ComEd

ZRA98053
November 10, 1998

U. S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555

Zion Nuclear Power Station Units 1 and 2
Facility Operating License Nos. DPR-39 and DPR-48
NRC Docket Nos. 50-295/304

Subject: Submittal of Defueled Safety Analysis Report

Reference: Letter from R. R. Assa (USNRC) to O. D. Kingsley (ComEd) dated June 30, 1998, "Exemption From The Requirements Of 10CFR50.71 - Zion Nuclear Power Station, Units 1 and 2"

Enclosed, as Attachment A, is the Defueled Safety Analysis Report for Zion Nuclear Power Station, Units 1 and 2. This is an update to the Zion Updated Final Safety Analysis Report (UFSAR) rewritten to reflect the permanent defueled condition of the plant. This Defueled Safety Analysis Report (DSAR) version of the UFSAR is provided pursuant to 10CFR50.71(e)(4) and the above reference.

Attachment A includes change instructions for the update and the DSAR pages. Attachment B is a description of change document and is provided in lieu of revision bars to indicate changes from the previous version of the UFSAR due to the extensive revision and reformatting of the document. Attachment C provides a listing of the commitments contained in this submittal.

Commonwealth Edison certifies that the information accurately presents changes made since the previous submittal necessary to reflect information and analyses submitted to the Commission or prepared pursuant to Commission requirements.

Pursuant to 10CFR50.4(b)(6), one signed original and ten copies of this update to the Zion Updated Final Safety Analysis Report are provided to the NRC Document Control Desk, plus one copy to the NRC Region III office.

Please direct any questions you may have concerning this submittal to this office.

Respectfully,

R. S. Starkey
Decommissioning Plant Manager
Zion Station

Attachments
cc: NRC Regional Administrator – RIII

Blind Copies w/o attachment

Zion Station Project Manager - NRR
Office of Nuclear Facility Safety - IDNS
IDNS Resident Inspector
Zion NLA
Master Files
Reg. Assurance File
DCD Licensing
Winston & Strawn, Washington D.C.

ZRA98053
Attachment A

Zion Station
August 1998
UFSAR Update

Description Of Change Document

In March 1998, Com Ed certified per 10CFR50.82 that the company had permanently ceased power operation and that all fuel was in the Spent Fuel Pool. This is a permanent, non-revocable certification that changed the Zion Station licensing basis.

The most significant effect of this licensing basis change was to eliminate nuclear safety functions for the majority of the structures, systems, and components (SSC's). Those SSC's, which had only performed a reactor safety function (i.e. SSC's that do not support spent fuel or radiation protection function), need no longer be maintained under nuclear grade controls.

The traditional and regulatory mandated approach to SSC classification involves a determination that an SSC is, or is not safety related. For Zion station there are no SSC's that meet the definition of safety related. Screening criteria was developed to add to the licensing basis to enable personnel to discriminate between those SSC's that are important to the Defueled Condition (ITDC), and those SSC's which are not required because the activity associated with the safety function is no longer allowed by regulation.

The Defueled Safety Analysis Report (DSAR) will be the principal licensing document describing pertinent ITDC SSC's, operational constraints and practices, and accident analyses associated with the permanently defueled condition of Zion Station. The criteria used to determine the content of the Zion DSAR is modeled after the criteria used to develop the Maine Yankee nuclear power station DSAR and is as follows:

1. Add screening criteria to determine those systems that are ITDC.
2. Reclassifies SSC's as required consistent with new analyses.
3. The removal of discussions in the UFSAR, which are not applicable to the defueled condition when, screened against the 4 ITDC criteria.
4. The replacement of UFSAR discussions pertaining to outdated analysis with the result of new thermal, radiological, structural and accident analyses.
5. The incorporation of relocated Technical Specifications.
6. The incorporation of previously approved relevant UFSAR change requests.
7. Clarifying and augmenting the existing UFSAR to more correctly reflect the existing, but still relevant, design or licensing basis.
8. The consolidation and integration of information into a revised format.

Description Of Change Document

The following is a table depicting the new format of the DSAR. The DSAR is arranged in seven chapters. The extant sections of the UFSAR have been relocated to appropriate sections in the DSAR, unless it was found that the SSC was not applicable to the defueled condition. Due to extensive revisions to the text, revision bars have been removed. In addition to removal of information, new information was added as necessary to the DSAR to discuss the permanently defueled condition of the plant. The applicable UFSAR Change requests that were incorporated into the DSAR are also identified.

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
1		1.0	**Introduction and General Description of Plant**
	1.1	1.1	*Introduction:* Revised to recognize the cessation of power operations. Added discussion of new classification of ITDC, a brief history of major plant operations, and a discussion of the DSAR as the licensing basis document that reflects the permanently defueled condition.
	1.2	1.2	*General Plant Description:* Revised the General design criteria to include only those that are applicable to the defueled condition. Changed conclusion that Zion Station is constructed to safely store fuel vs. Power Operation.
	1.3		*Comparison Tables*: Section deleted; no longer pertinent to the defueled condition.
	1.4	1.3	*Identification of Agents and Contractors*: Removed references to ongoing design engineering support.
	1.5		*Requirements for Further Technical Information*: Deleted; this section referred reader to another section, which was deleted.
	1.6	1.4	*Material Incorporated by Reference*: Deleted, since no further material is incorporated by reference.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	1.7	1.5	*Drawings and Other Detailed Information*: Reference table revised for figures that were added/deleted.
	1.8		*Conformance to NRC Regulatory Guides*: Deleted; not applicable to the Defueled Condition. Compliance to AEC 1967 Safety guidelines included in Chapter 3 of DSAR.
	1.9		*Standard Designs*: Deleted; was never applicable to Zion Station
	App. 1A		*Compliance to AEC Safety Guides*: Compliance to AEC 1967 Safety guidelines included in Chapter 3 of DSAR.
2		2.0	**Site Characteristics**
	2.1	2.1	*Geography and Demography*: Added introduction stating this chapter contains information that is historical in nature and that was used in the initial licensing of the plant. Changed discussion from a 50-mile radius of the plant to a 10-mile radius of the plant consistent with the new accident analyses for the defueled condition.
	2.2	2.2	*Nearby Industrial, Transportation, and Military facilities*: Updated information to a 10-mile radius. Corrected outdated information, and deleted obsolete information.
	2.3	2.3	*Meteorology*: Information remained unchanged; updated reference numbers.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	2.4	2.4	*Hydrology Engineering*: Updated information to a 10-mile radius. Incorporated UFSAR pending changes 96-081 and 97-035 for the D/G rooms flooding protection. Deleted references of flood protection for safety related equipment. Deleted discussions of instantaneous release, since this information is contained in Chapter 4 of DSAR.
	2.5	2.5	*Geology, Seismology and Geotechnical Engineering*: Information remained unchanged; updated reference numbers
	2.6	2.6	*Radiological Environmental Monitoring Program:* Remained Unchanged; updated reference numbers
	App. 2A		*A Study of the Probability of An Aircraft Using Waukegan Memorial Airport Hitting the Zion Station:* Deleted, since study was superceded and is discussed in section 2.2.
	App. 2B		*Potential Effects of Aircraft Impact and Post-Crash Fires on the Zion Station:* Deleted, since study was superceded and is discussed in section 2.2.
	App. 2C	App. 2A	*Five-Year Stability DATA (WINDIF) for Chicago and Milwaukee:* Remained unchanged.
	App. 2D	App. 2B	*Six Month Stability Data for Zion Power Station:* Remained unchanged.
	App. 2E	App. 2C	Site Airborne Effluent Diffusion and Record of Meteorological Monitoring for the Period of May 1, 1971 - April 30, 1972.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
3			**Design of Structures, Components, Equipment, and Systems:**
	3.1	3.1	*Conformance with NRC General Design Criteria*: Deleted criterion not applicable and revised some responses to be consistent with the defueled condition. The GDC criteria that remain applicable to the defueled condition are: Group I Overall Plant Requirements [1,2,3,5,] Group II Nuclear and Radiation Controls [11,12,17,18] Group III Fuel and Waste Storage Systems [66,67,68,69] Group IV Plant Effluents [70] 1971 General Design Criteria was deleted. Zion Station was licensed to AEC 1967 Safety guidelines.
	3.2	3.2	*Classification of Structures, Components, and Systems*: Deleted all references to the Operating Basis Earthquake. Deleted references to non-ITDC SSC's. Added discussion that no SSC's meet the criteria to be classified as Safety Related. Added 4 new criteria for SSC classification as ITDC.
	3.3	3.3	*Wind and Tornado Loadings*: Remained Unchanged
	3.4	3.4	*Water Level (Flood) Design*: Changed description of sump pump system to more generic statement.
	3.5	3.5	*Missile Protection*: Deleted descriptions for non-ITDC systems (RCS, MS, FW pipe ruptures)

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	3.6		*Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping*: Deleted in its entirety; not applicable to the defueled condition (applies to moderate and high-energy line breaks).
	3.7	3.7	*Seismic Design*: Deleted references to Operating Basis Earthquakes (OBE). Deleted discussion of non-ITDC systems seismic design (RCS, NSSS). Deleted discussion of seismic design modeling calculations and programs used.
	3.8	3.8	*Design of Category 1 Structures*: Section rewritten to concentrate on the ITDC seismic class 1 structures and deleted sections related to non-ITDC structures.
	3.9		*Mechanical Systems and Components*: Deleted in its entirety; systems discussed (Loose parts Monitor, Control Rod Drive, Reactor Pressure Vessel) are not applicable to the defueled condition.
	3.10	3.6	*Seismic Qualification of Seismic Category I Instrumentation and Electrical Equipment*: Deleted discussion of non-ITDC system (NSSS).
	3.11		*Environmental Design of Electrical Equipment*: Deleted in its entirety; EQ Program no longer applicable to the defueled condition.
	App. 3A		*Analysis of the Effects of a Main Steam or Feedwater Break Outside Containment*: Deleted in its entirety; not applicable to the defueled condition

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
4			**Reactor:**
	4.1		*Summary Description*: Deleted all but discussion of fuel assembly and control rod design.
	4.2		*Fuel System Design*: Deleted in its entirety; not applicable to the defueled condition
	4.3		*Nuclear Design*: Deleted in its entirety; not applicable to the defueled condition
	4.4		*Thermal and Hydraulic Design*: Deleted in its entirety; not applicable to the defueled condition
	4.5		*Reactor Materials*: Deleted in its entirety; not applicable to the defueled condition
	4.6		*Functional design of Reactivity Control Systems*: Deleted in its entirety; not applicable to the defueled condition
5.0			**Reactor Coolant System and Connected Systems** Chapter deleted in its entirety; not applicable to the defueled condition.
	5.1		*Summary Description*:
	5.2		*Integrity of Reactor Coolant Pressure Boundary*:
	5.3		*Reactor Vessels*:
	5.4		*Component and Subsystem Design*:
	App. 5A		*Criteria for Vessels and Piping within Reactor Coolant System Pressure Boundary*:
6			**Engineered Safety Features** Chapter deleted in its entirety; not applicable to the defueled condition.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	6.0		*General*:
	6.1		*Engineered Safety Feature Materials*:
	6.2		*Containment Systems*:
	6.3		*Emergency Core Cooling System*:
	6.4		*Habitability Systems*:
	6.5		*Fission Product Removal and Control Systems*:
	6.6		*Inservice Inspection of Class 2 and 3 Structures*
	6.7		*Main Steam Isolation Valve Leakage control System*:
	App. 6A		*Thermal Recombiner Demonstration Test:*
7			**Instrumentation and Control** Chapter deleted in its entirety; not applicable to the defueled condition (ESF and RX Protection related.).
	7.1		*Introduction*:
	7.2		*Reactor Protection System*:
	7.3		*Engineered Safety Feature Systems*:
	7.4		*Systems Required for Safe Shutdown*:
	7.5		*Safety-Related Display Instrumentation*:
	7.6		*All Other Instrumentation Required For Safety*:
	7.7		*Control Systems not Required for Safety*:
8			**Electric Power:**

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	8.1	3.11	*Introduction*: Deleted discussion of ESF/safety related features of the electrical systems, due to new analyses of extended time period to respond to accident scenarios.
	8.2	3.11	*Offsite Power System*: Deleted discussion of safety related features and references to the main generators.
	8.3	3.11	*Onsite Power Systems*: Deleted discussion of power operation of the electrical system (main generator, Unit Aux transformer). Deleted discussion of safety related features (Diesel Generators, Aux Power, Instrument buses, DC). Deleted cable tray loading seismic design criteria.
9			**Auxiliary Systems**
	9.0		*Summary*: Section deleted in its entirety, General Design Criteria (Shared systems, Reactivity control, and ESF performance capability) no longer applicable to the defueled condition.
	9.1	3.9	*Fuel Storage and Handling*: Deleted references to refueling operations and containment fuel handling systems. Deleted refueling scenarios decay heat analysis from design decay heat removal criteria. Added new analysis to assess the effects of thermal increase on the Spent Fuel pool structure, due to a loss of cooling event. Added relocated section of Tech Specs for new fuel storage design. Added descriptions of what parts of system are classified as ITDC.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	9.2	3.10	*Water Systems*: Deleted all references to safeguards requirements or accident conditions from both Service Water (SW) and Component Cooling (CC) systems. Tailored discussion of both SW and CC operation to the spent fuel cooling function. Eliminated discussion of all other supplies to equipment unless identified as support for an ITDC system. Added description of what parts of system are classified as ITDC.
	9.3		*Process Auxiliaries*: Deleted in its entirety; no systems classified as ITDC.
	9.4	3.10	*Air Conditioning, Heating, Cooling, and Ventilation Systems*: Deleted design basis for Control Room HVAC, Spent Fuel Pool Ventilation, as they are not ITDC and not required to mitigate the consequences of an accident. Discussion still included for those systems as they relate to the operation in the defueled condition to maintain temperature control, 10CFR20 monitoring requirements and facilitate general maintenance of the facility. Deleted discussion of all other non-ITDC ventilation systems
	9.5	3.10	*Other Auxiliary Systems*: Remained unchanged
	App. 9A	3.9	*Swinging Spent Fuel Cask Accident Analysis*: Remains unchanged; incorporated into text of Section 3.9
10			**Steam and Power Conversion System:** Chapter deleted in its entirety; not applicable to the defueled condition.
	10.1		*Summary Description*:
	10.2		*Turbine - Generator*:
	10.3		*Main Steam Supply System*:

