backflow from emptying the lines into the suppression pool. Past experience has shown that these valves could leak slightly, producing a small backflow that eventually empties the discharge piping. To ensure that this leakage from the discharge lines is replaced and the lines are always kept filled, a water leg pump is provided for each of the three ECCS divisions. The power supply to these pumps is classified as essential when the main ECCS pumps are deactivated. Indication is provided in the main control room as to whether these pumps are operating, and alarms indicate low discharge line pressure.

Criterion 4, Coolable Geometry

"Calculated changes in core geometry shall be such that the core remains amenable to cooling." As described in NEDE-20566-P[2], Section III, conformance to Criterion 4 is demonstrated by conformance to Criteria 1 and 2.

Criterion 5, Long-Term Cooling

"After any calculated successful initial operation of the ECCS, the calculated core temperature shall be maintained at an acceptably low value and decay heat shall be removed for the extended period of time required by the long-lived radioactivity remaining in the core." Conformance to Criterion 5 is demonstrated generically for GE BWRs in NEDE-20566-P[2], Section III.A. Briefly summarized, the core remains covered to at least the jet pump suction elevation and the uncovered region is cooled by spray cooling and/or by steam generated in the covered part of the core.

### 6.3.3.3 Single-Failure Considerations

The functional consequences of potential operator errors and single failures (including those that might cause any manually controlled electrically operated valve in the ECCS to move to a position that could adversely affect the ECCS), and the potential for submergence of valve motors in the ECCS are discussed in Section 6.3.1. No potential single failures are more severe than the single failures identified in Table 6.3-3. It is, therefore, only necessary to consider each of these single failures in the ECCS performance analyses.

For large breaks, failure of one of the standby diesel generators is in general the most severe failure. For small breaks, the failure of the HPCS is the most severe failure; neither failure results in unacceptable consequences. 2

### 6.3.3.4 System Performance During the Accident

In general, the system response to an accident can be described as:

1. Receiving an initiation signal,

2. A small lag time (to open all valves and have the pumps up to rated speed), and

3. ECCS flow entering the vessel.

Key ECCS actuation set points and time delays are provided in Table 6.3-1. The delay from the receipt of signal until the ECCS pumps have reached rated speed is subject to the physical limitations of accelerating the diesel generators and pumps. The delay time due to valve motion in the case of the high-pressure system provides a suitably conservative allowance for valves available for this application. In the case of the low-pressure system, the time delay for valve motion is such that the pumps are at rated speed prior to the time the vessel pressure reaches the pump shutoff pressure.

The flow delivery rates analyzed in Section 6.3.3 can be determined from the head-flow curves on Figures 6.3-3, 6.3-4, and 6.3-5 and the pressure versus time plots discussed in Section 6.3.3.7. Simplified piping and instrumentation and functional control diagrams for the ECCS are provided in Section 6.3.2. The operational sequence of the ECCS for the DBA is shown in Table 6.3-2.

Operator action is not required, except as a monitoring function, during the short-term cooling period following the LOCA. During the long-term cooling period, the operator takes action as specified in Section 6.2.2.2 to place the containment cooling system into operation.