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	10.4		*Other Features of Steam and Power Conversion Systems*:
11		4	**Radioactive Waste Management**
	11.0	4.5	*General*: Deleted discussion of gaseous Radwaste system. The six gas decay tanks have been released and the tanks released to atmosphere.
	11.1	4.5	*Source Term*: Deleted, since actual source terms are as identified by Chemical sampling.
	11.2	4.5	*Liquid Waste Management System*: Section rewritten to describe the method in a detail consistent with the defueled condition.
	11.3		*Gaseous Waste Management Systems*: Deleted discussion of gaseous Radwaste system. The six gas decay tanks have been released and the tanks contain negligible activity.
	11.4	4.5	*Solid Waste Management System*: Deleted references to Radwaste evaporator.
	11.5	4.6	*Process and Effluent Radiological Monitoring and Sampling Systems*: Added introduction to describe that the purpose of rad monitors in the defueled condition is to monitor for particulate and noble gases, but that no rad monitors are relied upon for accident mitigation. Deleted references to Rad monitors which were not ITDC. The applicable portions of UFSAR Change #96-062 have been incorporated.
12		4	**Radiation Protection**
	12.1	4.1	*Ensuring that Occupational Radiation Exposures are As Low As Reasonably Achievable*: Remained unchanged.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	12.2	4.2	*Radiation Sources*: Rewrote section to discuss the source term relative to a defueled condition.
	12.3	4.3	*Radiation Protection Design Features*: Deleted sections which referenced power operation. Deleted discussions of reactor containment shielding, RC loop shielding and Post DBA shielding that are not pertinent to the defueled condition.
	12.4		*Dose Assessment*: Deleted section; was never applicable to Zion Station
	12.5	4.4	*Health Physics Program*: Revised section for correct nomenclature for the decommissioning organization. Incorporated UFSAR pending change 97-093 to more correctly describe record/log keeping.
13		6	**Conduct of Operations**
	13.1	6.1	*Organizational Structure of Applicant*: Revised to describe the decommissioning organization.
	13.2	6.3	*Training*: Revised to describe the training required in the defueled condition.
	13.3	6.5	*Emergency Planning*: Incorporated select portions of UFSAR pending change 97-044, to standardize description of the emergency plan throughout Com Ed. Deleted remainder since information is covered in other documents.
	13.4	6.6	*Review and Audit*: Rewritten to refer to Tech Specs
	13.5	6.4	*Plant Procedures*: Rewritten to reflect the defueled condition.
	13.6	6.5	*Industrial Security*: Remained unchanged

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
14			**Initial Test Program**
	14.1		*Specific Information to be Included in Preliminary Safety Analysis Reports*: Deleted in its entirety; no longer applicable to the defueled condition
	14.2		*Specific Information to be Included in final Safety Analysis Reports*: Deleted in its entirety; no longer applicable to the defueled condition
15		5	**Safety Analysis**
	15.0	5.0	*General*: Added introduction of SAFSTOR condition of plant and limited chapter discussion to accidents related to movement and storage of irradiated fuel in the spent fuel pool. Deleted sections which referred to accident classification, plant characteristics, initial accident conditions assumed, computer codes used, and operator action for accidents initiating from power conditions.
	15.1		*Increase In Heat Removal by the Secondary System*: Deleted in its entirety; accidents no longer applicable to the defueled condition.
	15.2		*Decrease In Heat Removal by the Secondary System:* Deleted in its entirety; accidents no longer applicable to the defueled condition.
	15.3		*Decrease in Reactor Coolant System Flow Rate*: Deleted in its entirety; accidents no longer applicable to the defueled condition.
	15.4		*Reactivity and Power Distribution Anomalies*: Deleted in its entirety; accidents no longer applicable to the defueled condition.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
	15.5		*Increase in Reactor Coolant Inventory*: Deleted in its entirety; accidents no longer applicable to the defueled condition.
	15.6		*Decrease in Reactor Coolant Inventory*: Deleted in its entirety; accidents no longer applicable to the defueled condition.
	15.7	5.1 5.2 5.3	*Radioactive Release from a Subsystem or Component*: All accidents, with the exception of the Fuel Handling accident in the Fuel Building, were deleted. The Fuel Handling Building accident method of analyses and results were modified to be consistent with new accident analyses. Added section with new accident analyses for Spent Fuel Pool Accident, Loss of Spent Fuel Pool Cooling, and HIC Drop Accident.
	15.8		Anticipated Transient Without a Scram: Deleted in its entirety; accidents no longer applicable to the defueled condition.
	App. 15A		*Various Aspects of ECCS Performance*: Deleted in its entirety; accidents no longer applicable to the defueled condition.
	App. 15B		*Radiation Sources*: Deleted. Relevant information moved to Chapter 4.
	App. 15C		*Hydrogen Purge System*: Deleted in its entirety; no longer applicable to the defueled condition.

Description Of Change Document

UFSAR Section	UFSAR Sub-Section	DSAR Section	Section Name/Comments
16			**Technical Specifications**
	16.1		*Preliminary Technical Specifications*: Deleted; was never applicable to Zion Station
	16.2	6.2	*Proposed final Technical Specifications*: Revised to clarify that Zion Station is governed by the Technical Specifications provided by the NRC as Appendix A to Operating License Nos. DPR-39 and DPR-48, Docket Nos. 50-295 and 50-304.
	16.3		*Component Lists*: This section of relocated Technical Specifications was deleted in its entirety, since the SSC's are no longer ITDC. Sealed Source Tech Spec was relocated to Chapter 4.
17		7	**Quality Assurance**:
	17.0	7.1	*General Quality Program Description*: This section was rewritten to address the new quality program for the defueled condition. ITDC components are not safety related and as such, are not required to satisfy 10CFR50, Appendix B. Criteria were added to assure continued reliability of ITDC SSC's.
	17.1		*References Chapter 17*: Deleted in it its entirety.

List of Commitments Identified in ZRA98053

The following table identifies those actions committed to by ComEd in this document. Any other actions discussed is this submittal represent intended or planned actions by ComEd. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify Mr. Robert Godley, Zion Station Regulatory Assurance Manager, of any questions regarding this document or any associated regulatory commitments.

Commitment	Tracking Number
None	

Zion Station

DEFUELED SAFETY ANALYSIS REPORT (DSAR)

ComEd

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CHAPTER 1

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1. INTRODUCTION AND GENERAL DESCRIPTION OF PLANT

1.1 INTRODUCTION

In February 1998, ComEd certified the permanent cessation of operation of Zion Station Units 1 and 2 to the NRC (Reference 3). In March 1998, ComEd certified to the NRC that all fuel assemblies have been permanently removed from both Zion Station reactor vessels and placed in the spent fuel pool (Reference 4). ComEd plans to maintain Zion Station in the SAFSTOR condition (a period of safe storage of the stabilized and defueled facility) until final decommissioning and dismantlement.

This Defueled Safety Analysis Report (DSAR) is derived from the July, 1996 update of the Zion Station Updated Final Safety Analysis Report (UFSAR). The DSAR has been developed as a licensing basis document that reflects the permanently defueled condition of Zion Station and supercedes the UFSAR. As such, the DSAR is intended to serve the same function during SAFSTOR and decommissioning that the UFSAR served during operation of the facility. An evaluation of the systems, structures and components (SSCs) described in the UFSAR was performed to determine the function, if any, these systems would perform in a defueled condition. Each major SSC was evaluated to determine if it was required to support the safe storage of irradiated fuel in the spent fuel pool, or needed to support decommissioning activities. The criteria used to evaluate the major SSCs and the conclusion of the evaluations are provided in Section 3 of the DSAR.

A brief history of major plant operations and licensing related actions for Zion Station is as follows:

1. Construction Permit issued, December 1968,
2. Final Safety Analysis Report submitted, December 1970,
3. Operating license issued, April 1973 for Unit 1 and November 1973 for Unit 2,
4. Commercial Operations achieved, December 1973 for Unit 1 and September 1974 for Unit 2,
5. Certification of permanent cessation of plant operation submitted, February 1998,
6. Certification of permanent removal of all fuel from the reactor vessels, March 1998.

Upon docketing of the certification for permanent cessation of operation and permanent removal of fuel from the reactor vessels, the 10 CFR Part 50 license no longer authorizes operation of the reactors or emplacement or retention of fuel in the reactor vessels. In addition, the operating licenses scheduled to expire in April 2013 for Unit 1 and November 2013 for Unit 2 continue to remain in effect until the Nuclear Regulatory Commission notifies ComEd that the licenses have been terminated.

Certain sections of the DSAR may contain figures that are copies of controlled Zion Station drawings and diagrams. These figures are included to supplement the text and aid in the understanding of the represented system and its operation. As a result of updating the Zion Station DSAR on a biennial basis in accordance with 10CFR50.71(e), later revisions of the controlled drawings or diagrams may exist.

1.2 GENERAL PLANT DESCRIPTION

Westinghouse Electric Corporation, Sargent and Lundy Engineers, and the Commonwealth Edison Company jointly participated in the design and construction of each unit. The plant was operated by the Commonwealth Edison Company. Each unit employed a pressurized water reactor nuclear steam supply system furnished by Westinghouse Electric Corporation designed for a power output of 3250 MWt. The equivalent warranted gross and approximate net electrical outputs of the plant were 1085 MWe and 1050 MWe, respectively.

In the permanently defueled condition, certain structures, systems and components (SSCs) are required to safely store new and spent nuclear fuel, prevent the uncontrolled release of radioactive effluents, and provide shielding to maintain occupational radiological exposures As Low As Reasonably Achievable (ALARA). In addition, certain structures and equipment function to prevent or mitigate accidents and their consequences.

1.2.1 General Design Criteria

The general design criteria followed in the design of Zion Station were developed as performance criteria which define or describe safety objectives and procedures. Along with these performance criteria, Zion Station was designed to comply with Commonwealth Edison's understanding of the intent of the Atomic Energy Commission's (AEC) proposed General Design Criteria, as published for comment by the AEC in July 1967 (see Reference 1). The Zion construction permit, which fixed many of the safety-related design criteria, was issued in December 1968. The Zion FSAR, which presented the detailed design of the plant, was submitted in December 1970. Subsequent to this submittal, the AEC's final General Design Criteria (see Reference 2) were published as Appendix A to 10CFR50 in July 1971.

The separate performance criteria that are applicable to the defueled condition are specifically addressed in the DSAR where pertinent. As applicable, the performance criteria are quoted and followed by a brief summary of the design or procedures. The design or procedures are then more fully described in other sections of the chapter.

Compliance with Commonwealth Edison's understanding of the intent of the AEC's proposed General Design Criteria, as published in July 1967, is presented in Chapter 3.

1.2.1.1 Overall Requirements

1. Quality and Performance Standards

Those features of the facility which are essential to the prevention of accidents which could affect the public health and safety or to the mitigation of their consequences are designed, fabricated, and erected to:

a. Quality standards that reflect the importance of the safety function to be performed. Recognized codes and standards are used when appropriate to the application.
b. Performance standards that will enable the facility to withstand, without loss of the capability to protect the public, the additional forces imposed by the most severe earthquakes, flooding conditions, winds, ice, or other natural phenomena characteristic of the Zion site.

Features of the facility essential to accident prevention and mitigation are the controls and cooling systems necessary to maintain the integrity of the fuel cladding, the power supplies and supporting services to these systems, and the components employed to safely convey and store radioactive wastes and spent reactor fuel.

Quality standards of material selection, design, fabrication, and inspection governing the above features conform to the applicable provisions of recognized codes and good nuclear construction practice. Visual structural weld inspections in accordance with guidelines prepared by the Nuclear Construction Issues Group, NCIG-01 Rev. 2 (5/7/85), titled "Visual Weld Acceptance Criteria for Structural Welding at Nuclear Power Plants," were implemented and used effective July 1, 1986. Vessels comply with the ASME Boiler and Pressure Vessel Code under the specific classification dictated by their use, or other appropriate Codes. The principles of this Code, or equivalent guidelines, are employed where the Code is not strictly applicable but where the safety function calls for an equivalent assurance of quality. In the same manner, piping conforms to the requirements of USA Standard Code for Pressure Piping (ASA B31.1-1955) and Nuclear Code Cases N-7 and N-10.

In the normal course of valve vendor quality control, periodic dimensional checks on a sampling or spot check basis were made. When errors in thickness were found, the output from the foundries have been checked and repairs have been made, as necessary. In addition to the above, those valves 2-1/2 inches and up were generally subjected to volumetric inspection by ultrasonic or radiographic means (or by both) and hydrostatically tested.

In the case of valves furnished under the NSSS contract, Westinghouse conducted periodic vendor inspections to verify that the vendor was indeed complying with the approved program and procedures. Commonwealth Edison has audited Westinghouse to confirm this action sequence.

For valves purchased by Commonwealth Edison, audits and inspections of various vendors have been conducted by Commonwealth Edison to verify that the vendors have complied with the approved programs and procedures.

All of the above actions were performed in accordance with the Commonwealth Edison Company Quality Assurance Program.

No reliance has been placed on the ASME survey and inspection system for equipment. The majority of the Seismic Class I equipment was purchased before the ASME system was instituted.

Structural, equipment, and piping materials, in the Auxiliary Building have been selected for their compatibility with the expected normal and accident environments.

2. Fire Protection

Fire protection facilities are provided in accordance with the recognized guidelines of the National Fire Protection Association, Nuclear Electric Insurance Limited, and Underwriters Laboratory.

The Fire Protection Report outlines the basic design and operational features of the plant Fire Protection System.

3. Record Requirements

Commonwealth Edison or its authorized representatives and Westinghouse Electric Corporation have retained complete documentation of the design, fabrication, and construction of all essential plant components.

These records are available to verify the high quality and performance standards applicable to all essential plant components.

1.2.1.2 Radiation Controls

Monitoring potentially radioactive areas is accomplished in the Control Room from which most actions required to maintain the safe operational status of the plant are centered.

In addition to instrumentation and controls which are required to maintain plant variables within prescribed operating ranges, means are provided to monitor fuel and waste storage and handling areas and all potentially contaminated facility effluent discharge paths.

Monitoring and alarm instrumentation is provided for fuel and waste storage and handling areas to detect inadequate cooling and to detect excessive radiation levels. Radiation monitors are provided to maintain surveillance over the release of radioactive gases and liquids.

A controlled ventilation system removes gaseous radioactivity from the atmosphere of the fuel and waste storage and handling areas of the Auxiliary Building and discharges it to the atmosphere via the plant vent. Radiation monitors are in continuous service in these areas to actuate high-activity alarms in the Control Room, as described in Section 3.

1.2.1.3 Fuel and Waste Storage Systems

All fuel storage and waste handling facilities are contained and the facility design is such that accidental releases of radioactivity directly to the atmosphere will not exceed the limits of 10CFR100.

All operations with the spent fuel are conducted underwater (see section 3). This provides visual control of the operation at all times and also maintains low radiation levels. The borated water assures subcriticality at all times and also provides adequate cooling for the spent fuel. The spent fuel storage pool is supplied with a cooling system for the removal of the decay heat of the spent fuel. Racks are provided to accommodate the storage of 3012 fuel assemblies. The storage pool is filled with borated water. The spent fuel is stored in a vertical array with sufficient center-to-center distance between assemblies to assure a K effective of less than 0.95, even if unborated water is used to fill the pit, for fuel having a maximum loading of 57.4 grams U-235 per axial centimeter of fuel assembly length. The water level maintained in the pool will provide sufficient shielding to permit normal occupancy of the area by operating personnel. The spent fuel pool is also provided with systems to maintain water cleanliness and to indicate pool water level. Gamma radiation in the Auxiliary Building is monitored and a high level is annunciated in the Control Room.

Water removed from the pool must be pumped out as there are no gravity drains. Spillage or leakage of any liquids from waste handling facilities go to floor drains which flow to sumps.

Postulated accidents involving the release of radioactivity from the fuel and waste storage and handling facilities are shown in Chapter 5 to result in exposures well within the limits of 10CFR100.

The spent fuel storage pool is a reinforced concrete structure with a corrosion resistant liner. This structure is designed to withstand the anticipated earthquake loadings so that the liner will prevent leakage even in the event the reinforced concrete develops cracks. The transfer tube which connects the refueling canal and the spent fuel pool and forms part of the Reactor Containment is provided with a valve and a blind flange which effectively closes off the transfer tube.

1.2.1.4 Effluents

Gaseous, liquid, and solid waste disposal facilities are designed so that discharge of effluents and-offsite shipments shall be in accordance with applicable governmental regulations.

Process and discharge streams are appropriately monitored and safety features are incorporated to preclude releases more than the limits of 10CFR20.

The plant restricted area, as it is applied to the definitions in 10CFR20, is defined in Appendix F of the Offsite Dose Calculation Manual (ODCM). This area includes sections of shoreline. The area is owned and controlled by Commonwealth Edison Company; the control being required in 10CFR20.

Commonwealth Edison Company has no riparian ownership extending out into the lake.

Verification of annual exposures to persons in those portions of the lake which constitute the restricted area will be accomplished by station release records and the environmental monitoring program. The restricted area does include shoreline frontage. This shoreline will be controlled. The shoreline is monitored at both the northern and southern boundaries by on-site stations as shown on Figure 1-1.

Environmental conditions do not place any restrictions on the normal release of operational radioactive effluents to the atmosphere. Radioactive fluids entering the WD System are collected in analysis tanks until the course of subsequent treatment is determined.

All solid wastes are placed in suitable containers and stored onsite until shipment offsite for disposal.

Liquid wastes are processed to remove most of the radioactive material. The spent resins from the demineralizers and the filter cartridges are packaged and stored onsite until shipment offsite for disposal. The processed water, from which most of the radioactive material has been removed, is recycled for reuse within the plant or is discharged through a monitored line into the circulating water discharge.

1.2.2 Structures

The major structures include a separate and independent Containment for each reactor, a common Auxiliary Building with holdup tank vault, a common Fuel Handling Building, a common Turbine Building, a common Cribhouse, and a common Administration and Service Building. General layouts of the Reactor Containment, Auxiliary Building and interior components arrangements are shown in figures 1-1 through 1-16.

1.2.3 Waste Disposal System

The shared WD System provides all equipment necessary to collect, process, and prepare for disposal all radioactive liquid, gaseous, and solid wastes produced as a result of reactor operation and decommissioning activities.

After collection, liquid wastes are demineralized. The treated water from the demineralizers may be recycled for use in the plant or may be discharged via the circulating water discharge at concentrations well within the limits of 10CFR20. The spent demineralizer resins are drummed, dewatered and shipped from the site for ultimate disposal in an authorized location.

Gaseous waste discharge to the environment is controlled to keep the offsite dose well within the limits of 10CFR20.

1.2.4 Fuel Handling System

The fuel handling equipment is designed to handle spent fuel under water from the time it leaves its fuel rack until it is placed in a cask for shipment from the site. Underwater transfer of spent fuel provides an optically transparent radiation shield, as well as a reliable source of coolant for removal of decay heat. This system also provides capability for receiving, handling and storage of new fuel. Both the new fuel storage facility and the spent fuel storage facility are shared by the two units.

1.2.5 Electrical System

The station auxiliary power system consists of auxiliary transformers, 4160-V and 480-V switchgear, 480-V motor control centers, 120-Vac instrument buses and 125-Vdc battery buses.

Figure 1-1 indicates the six 345-kV lines that service the 345-kV transmission terminal. The two Libertyville lines share a double circuit tower line and the two Wisconsin lines share a second double circuit tower line on a common right-of-way for 6.1 miles. The two Northbrook lines on a double circuit tower line approach the terminal from the south. This Northbrook right-of-way does not connect or intersect with the Libertyville or the Wisconsin right-of-way.

1.2.6 Site and Environment

The characteristics of the site and its environs have been investigated to establish bases for determining criteria for storm, flood, and earthquake protection and to evaluate the validity of calculational techniques for the control of routine and accidental releases of radioactive liquids and gases to the environment. Field programs to investigate geology and seismology are completed. A Preoperational Meteorological Program to provide onsite observations of wind speed and direction was begun January 1970. A radiological study of the site environs was initiated March 1970 with the objective of establishing background radiation levels.

The site is in Northeast Illinois on the west shore of Lake Michigan about 40 miles north of Chicago, Illinois, and about 42 miles south of Milwaukee, Wisconsin, as shown in Figure 1-17.

The site is covered mainly by sandy soil with patches of peat and muck in the marshy western portions of the site. Test borings, to investigate subsurface conditions reveal that the site is blanketed by granular lake deposits underlain by glacial drift consisting of till, outwash and lake deposits. The site is well ventilated and not subject to severe persistent inversion. While tornadoes occur in the region, none have been reported to affect the lake shore site directly. High winds (on the order of 70-mph) can be expected once in 50 years from storms.

A horizontal ground acceleration, at the site, of 0.17 times gravity (0.17g) combined with a vertical acceleration of 0.11 times gravity (0.11g) has been used for the earthquake design criteria based on site investigations.

1.2.7 Facility Safety Conclusions

The safety of the public and plant operating personnel and reliability of plant equipment and systems have been the primary considerations in the plant design. The approach taken in fulfilling the safety consideration were three-fold. First, careful attention has been given to the design so as to prevent the release of radioactivity to the environment under conditions which could be hazardous to the health and safety of the public. Second, the plant has been designed so as to provide adequate protection for plant personnel wherever a potential radiation hazard exists. Third, Engineered Safety Features were designed with redundancy and diversity, and to stringent quality standards. The first two approaches above remain applicable to the permanently defueled condition of the facility, while the third is no longer applicable to the permanently defueled condition.

Based on the overall design of the plant including its safety features and the analyses of the possible incidents it is concluded that Zion Station does not represent an undue hazard to the health and safety of the public.

1.3 IDENTIFICATION OF AGENTS AND CONTRACTORS

As owner, Commonwealth Edison Company engaged, or approved the engagement of, the contractors identified below in the construction of Units 1 & 2 which were put in commercial service in December of 1973 and September of 1974, respectively. However, irrespective of the explanation of contractual arrangements offered below, Commonwealth Edison Company was the sole applicant for the construction permit and operating license. Commonwealth Edison Company, as owner and applicant, was responsible for the design, construction and operation of the plant.

The plant was designed by Westinghouse Electric Corporation and Sargent and Lundy for Commonwealth Edison Company. Westinghouse Electric provided the nuclear steam supply equipment and system including the fuel assemblies. Commonwealth Edison Company engaged the architect-engineering services of Sargent and Lundy, Chicago, Illinois, to provide the design of the balance of the plant and to prepare specifications for the purchase and construction thereof. Commonwealth Edison reviewed the designs, construction and purchase specifications prepared by Sargent and Lundy and Westinghouse Electric Corporation to assure that the general plant arrangements, equipment and operating provisions were satisfactory.

Analysis of all environmental data was performed by NUS Corporation. Specific investigations regarding seismic, geologic and hydrologic features were prepared by Dames and Moore.

1.4 DRAWINGS AND OTHER DETAILED INFORMATION

Table 1-1 lists DSAR figures that are controlled drawings.

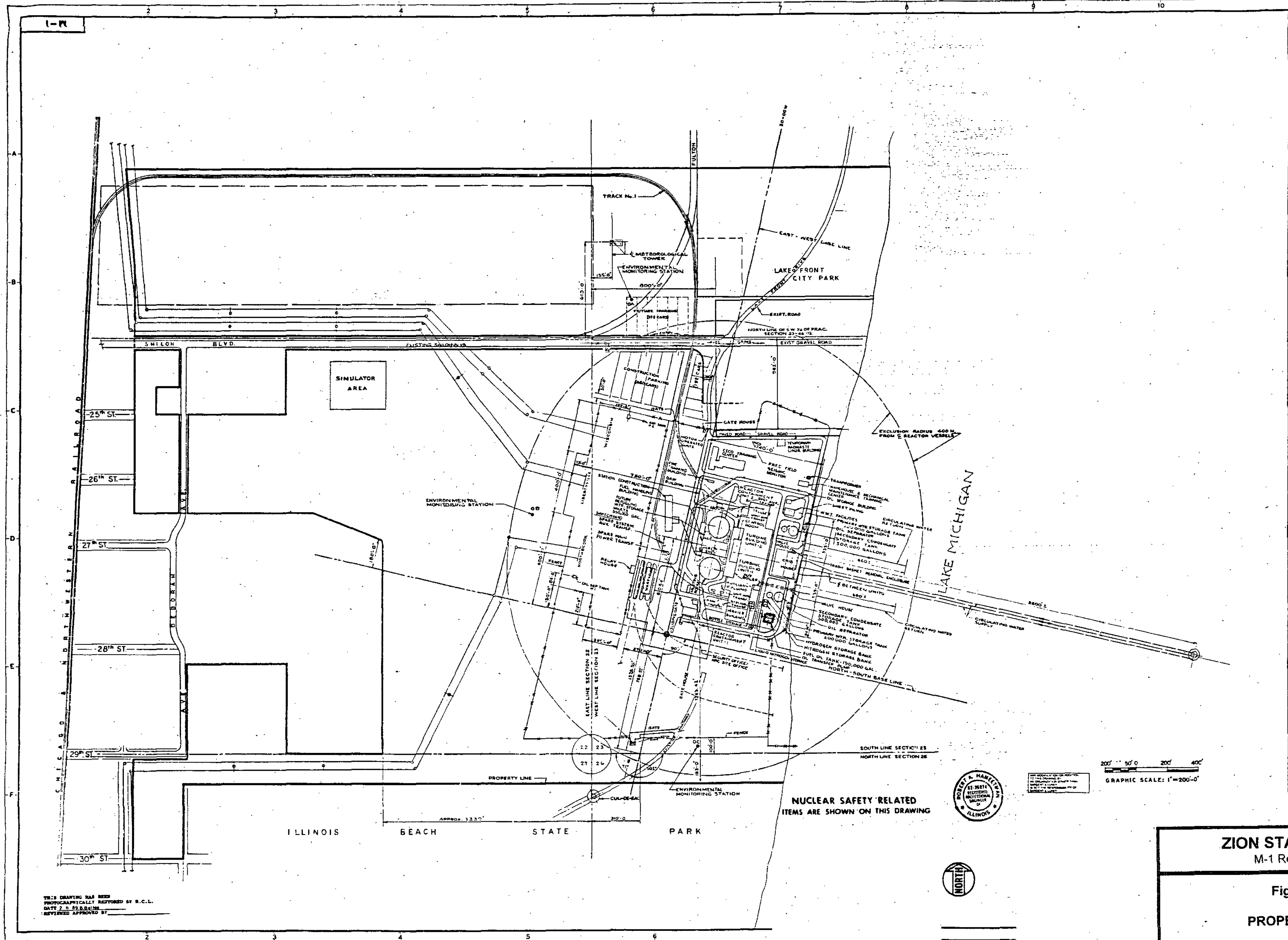
1.5 REFERENCES, Section 1.0

1. Atomic Energy Commission, Proposed General Design Criteria, Federal Register, July 11, 1967.
2. Atomic Energy Commission, General Design Criteria, Federal Register, July 1971.
3. Letter from O. D. Kingsley, ComEd to U.S. NRC, dated February 13, 1998, Certification of Permanent Cessation of Plant Operation
4. Letter from O. D. Kingsley, ComEd to U.S. NRC, dated March 9, 1998, Certification of Permanent Removal of all Fuel from the Reactor Vessels