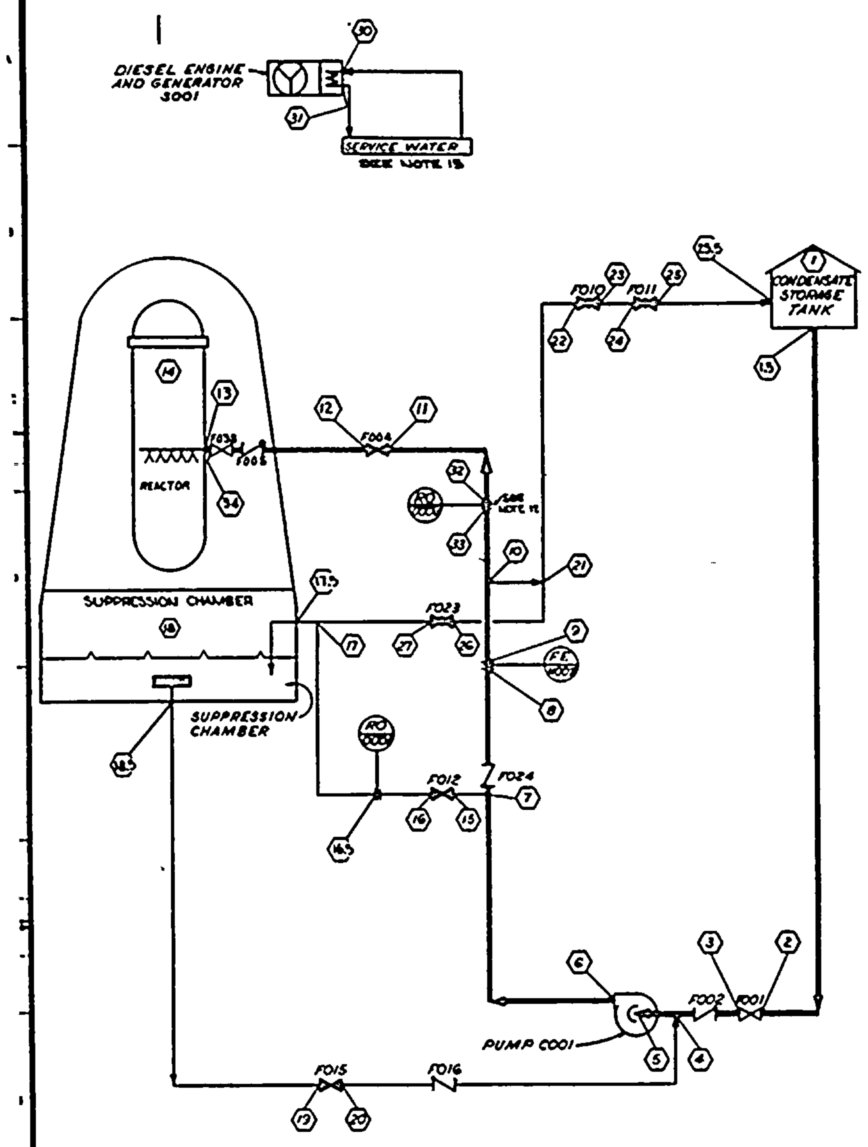
6.3.3.5 Use of Dual Function Components for ECCS

With the exception of the LPCI system, the systems of the ECCS are designed to accomplish only one function: to cool the reactor core following a loss of reactor coolant. To this extent, components or portions of these systems (except for pressure relief) are not required for operation of other systems that have emergency core cooling functions, or vice versa. Because either the ADS initiating signal or the overpressure signal opens the SRV, no conflict exists.

The LPCI subsystem, however, uses the RHR pumps and some of the RHR valves and piping. When the reactor water level is low, the LPCI subsystem has priority through the valve control logic over the other RHR subsystems for containment cooling, shutdown cooling, or steam condensing. Immediately following a LOCA, the RHR system is directed to the LPCI mode.

6.3.3.6 Limits on ECCS Parameters

The limits on the ECCS parameters are discussed in Sections 6.3.3.1 and 6.3.3.7.1. Any number of components in any given system may be out of service, up to and including




## PRIMARY MODES

(SEE NOTE 21)
MODE A. ACCIDENT OR RCIC BACKUP, REACTOR AT HIGH PRESSURE, SUCTION FROM CONDENSATE STORAGE

| POSITION ○ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM | N/A | 1550 | ← | | | | | | | | | → | 1550 | N/A |
| PRESS. PSIA | 14.7 | | | | | | | | | | | | | 1145 |
| TEMP. °F | AMB | 120/40 | ← | | | | | | | | | → | 120/40 | AMB |
| MAX PRESS. DROP FEET | | | | | ←2787→ | | | | | | | | | |

(SEE NOTE 21)
MODE B ACCIDENT, REACTOR AT HIGH PRESSURE, SUCTION FROM SUPPRESSION POOL

| POSITION ○ | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 19 | 20 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM | 1550 | ← | | | | | | | → | 1550 | N/A | 1550 | 1550 | N/A |
| PRESS. PSIA | | | | | | | | | | | 1145 | | | 14.7 |
| TEMP. °F | 120/40 | ← | | | | | | | → | 120/40 | AMB | 120/40 | 120/40 | AMB |
| MAX PRESS. DROP FEET | | ←2787→ | | | | | | | | | | | | |

MODE C ACCIDENT, SYSTEM INJECTION AT RATED CORE SPRAY, SUCTION FROM SUPPRESSION POOL

| POSITION ○ | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 19 | 20 | 18 | | | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM | 6350 | ← | | | | | | | → | 6350 | N/A | 6350 | 6350 | N/A | | | ←800→ | |
| PRESS PSIA | | | | | | | | | | | 218 | | | 14.7 | | | | |
| TEMP °F | 170/40 | ← | | | | | | | → | 170/40 | AMB | 170/40 | 170/40 | AMB | | | ←77→ | |
| MAX PRESS. DROP FEET | | ←845→ | | ←21→ | | | | ←2.2→ | | ←138→ | ←30→ | | | | | | ←40→ | |

MODE D ACCIDENT, SYSTEM INJECTION AT RATED CORE FLOOD, SUCTION FROM SUPPRESSION POOL

| POSITION ○ | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 19 | 20 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM | 6856 | ← | | | | | | | → | 6856 | N/A | 6856 | 6856 | N/A |
| PRESS PSIA | | | | | | | | | | | 41 | | | 14.7 |
| TEMP °F | 170/40 | ← | | | | | | | → | 170/40 | AMB | 170/40 | 170/40 | AMB |
| MAX PRESS. DROP FEET | | ←557→ | | ←24→ | | | | ←2.5→ | | ←231→ | | | | |

MODE E ACCIDENT, SYSTEM INJECTION AT RATED CORE FLOOD, SUCTION FROM CONDENSATE STORAGE

| POSITION ○ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM SEE NOTE 5,8 | N/A | 6856 | ← | | | | | | | | | → | 6856 | N/A |
| PRESS PSIA | 14.7 | | | | | | | | | | | | | 30 |
| TEMP. °F | AMB | 170/40 | ← | | | | | | | | | → | 170/40 | AMB |
| MAX PRESS. DROP FEET | | ←79→ | | | 557 | | | ←24→ | | | ←2.5→ | | ←231→ | |

MODE F ACCIDENT, SYSTEM OPERATING AT RUNOUT, SUCTION FROM SUPPRESSION POOL

| POSITION ○ | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 19 | 20 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM SEE NOTE 9 | 7175 | ← | | | | | | | → | 7175 | N/A | 7175 | 7175 | N/A |
| PRESS PSIA | | | | | | | | | | | 14.7 | | | 14.7 |
| TEMP °F | 170/40 | ← | | | | | | | → | 170/40 | AMB | 170/40 | 170/40 | AMB |
| MAX PRESS. DROP FEET | | ←462→ | | | | | | | | ←46→ | | | | |

MODE G SYSTEM-TEST, SUCTION FROM SUPPRESSION POOL

| POSITION ○ | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 21 | 26 | 27 | 17 | 19 | 20 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM SEE NOTE 9 | 7175 | ← | | | | | | | | | | | 7175 | N/A |
| PRESS PSIA | | X | X | X | X | X | X | X | X | X | X | X | X | 14.7 |
| TEMP °F | 170/40 | ← | | | | | | | | | | | 170/40 | AMB |
| MAX PRESS. DROP FEET | | ←462→ | | | | | | | SEE NOTE 10 | | | | | |