TABLE 1-1

CROSS-REFERENCE FOR CONTROLLED DRAWINGS

DSAR FIGURE NUMBER	DRAWING NUMBER
1-1	M-1
1-2	M-2
1-3	M-3
1-4	M-4
1-5	M-5
1-6	M-6
1-7	M-7
1-8	M-8
1-9	M-9
1-10	M-10
1-11	M-11
1-12	M-12
1-13	M-13
1-14	M-14
1-15	M-15
1-16	M-16
2-16	B-32
3-23	B-277
3-24	B-50
3-25	B-404
3-26	B-421
3-27	B-390
3-28	B-172



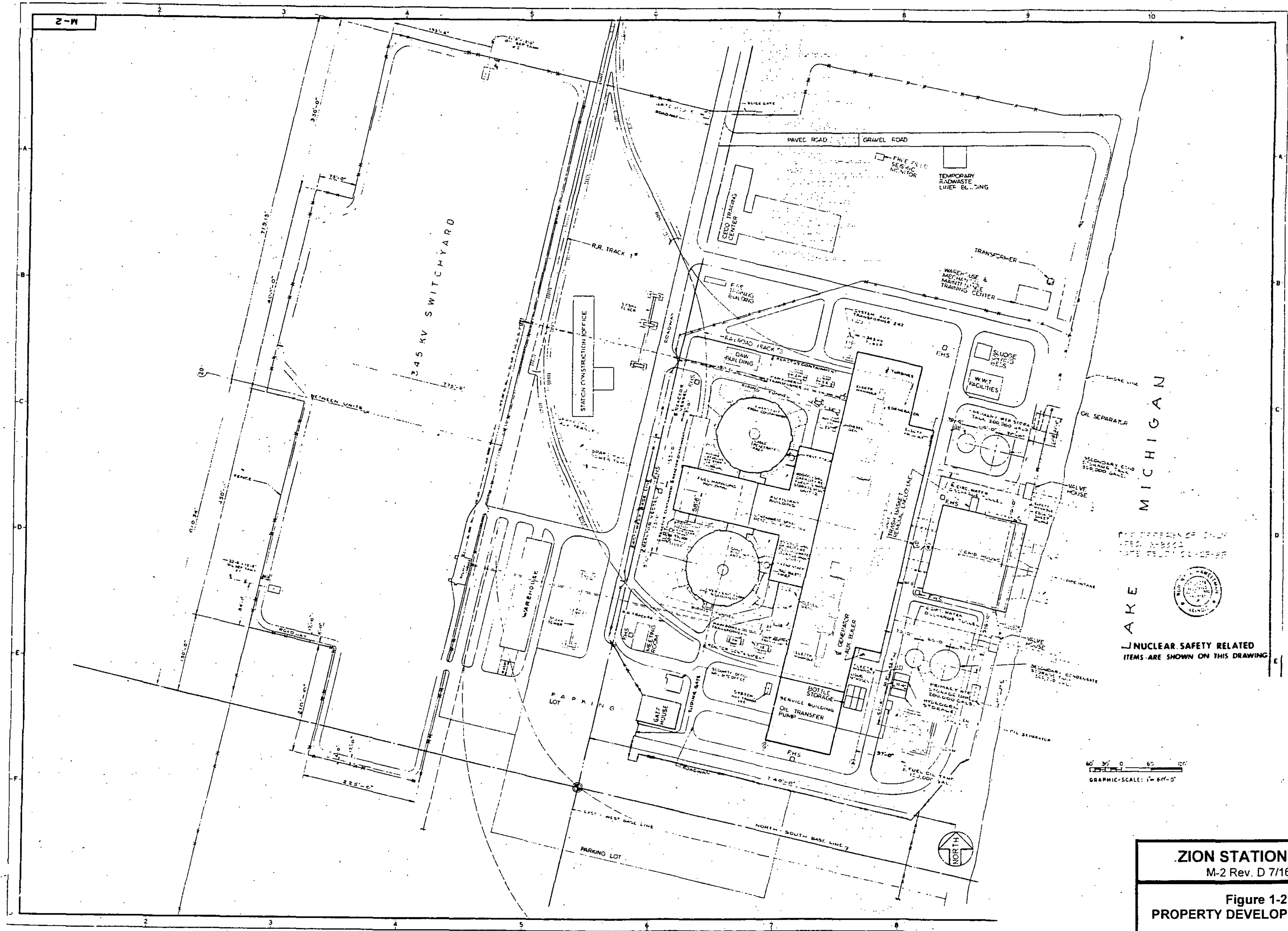
ZION STATION DSAR

M-1 Rev. D 3/6/89

Figure 1-1

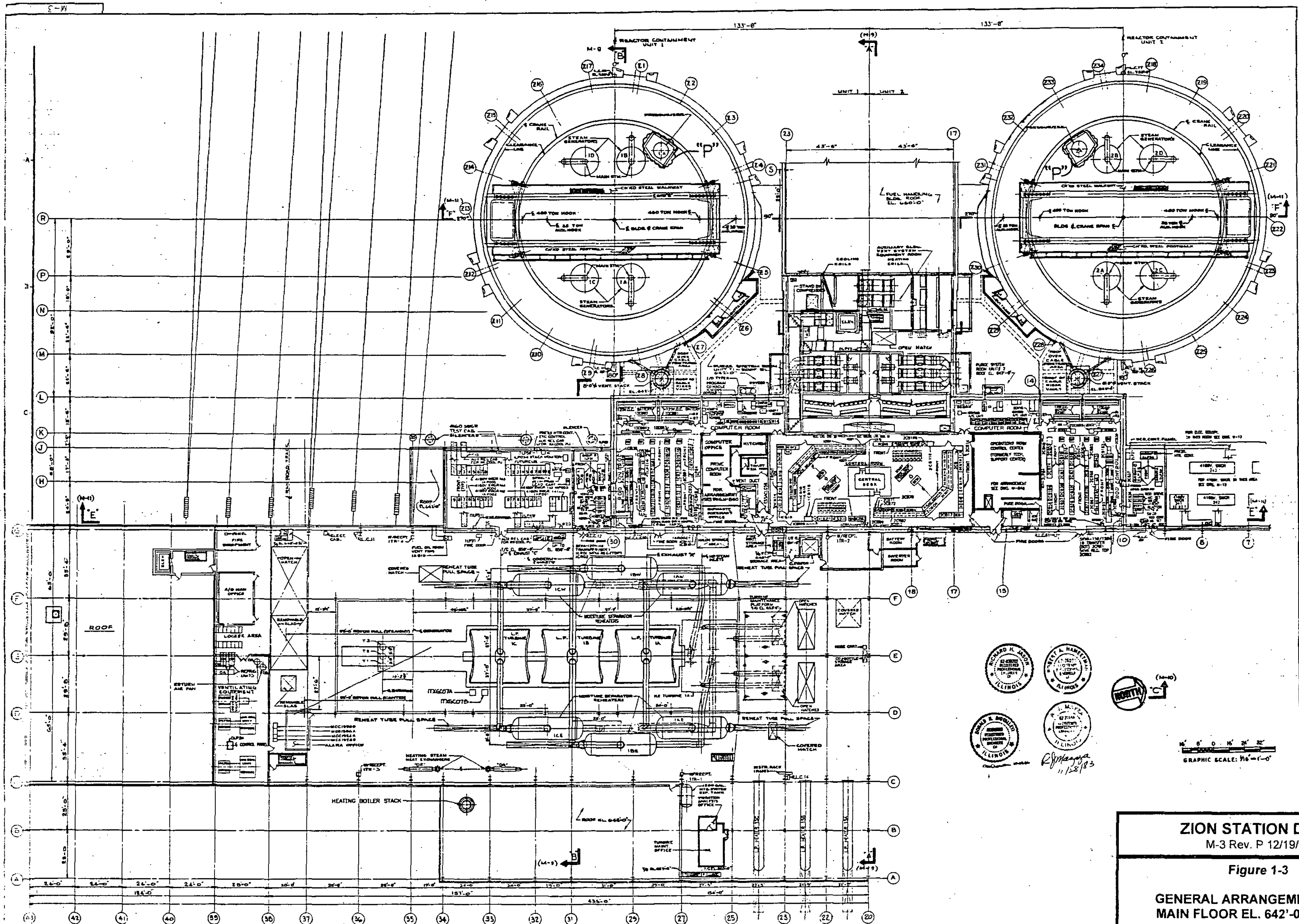
PROPERTY PLAT

AUGUST 1998



ZION STATION DSAR
M-2 Rev. D 7/16/84

Figure 1-2
PROPERTY DEVELOPMENT PLAT
AUGUST 1998



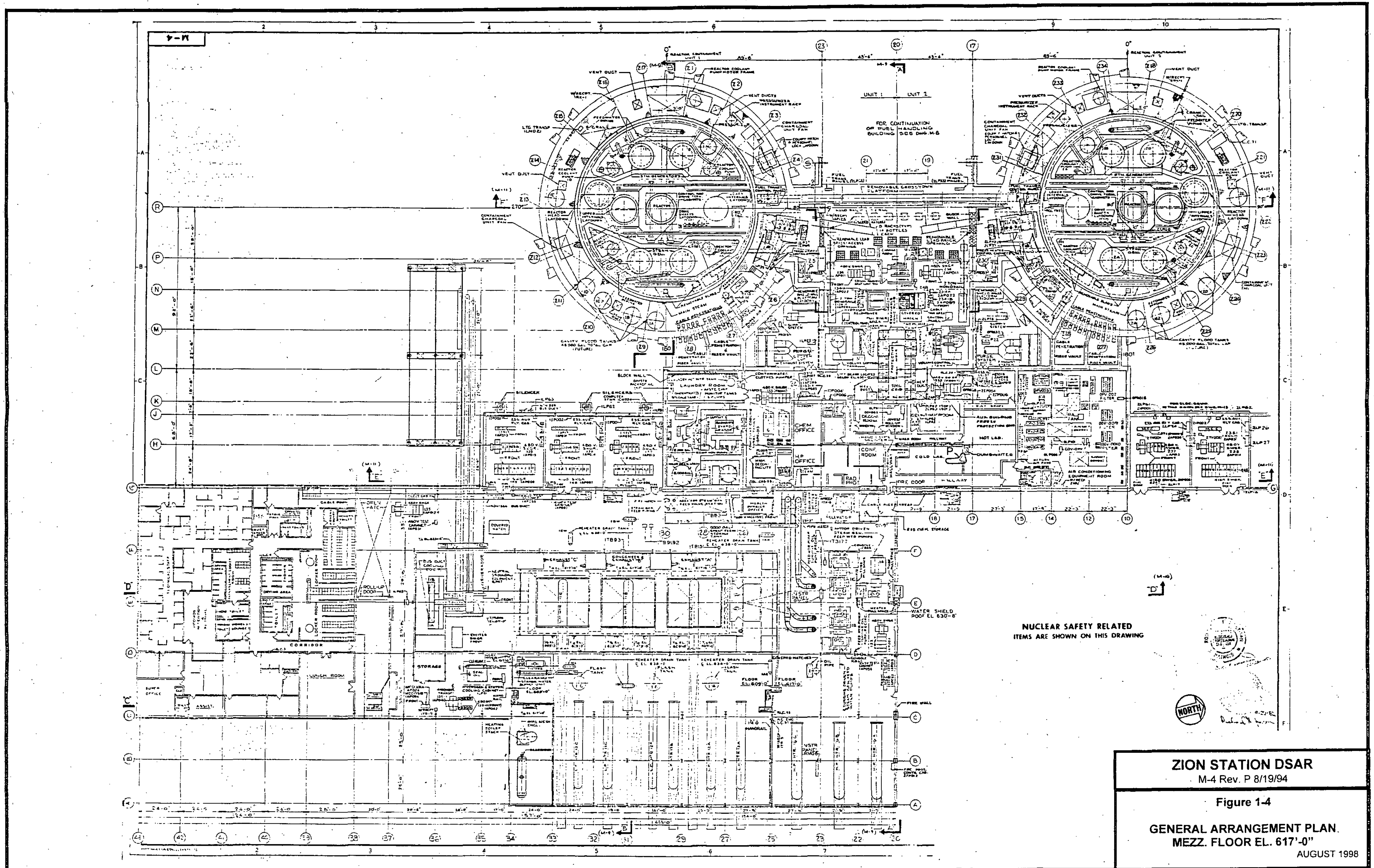
ZION STATION DSAR

M-3 Rev. P 12/19/97

Figure 1-3

GENERAL ARRANGEMENT PLAN
MAIN FLOOR EL. 642'-0" (UNIT 1)