TABLE I
VALVE POSITION TABLE

| VALVE | F001 | F004 | F010 | F011 | F012 | F015 | F023 | F038 |
|---|---|---|---|---|---|---|---|---|
| MODE A | O | O | C | C | C | C | C | O |
| MODE B | C | O | C | C | C | O | C | O |
| MODE C | C | O | C | C | C | O | C | O |
| MODE D | C | O | C | C | C | O | C | O |
| MODE E | O | O | C | C | C | C | C | O |
| MODE F | C | O | C | C | C | O | C | O |
| MODE G | C | C | C | C | C | O | O | O |
| MODE H | O | C | O | O | C | C | C | O |
| MODE J | O | C | C | C | O | C | C | O |
| MODE S | O | C | C | C | C | C | C | O |
| MODE CC | C | O | C | C | O | O | C | O |

O VALVE OPEN
C VALVE CLOSE

MODE J PUMP OPERATING ON BYPASS, SUCTION FROM CONDENSATE STORAGE

| POSITION ○ | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FLOW GPM | N/A | 640 | ← | | | | | SEE NOTE 11 | → | 640 | N/A |
| PRESS. PSIA | 14.7 | X | X | X | X | X | X | X | X | X | 14.7 |
| TEMP. °F | AMB | 170/40 | ← | | | | | | → | 170/40 | AMB |
| MAX. PRESS. DROP FEET | | | | | ←3000→ | | | ←2.0→ | | | |

NOTES:

1. ALL EMPTY PRESSURE DATA BLANKS CAN BE FILLED IN BY OTHERS (BASED ON ACTUAL ARRANGEMENT) OR EQUIV. HYDRAULIC DATA SUBMITTED TO BWRSO FOR REVIEW. [X] INDICATES THE DATA IS NOT SIGNIFICANT.
2. [MAX/MIN] INDICATES MAXIMUM & MINIMUM VALUE OF PARAMETER FOR THE MODE SPECIFIED.
3. ELEVATIONS ARE NOT INCLUDED IN ΔP VALUES GIVEN. ELEVATIONS SHALL BE INCLUDED WHEN DETERMINING FINAL VALUES FOR THE EMPTY PRESSURE DATA BLANKS.
4. THE PUMP MAXIMUM SHUTOFF HEAD WILL NOT EXCEED 3450 FT.
5. IN MODE E WITH A PUMP TDH OF 845 FT AND A VESSEL PRESSURE OF 215 PSIA THE FLOW MUST BE EQUAL TO OR GREATER THAN 6350 GPM.
6. THE PUMP TDH GIVEN FOR MODE E IS BASED ON A MAXIMUM CONTAINMENT PRESSURE OF 45 PSIG. BWRSO MUST BE ADVISED IF THE CONTAINMENT DESIGN IS BASED ON A HIGHER PRESSURE AND THE IMPACT ON THE HIGH PRESSURE CORE SPRAY SYSTEM EVALUATED.
7. IN MODE F, THE NET POSITIVE SUCTION HEAD (NPSH) AVAILABLE AT A REFERENCE LOCATION 2 FEET ABOVE THE PUMP MOUNTING FLANGE MUST EQUAL OR EXCEED 35 FT. THE NPSH AVAILABLE AT THE PUMP SUCTION NOZZLE MUST EQUAL THIS VALUE PLUS THE DIFFERENCE IN ELEVATION BETWEEN THE REFERENCE LOCATION AND THE CENTERLINE OF THE PUMP SUCTION NOZZLE.
8. IN MODE E AND AT A FLOW RATE OF 7175 GPM, THE AVAILABLE NPSH MUST EQUAL OR EXCEED THE VALUE SPECIFIED IN NOTE 7 ABOVE.
9. THE FLOW SPECIFIED FOR MODES F AND G IS APPROXIMATE AND MUST BE DETERMINED BASED ON FINAL SYSTEM DESIGN. THE FLOW GIVEN FOR THESE MODES IS THE MAXIMUM ALLOWABLE.
10. THE ΔP GIVEN FOR THE VALVES IN MODES G AND H IS THE MINIMUM POSSIBLE AND MAY BE INCREASED BY OTHERS (THROTTLING) TO ACCOMMODATE PIPING ARRANGEMENT.
11. THE BYPASS FLOW SPECIFIED IN MODE J IS APPROXIMATE AND WILL BE SPECIFIED BY THE PUMP VENDOR.
12. THE ΔP BETWEEN LOCATION (32) AND (33) WILL BE DETERMINED IN PRE-OPERATIONAL TEST. THE ΔP WILL BE ADJUSTED TO MEET THE FLOW REQUIREMENTS OF MODE C, D AND/OR E. AND TO LIMIT RUNOUT FLOW TO 7175 GPM.
14.
15. THE DIESEL SERVICE WATER FLOW RATE IS A FUNCTION OF MAXIMUM SITE SERVICE WATER TEMPERATURE AS SPECIFIED IN THE DATA SHEETS OF REF. 3.
16. ΔP VALUES FOR EQUIPMENT WITHIN GE-BWRSO SCOPE ARE AS NOTED.
17. TABLE I INDICATES VALVE POSITION DURING VARIOUS OPERATING MODES.
18. PIPING SYSTEM DESIGN PRESSURE AND TEMPERATURE AND THE ESTIMATED LINE SIZES ARE FOR INFORMATION ONLY. ACTUAL DESIGN TEMPERATURE AND PRESSURE AND LINE SIZES AS DETERMINED BY OTHERS SHALL MEET THE PROCESS DIAGRAM HYDRAULIC REQUIREMENTS.
20. IN MODE E AND WITH A VESSEL PRESSURE OF 16.7 PSIA, THE FLOW SHALL NOT EXCEED 7175 GPM.
21. FOR MODES A & B, ONE THIRD OF TABULATED FLOW SHALL BE DELIVERED TO THE VESSEL WITH REACTOR VESSEL PRESSURE BETWEEN 1175 PSIA AND 1145 PSIA.
22. THE FLOW SPECIFIED FOR MODE CC MUST BE EQUALED OR EXCEEDED WITH THE SUCTION FROM THE CONDENSATE STORAGE SYSTEM AND WITH THE REACTOR PRESSURE EQUAL TO 1175 PSIA.
23. CAUTION: TO AVOID PUMP DAMAGE/FAILURE, THE MAXIMUM RUNOUT FLOW FOR ANY PUMP OPERATING MODE (eg PREOPERATIONAL TEST, PRELIMINARY PUMP CHECK, STARTUP AND ALL MODES ON THE PROCESS DIAGRAM) SHALL NOT EXCEED 7175 GPM AND THE MINIMUM FLOW SHALL NOT BE BELOW 640 GPM.

SUPPORTING DOCUMENTS: MPL ITEM NO.

1. PIPING & INSTRUMENT SYMBOLS .......... A42-1010

SUPPLEMENTAL DOCUMENTS UNDER THE FOLLOWING IDENTITIES ARE TO BE USED IN CONJUNCTION WITH THIS DRAWING. REFERENCE DOCUMENT

1. HIGH PRESSURE CORE SPRAY P&ID .......... E22-1010
2. NUCLEAR BOILER SYSTEM PROC. DIA. .......... B22-1020
3. HIGH PRESSURE CORE SPRAY DESIGN SPEC. .......... E22-4010