AUGUST 1998



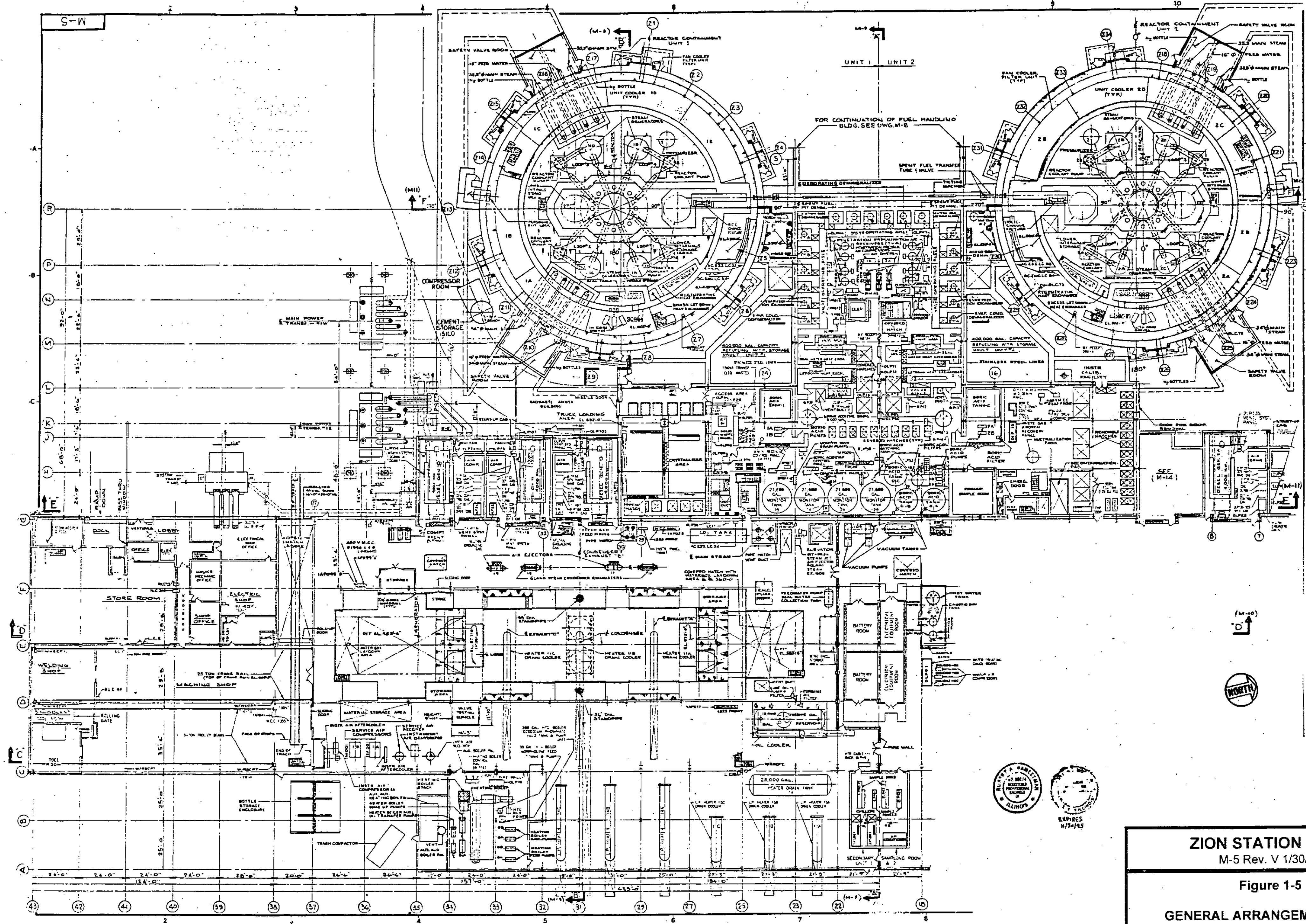
ZION STATION DSAR

M-4 Rev. P 8/19/94

Figure 1-4

**GENERAL ARRANGEMENT PLAN.
MEZZ. FLOOR EL. 617'-0"**

AUGUST 1998



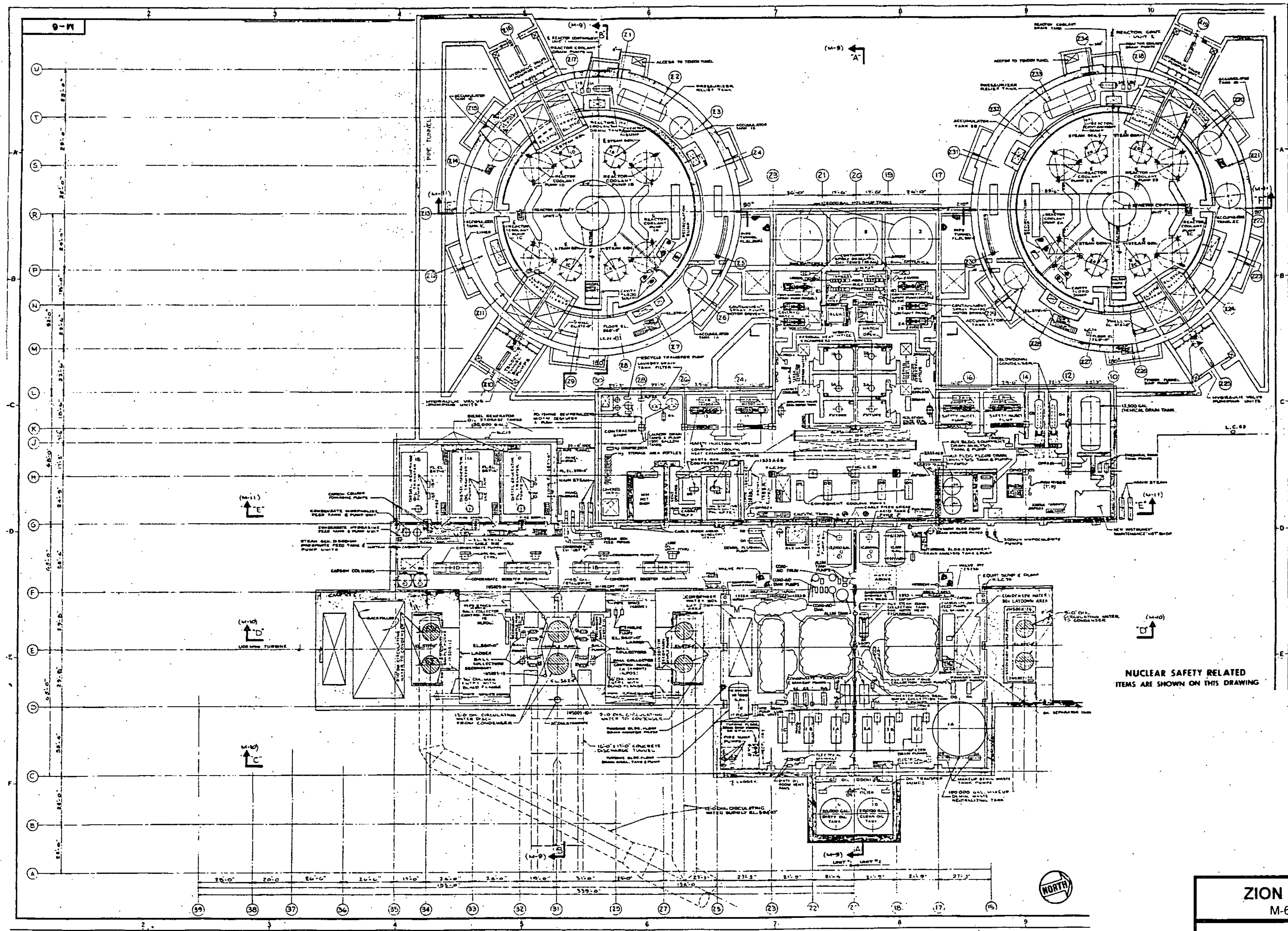
ZION STATION DSAR

M-5 Rev. V 1/30/97

Figure 1-5

GENERAL ARRANGEMENT PLAN GROUND FLOOR EL. 592'-0" (UNIT 1)

AUGUST 1998

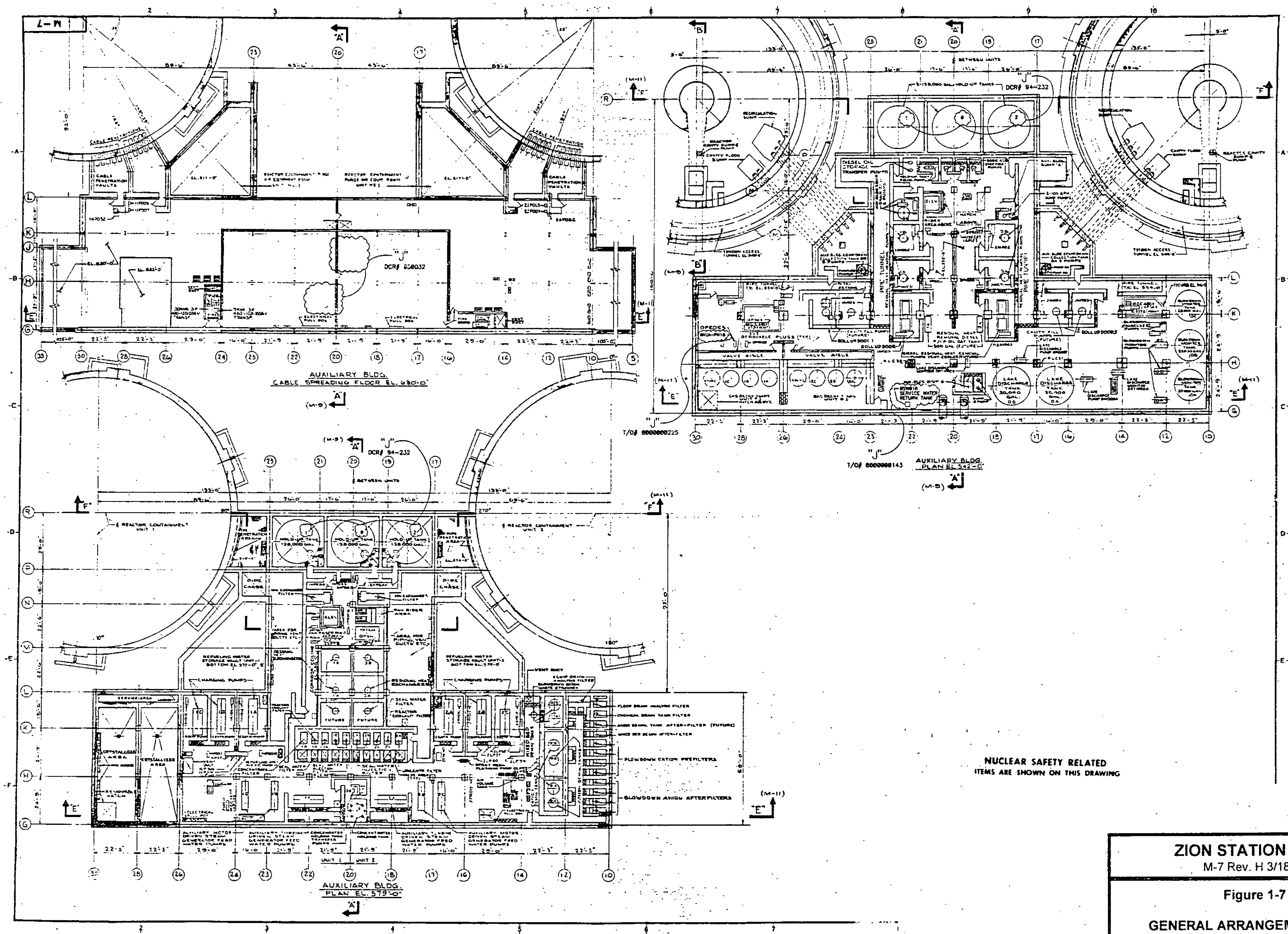


ZION STATION DSAR

M-6 Rev. M 10/14/96

Figure 1-6
GENERAL ARRANGEMENT PLAN
BASEMENT FLOOR EL. 560'-0"