MISCELLANEOUS INFORMATION
(SEE NOTE 18)

| LOCATION | 1,3 | 2, 4 | 18.5, 4, 5 | 6, 8 | 11, 34 | 13, 7 | 16.5, 17 | 10, 27, 17.5 | 21, 25 | 25.5 | 30, 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DESIGN TEMP (°F) | 140 | 212 | 212 | 212 | * / 575 | 212 | | 212 | 212 | 140 | 100 / 120 |
| DESIGN PRESS (PSIG) | 100 | | 100 | 1575 | * / 1250 | 1575 | 100 | 1575 / 100 | | | |
| ESTIMATED LINE SIZE (IN.) | 14 | | 18 | 16 | 12 | 4 | | 12 | 10 | | 5 |
| | CONDENSATE STG SUCTION LINE | | POOL SUCTION LINE | MAIN HPCS LINE TO REACTOR | | BY-PASS LINE | | SUPPRESSION POOL TEST LINE | CONDENSATE STORAGE TEST RETURN LINE | | COOLING WATER LINE |

* DUAL DESIGN CONDITIONS
1250 PSI AND 575 °F
OR
1575 PSI AND 140 °F

FIGURE 6.3-1

HIGH PRESSURE CORE SPRAY
PROCESS DIAGRAM
SHEET 1 OF 2

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT

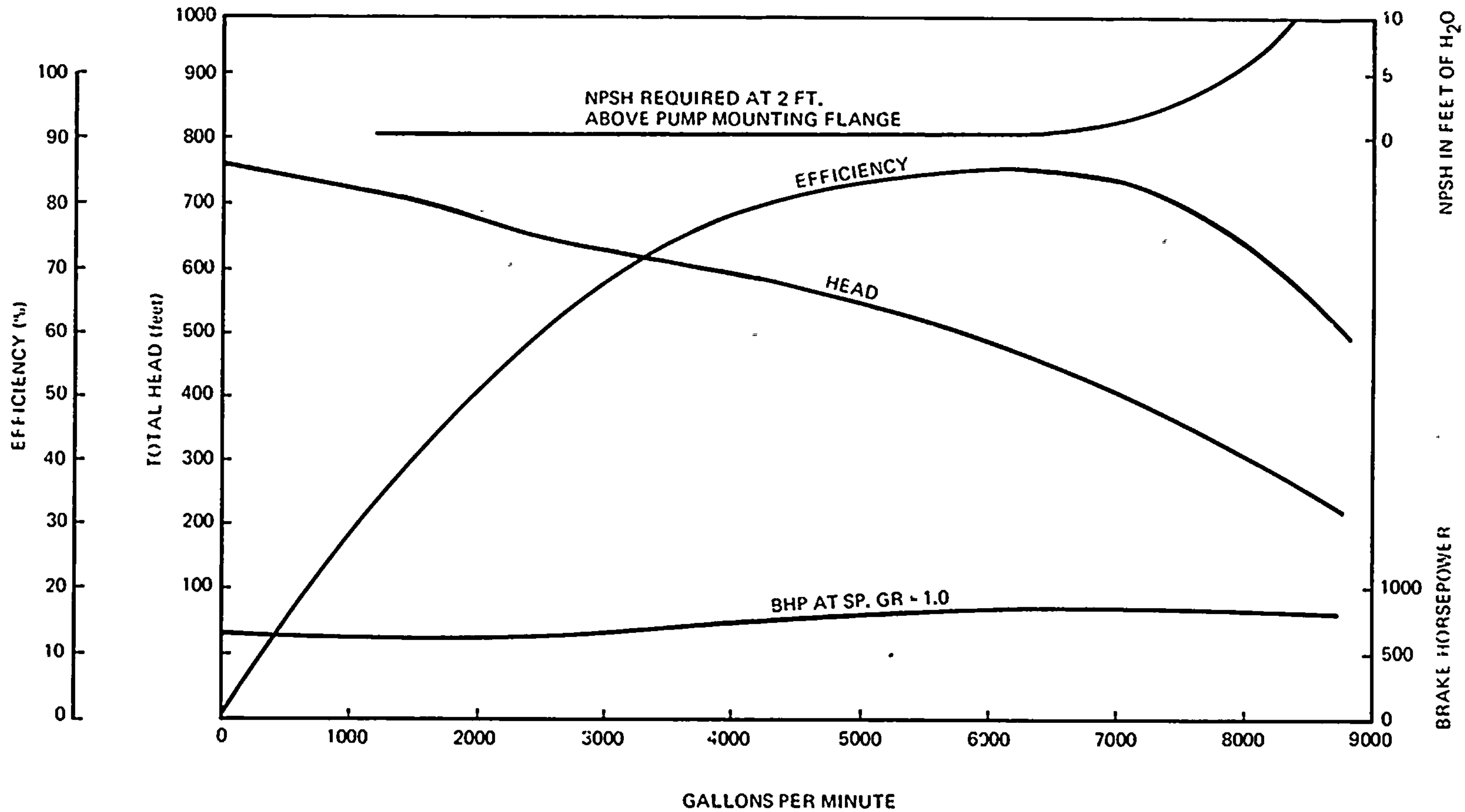



FIGURE 6.3-5b

HIGH PRESSURE CORE SPRAY
PUMP CHARACTERISTICS

NIAGARA MOHAWK POWER CORPORATION
NINE MILE POINT-UNIT 2
FINAL SAFETY ANALYSIS REPORT

# CHAPTER 8

## LIST OF FIGURES


| Figure Number | Title |
|---|---|
| 8.1-1 | NEW YORK POWER POOL |
| 8.2-1 | SITE TRANSMISSION NETWORK |
| 8.2-2 | 345 KV TRANSMISSION TOWERS (TWO POLE TANGENT "H" FRAME) |