AUGUST 1998



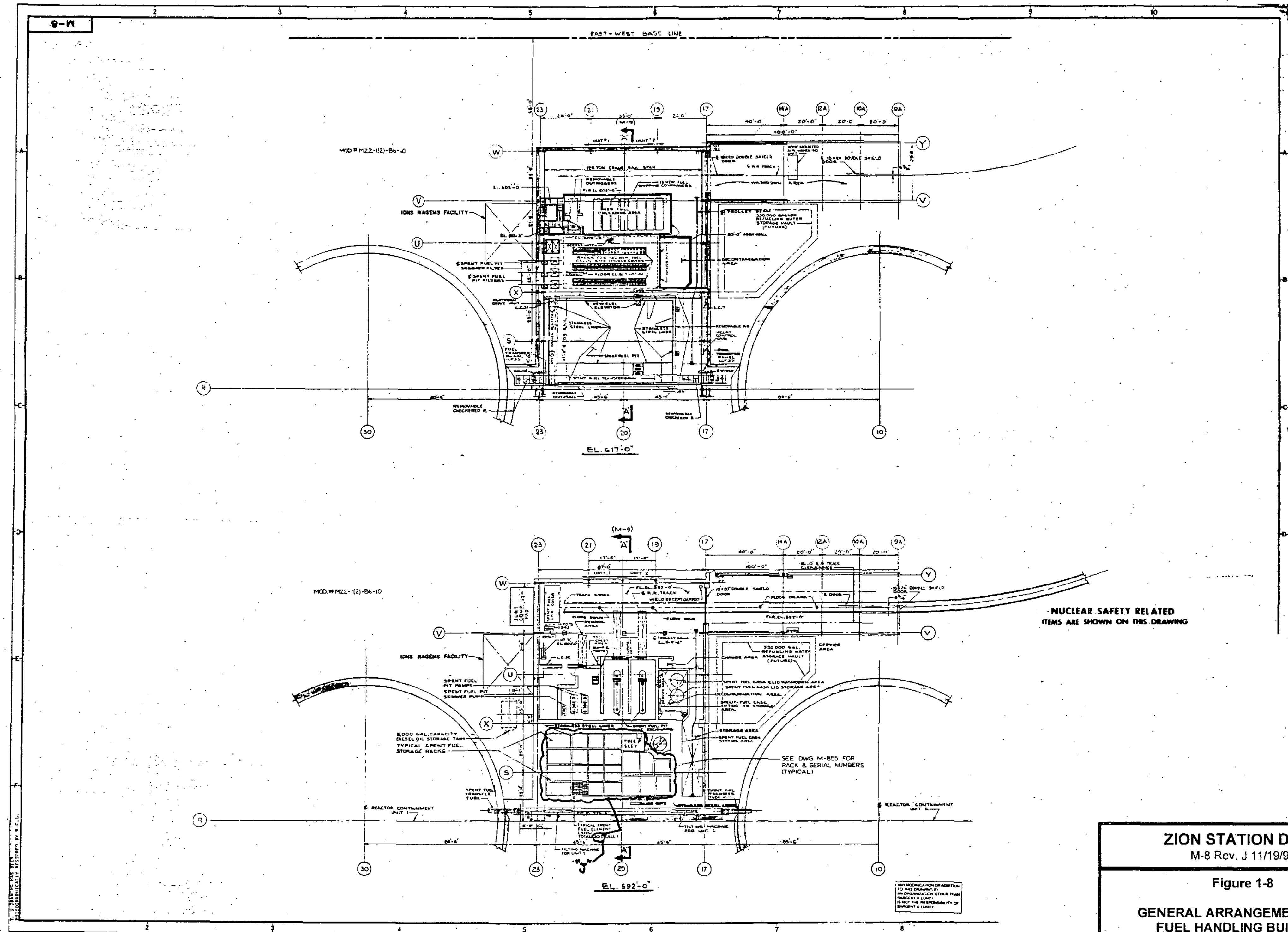
ZION STATION DSAR

M-7 Rev. H 3/18/87

Figure 1-7

GENERAL ARRANGEMENT PLAN MISC. FLOORS

AUGUST 1998



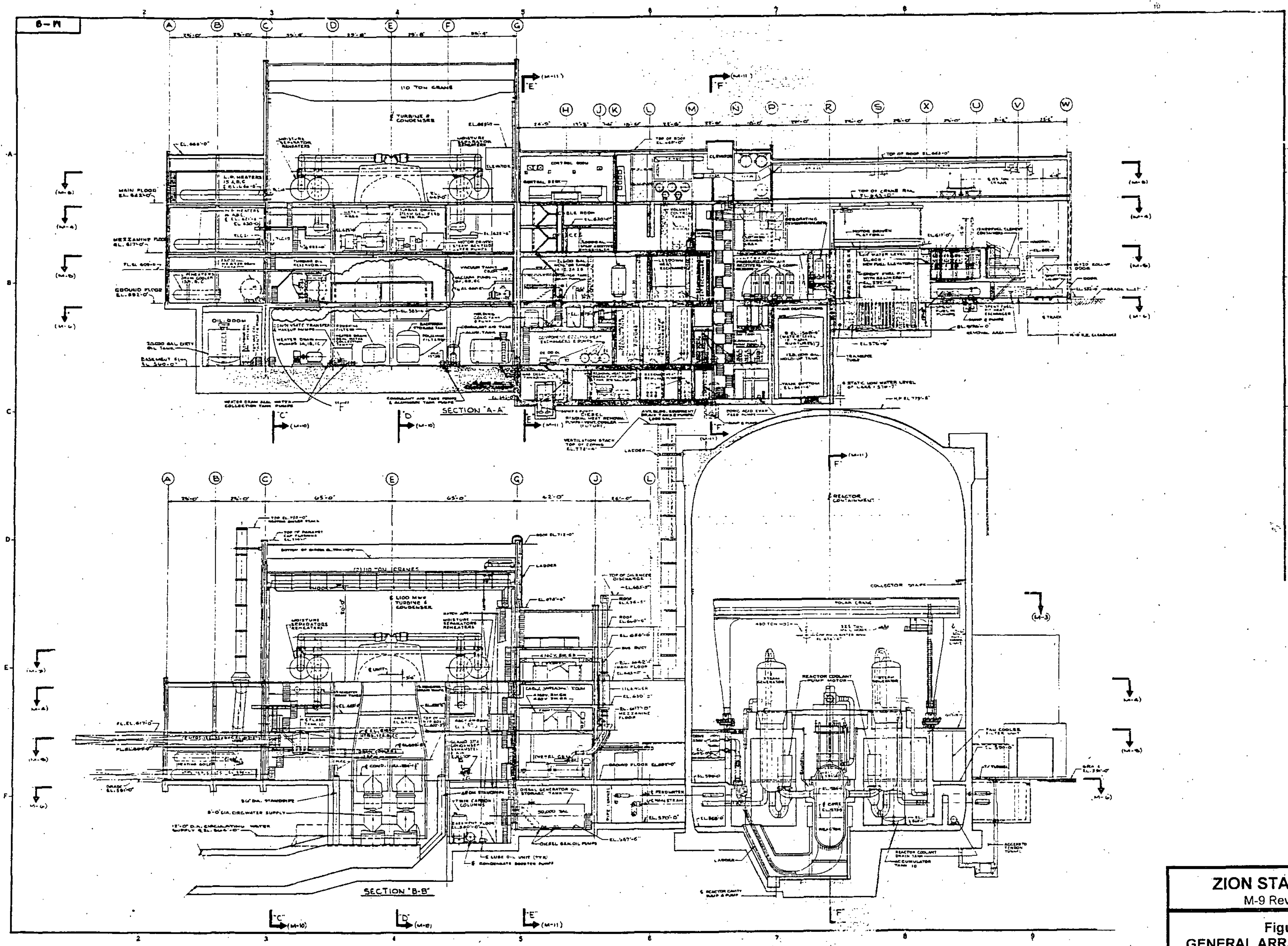
ZION STATION DSAR

M-8 Rev. J 11/19/93

Figure 1-8

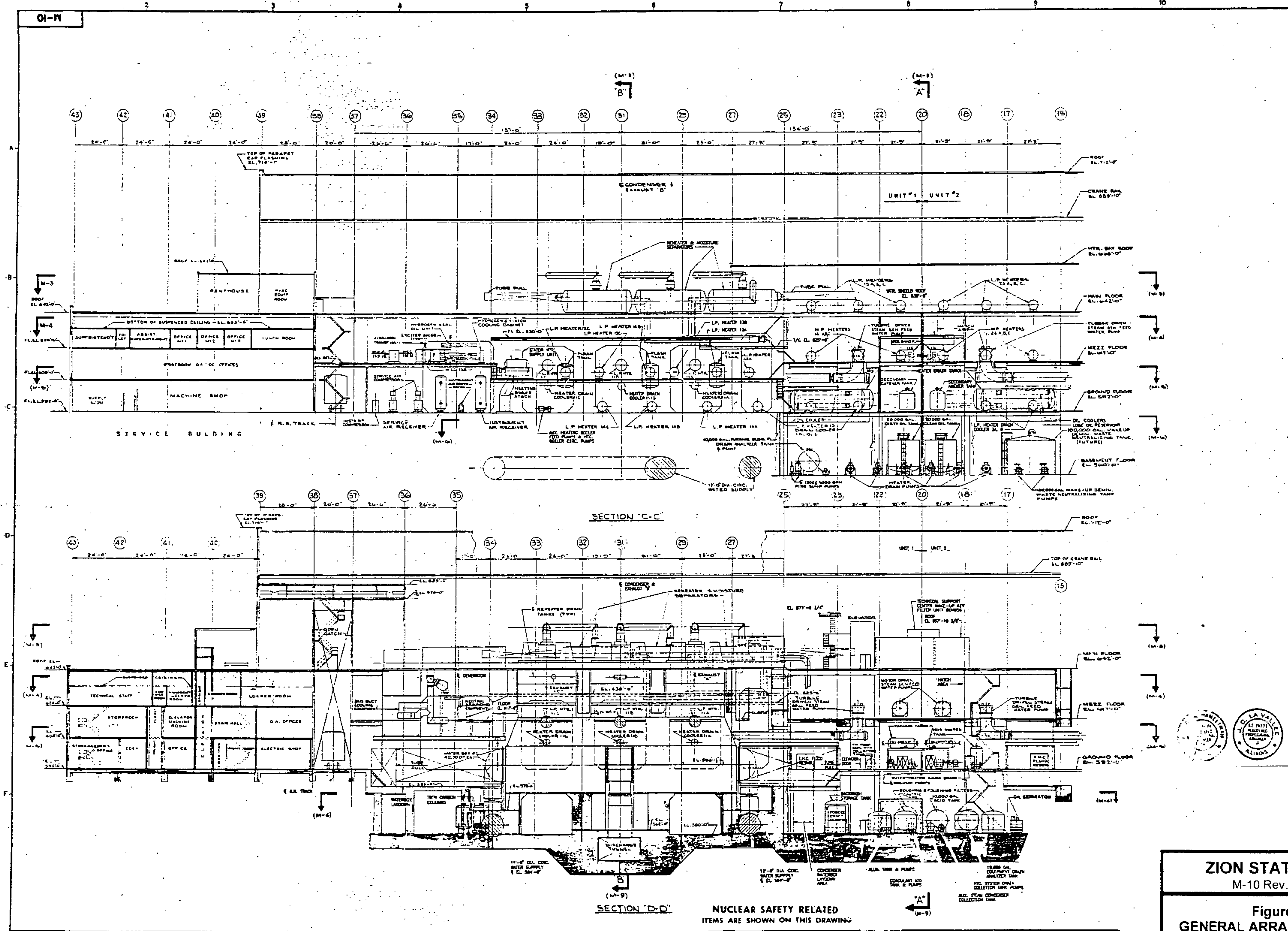
GENERAL ARRANGEMENT PLAN FUEL HANDLING BUILDING

AUGUST 1998



ZION STATION DSAR
M-9 Rev. F 10/2/96

Figure 1-9
GENERAL ARRANGEMENT PLAN
SECTIONS A-A AND B-B (UNIT 1)
AUGUST 1998

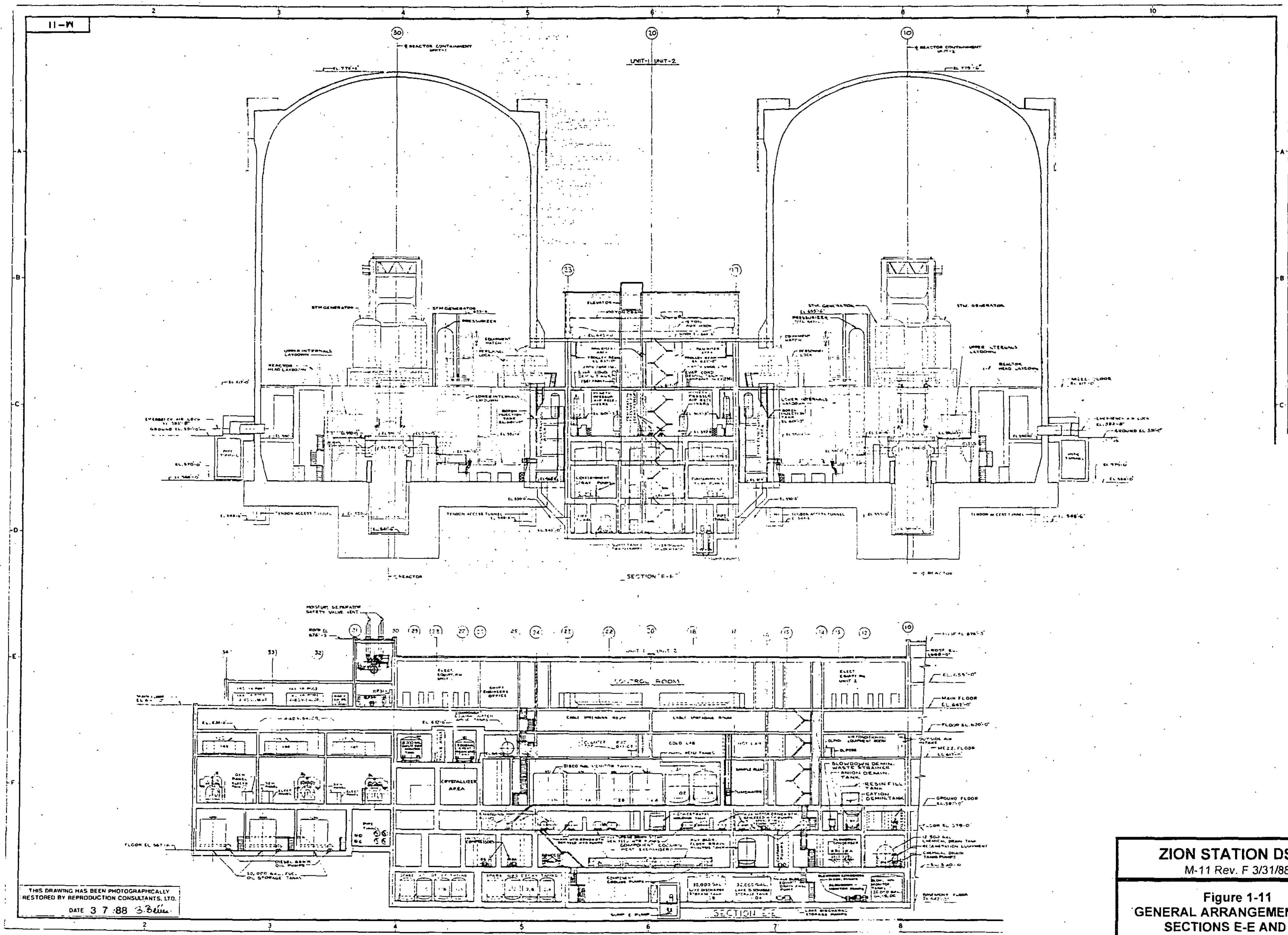


ZION STATION DSAR

M-10 Rev. F 1/30/97

Figure 1-10
GENERAL ARRANGEMENT PLAN
SECTIONS C-C AND D-D (UNIT 1)