| 8.2-3 | 345 KV TRANSMISSION TOWERS (SINGLE CIRCUIT STEEL 60° ANGLE SQUARE BASE DE) |
| 8.2-4 | 115 KV TRANSMISSION TOWERS (SINGLE CIRCUIT - 3 STEEL POLE STRUCTURE TYPE 115 KV DE) |
| 8.2-5 | 115 KV TRANSMISSION TOWERS (TWO POLE TANGENT "H" FRAME) |
| 8.2-6 | 115 KV TRANSMISSION TOWERS (SINGLE POLE - VERTICAL - ANGLE) |
| 8.2-7 | 345 KV SWITCHYARD ONE LINE DIAGRAM |
| 8.2-8 | 115 KV SWITCHYARD |
| 8.2-9 | NMPC GRID (MID-EIGHTIES) |
| 8.3-1 | PLANT MASTER ONE LINE DIAGRAM, NORMAL POWER DISTRIBUTION |
| 8.3-2 | PLANT MASTER ONE LINE DIAGRAM, EMERGENCY POWER DISTRIBUTION |
| 8.3-3 | PLANT MASTER ONE LINE DIAGRAM NORMAL 600V AND 120V AC |
| 8.3-4 | PLANT MASTER ONE LINE DIAGRAM EMERGENCY 600V AND 120V AC |
| 8.3-5 | 25KVA SINGLE PHASE UNINTERRUPTIBLE POWER SUPPLY SYSTEM |

CHAPTER 8

LIST OF FIGURES (Cont)


| Figure Number | Title |
|---|---|
| 8.3-6 | STANDBY DIESEL GENERATOR CONTROL AND PROTECTION LOGICS |
| 8.3-7 | REACTOR PROTECTION SYSTEM MG SET CONTROL |
| 8.3-8 | ELECTRICAL PENETRATIONS MEDIUM VOLTAGE (TYPICAL) |
| 8.3-9 | PHYSICAL SEPARATION OF SAFETY RELATED ELECTRICAL EQUIPMENT - EL 261'-0" |
| 8.3-10 | PLANT MASTER ONE LINE DIAGRAM EMERGENCY 125V DC SYSTEM AND NORMAL ±24V DC SYSTEM |
| 8.3-11 | PLANT MASTER ONE LINE DIAGRAM NORMAL 125V DC SYSTEM |