AUGUST 1998

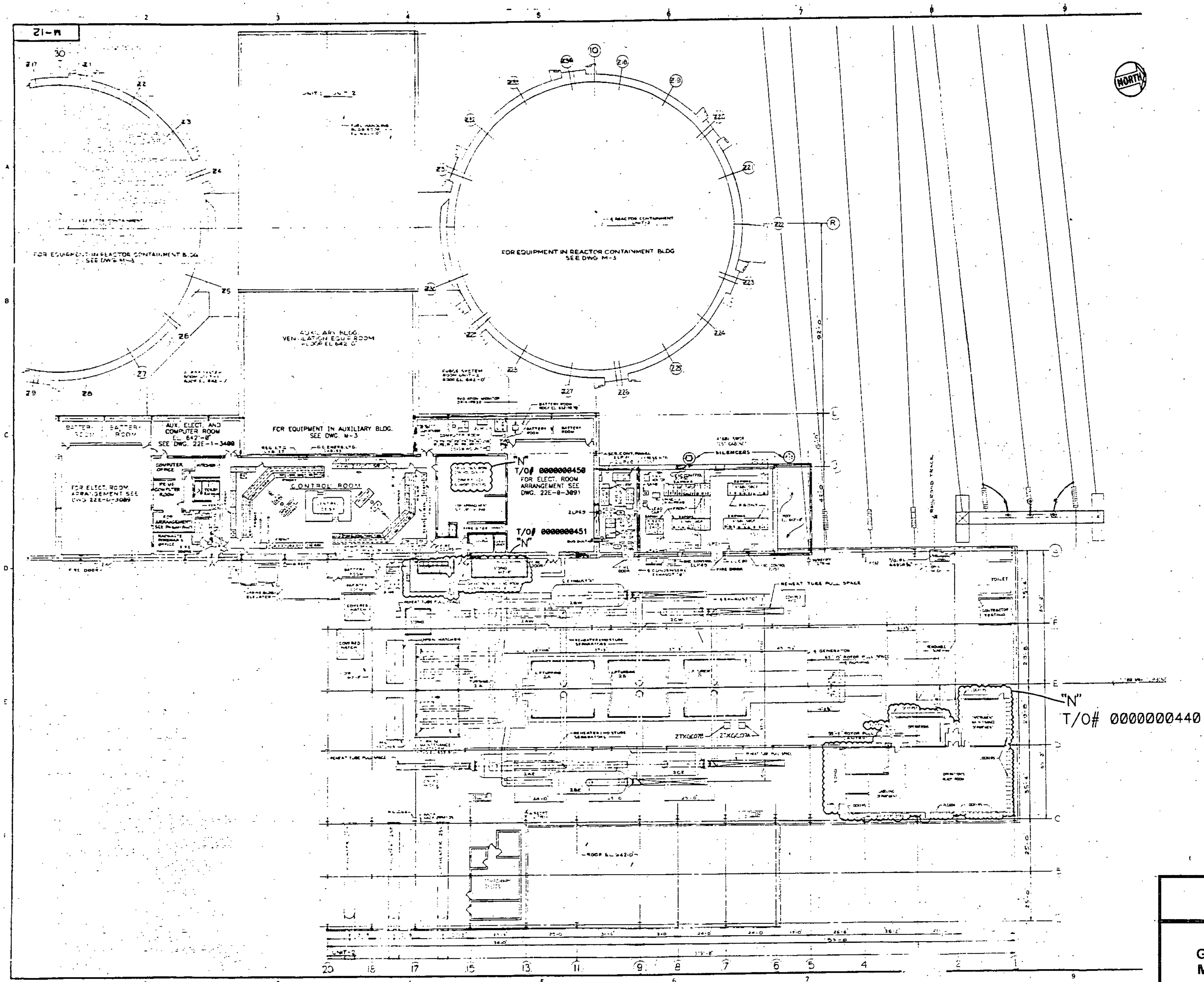


ZION STATION DSAR

M-11 Rev. F 3/31/88

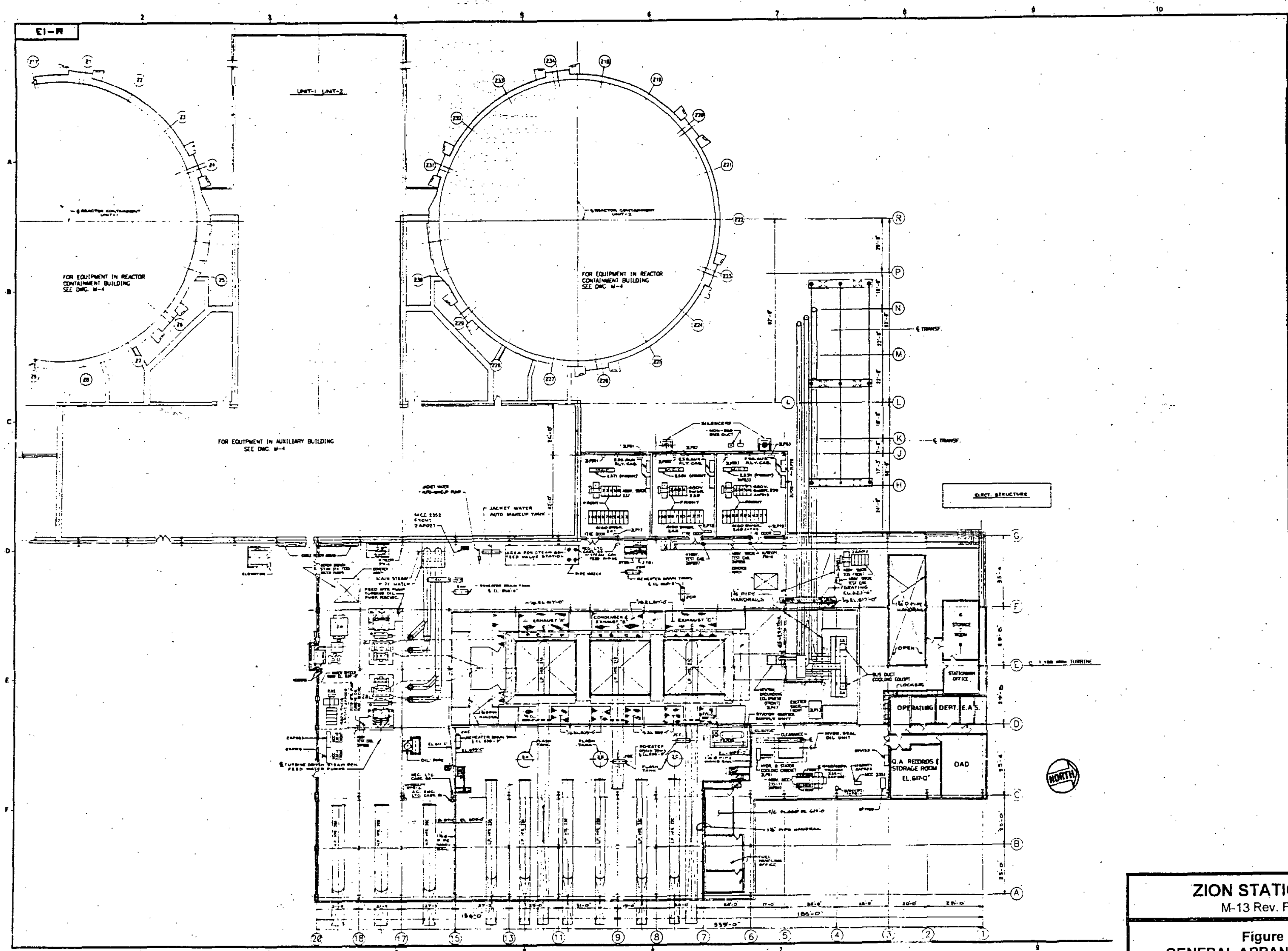
Figure 1-11
GENERAL ARRANGEMENT PLAN
SECTIONS E-E AND F-F

AUGUST 1998



ZION STATION DSAR
M-12 Rev. N 10/7/97

Figure 1-12
GENERAL ARRANGEMENT PLAN
MAIN FLOOR EL. 642'-0" (UNIT 2)
AUGUST 1998



ZION STATION DSAR

M-13 Rev. F 1/30/97

Figure 1-13
GENERAL ARRANGEMENT PLAN
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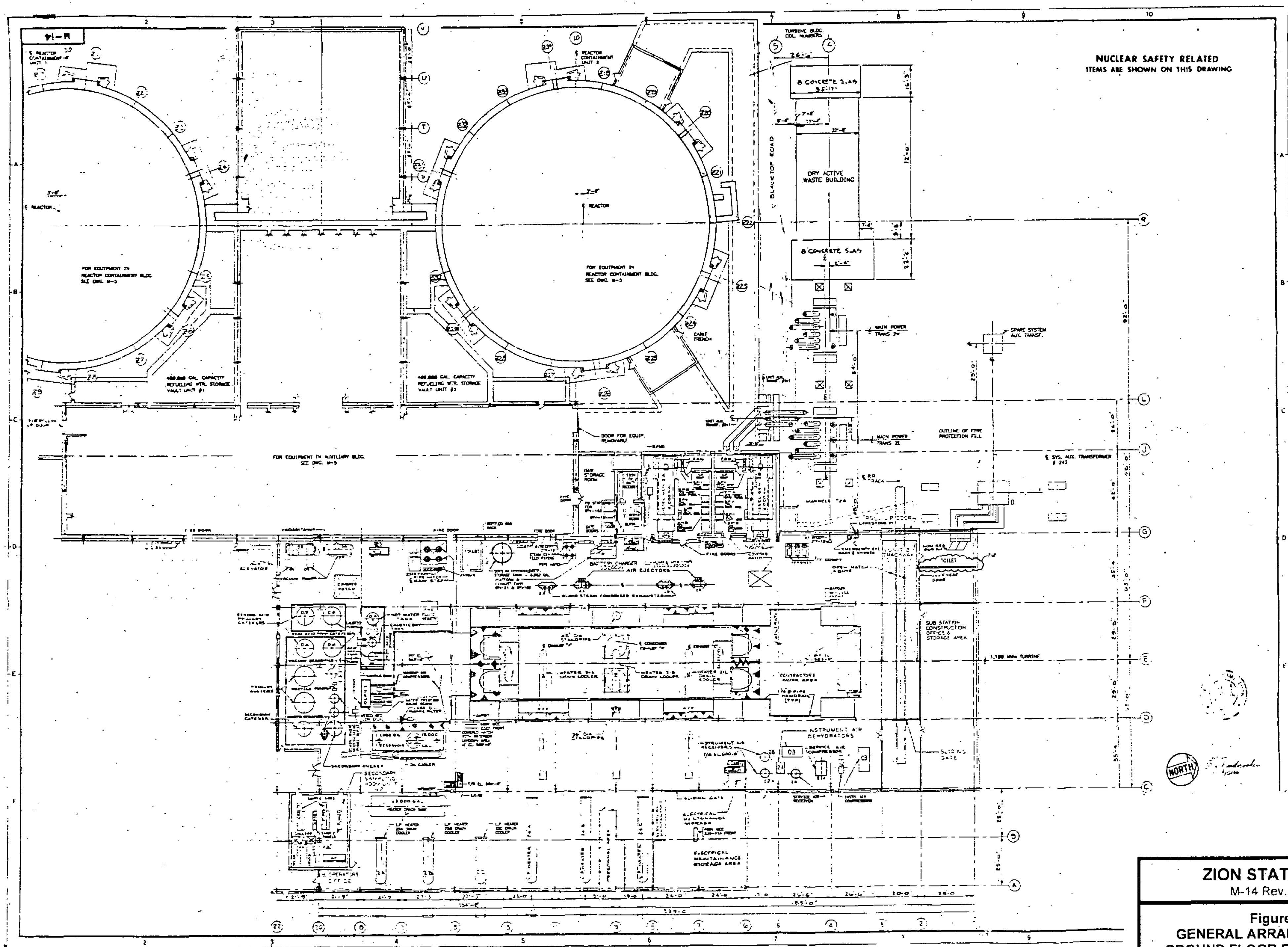
AUGUST 1998

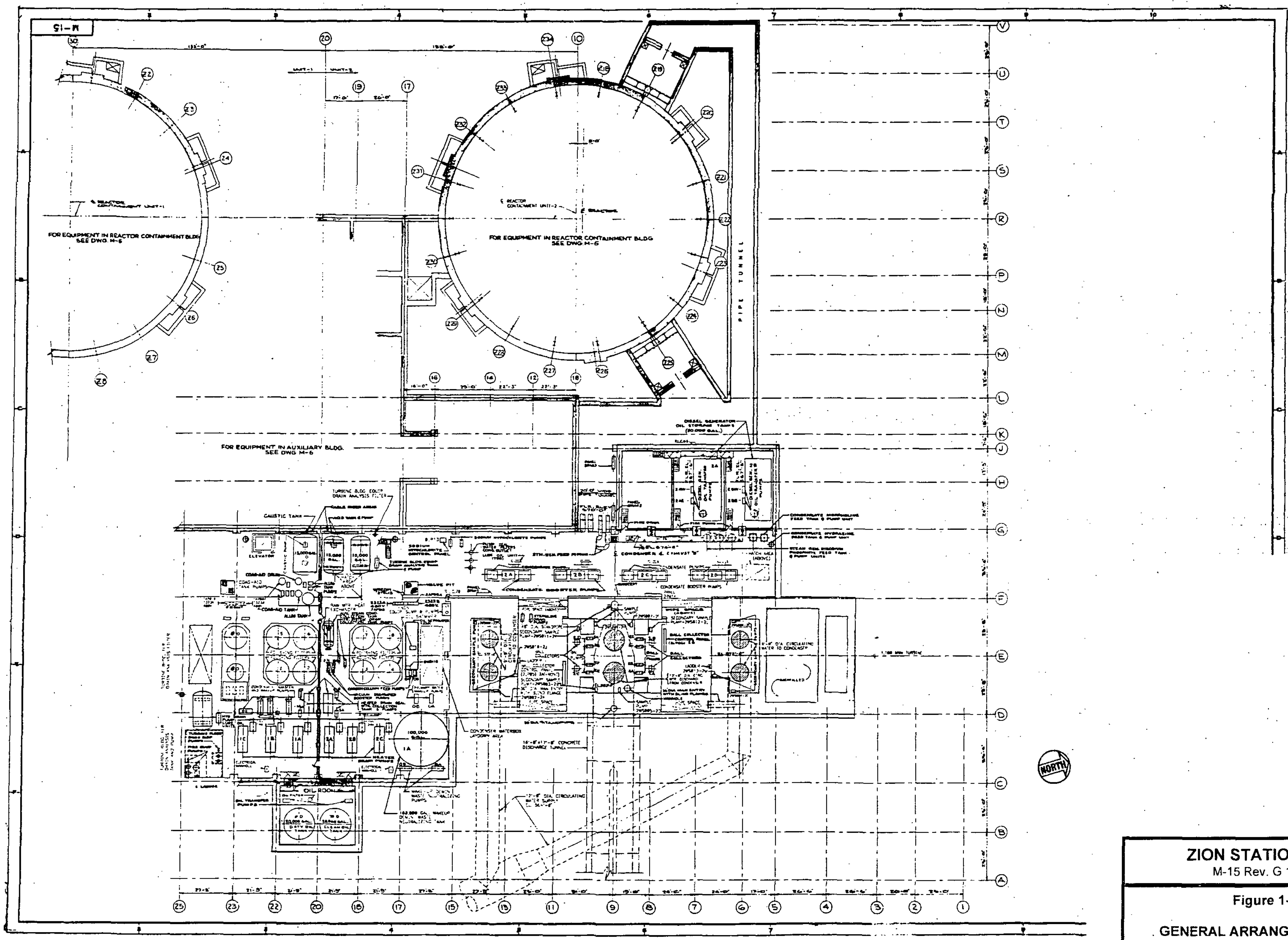


ZION STATION DSAR

M-14 Rev. L 1/30/97

Figure 1-14
GENERAL ARRANGEMENT PLAN
GROUND FLOOR EL. 592'-0" (UNIT 2)

AUGUST 1998



ZION STATION DSAR
M-15 Rev. G 1/30/97

Figure 1-15

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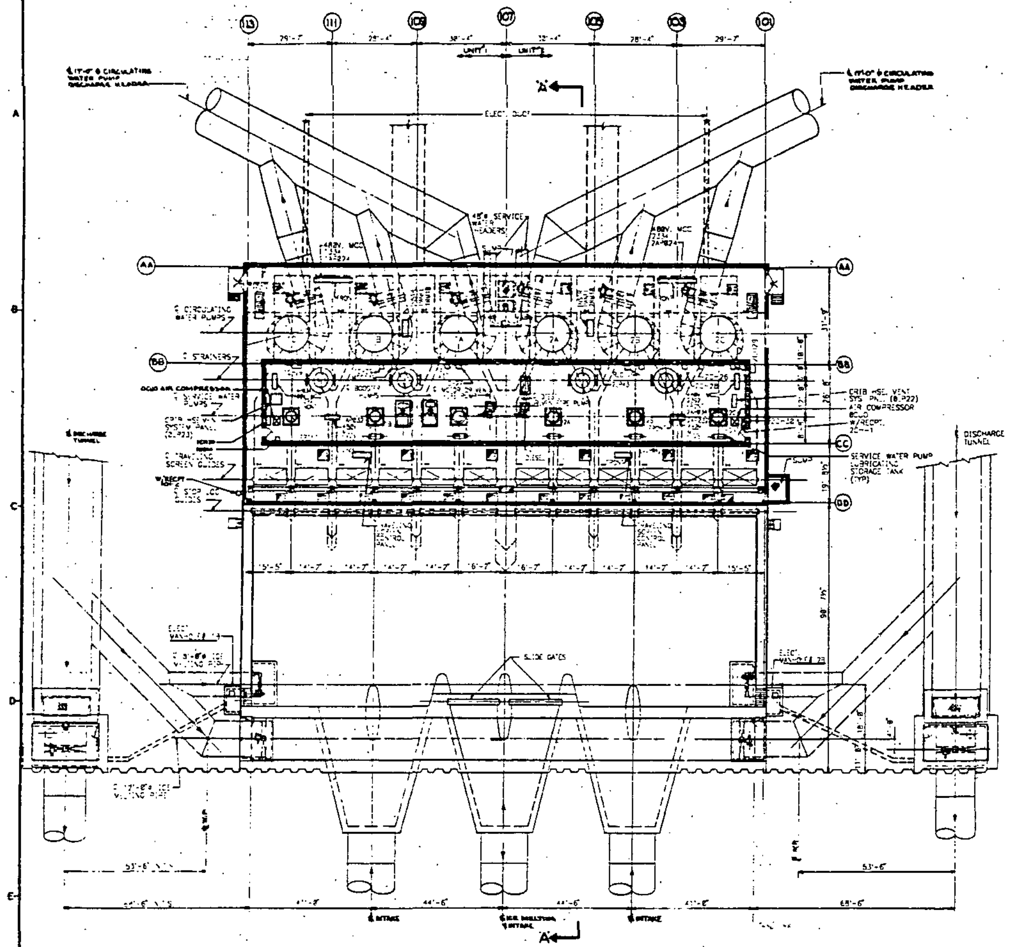
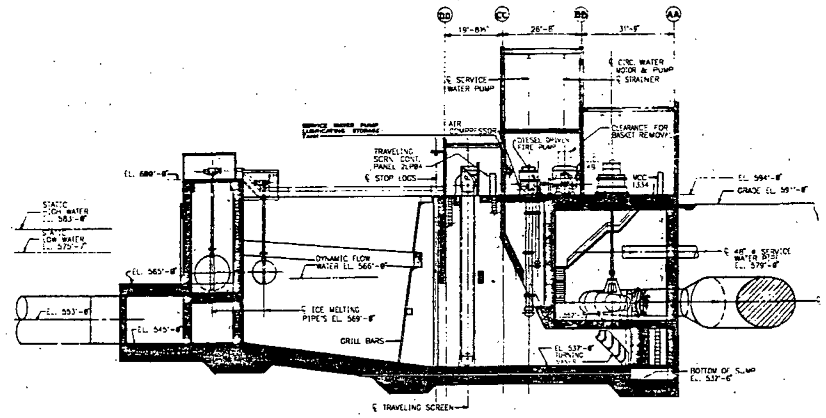
AUGUST 1998



PLAN

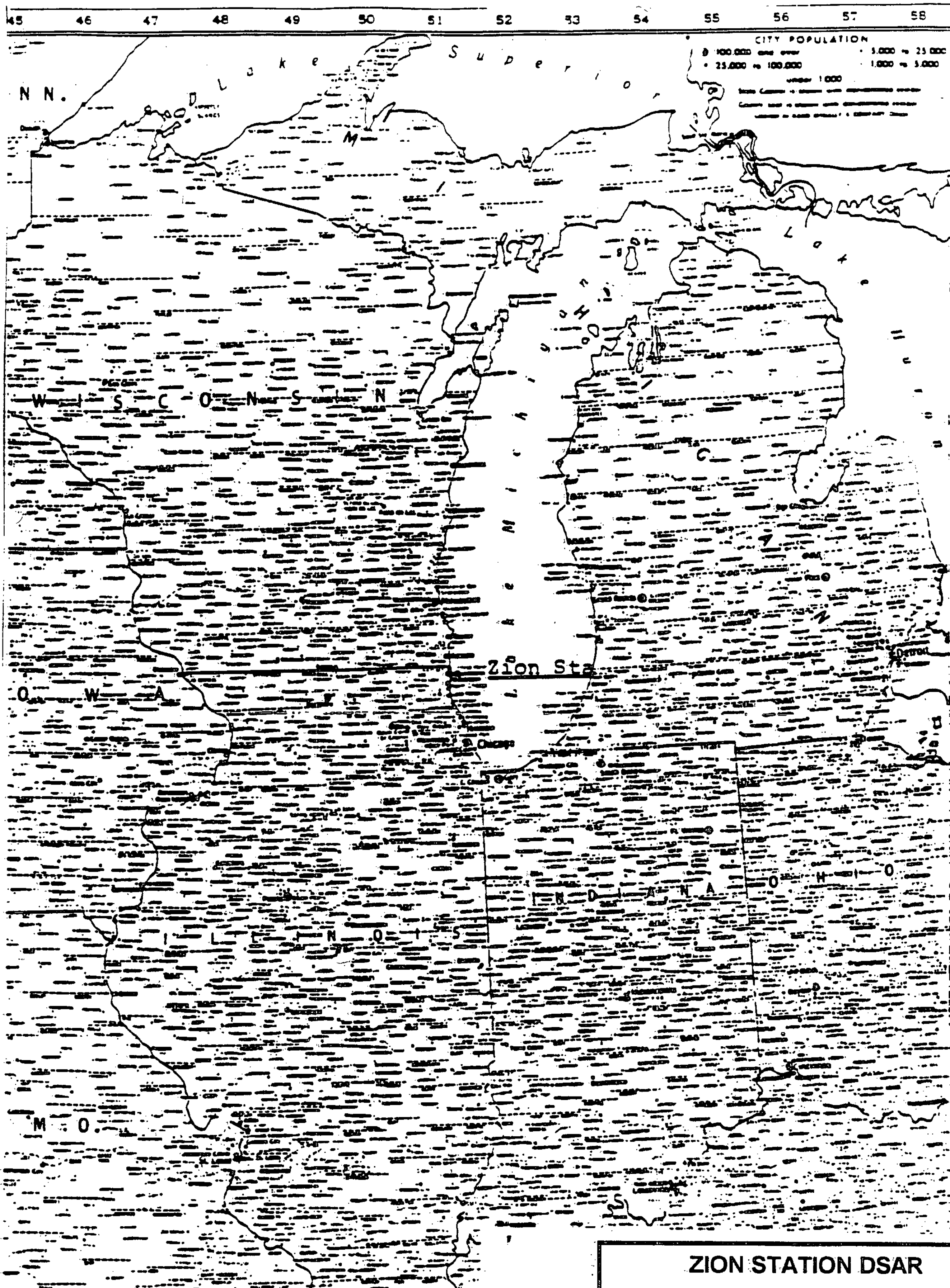


SECTION "A"-"A"

ZION STATION DSAR
M-16 Rev. C 1/30/97

Figure 1-16
GENERAL ARRANGEMENT PLAN
CRIB HOUSE

AUGUST 1998



ZION STATION DSAR

Figure 1-17

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AUGUST 1998

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2. SITE CHARACTERISTICS

2.0 INTRODUCTION

This chapter summarizes information on the geological, seismological, hydrological, and meteorological characteristics of the site and vicinity, in conjunction with population distribution, land use, and site activities and controls. The purpose is to indicate how these site characteristics influenced plant design, operating criteria, and overall adequacy of the site for nuclear power operations. Much of this information is historical in nature. This information demonstrates, in complement with more detailed discussions provided in other chapters, the overall adequacy of the site for safely storing, monitoring, and handling of fuel, to safely handle radioactive waste, and to monitor all radiological effluent release paths.

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 Site Location and Description

The site is in Northeast Illinois on the west shore of Lake Michigan about 40 miles N of Chicago, Illinois, and about 42 miles S of Milwaukee, Wisconsin, as shown in Figure 2-1. The site is in the extreme eastern portion of the city of Zion, (Lake County) Illinois, on the west shore of Lake Michigan approximately 6 miles NNE of the center of the city of Waukegan, Illinois, and 8 miles south of the center of the city of Kenosha, Wisconsin. It is located at longitude 87 degrees 48.1 minutes W and latitude 42 degrees 26.8 minutes N.

The site comprises approximately 250 acres which is owned by Commonwealth Edison Company. The site is traversed from west to east by Shiloh Boulevard near the northern property boundary. Site maps covering details out to a 10 mile radius and in the Low Population Zone (LPZ) and Exclusion areas, are respectively shown in Figures 2-1 and 2-2. Figure 2-3 is an aerial photograph depicting the site boundaries and details of the site.

In addition to those roads which connect directly with the site, there is a network of primary and secondary highways and section line roads in the adjacent area which provide a variety of high capacity routes to and from the site and the immediate vicinity, as indicated on Figure 2-2. For example, in addition to Shiloh Boulevard, which extends approximately 2 miles west of the plant site, there are within 1-mile of the site three other highways or roads (Ill. Rt. 173, 29th Street, and Wadsworth Road) extending westerly and intersecting each of the principal north-south secondary highways located within four miles of the site, i.e., Sheridan Road, Lewis Avenue, Kenosha and Green Bay Roads (Ill. Rt. 131), and also U.S. Rt. 41, a four lane, highspeed, divided highway. In addition, Interstate 94, a limited access, four lane tollway, is situated approximately 6 miles west of Zion.

2.1.2 Exclusion Area Authority and Control

The site, consisting of approximately 250 acres owned solely by Commonwealth Edison Company, provides the requisite exclusion area. Reference Section 1.2.1.4 for discussion of the restricted area.

There are no residences on the site or within 2000 feet of the station structures.

2.1.3 Population Distribution

The 0-10 mile population estimates were made using the 1980 Census Bureau population data for the incorporated areas and 1980 aerial photographs for unincorporated areas. The incorporated area totals were added to the unincorporated area totals to obtain population estimates by zone which appear in Table 2-1.

A list of incorporated villages and cities within 10 miles of Zion was prepared by finding their distance and direction using the following maps: USGS 1:250,000 topographical map, Illinois Highway map, Wisconsin Highway map 1981-1982, New Expanded Chicago Tribune Chicagoland map, Kenosha County Highway map and official township maps for Kenosha and Lake counties. Population totals for these municipalities were obtained from the 1980 US Census Bureau lists of Incorporated Municipalities for Illinois and Wisconsin. Those areas with 25,000 inhabitants or more are listed by distance and population in Table 2-2.

As tabulated in Chapter 5, the total radiation doses under postulated hypothetical accidents to an individual at the boundary of the exclusion area or at the boundary of the "low population zone" are within the limits prescribed by 10CFR100 and within USEPA Protective Action Guidelines.

The population density and use characteristics of the environs are compatible with the operation of the Zion Station.

2.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

2.2.1 Locations and Routes (References 1 and 2)

The Waukegan-North Chicago area is predominantly an industrial region with 144 manufacturing establishments. The product of the largest of these manufacturing firms is pharmaceuticals and chemicals with the most predominant product of the remainder being in the metallurgical and fabricated metal products field. None of the industries listed by the Waukegan-North Chicago Chamber of Commerce will represent a limitation to the operation of the Zion Station.

2.2.2 Descriptions (References 3, 4, and 5)

2.2.2.1 Nonmilitary Facilities

The Zion-Winthrop Harbor area is a small industrial region. A portion of this industry is located between the western boundary of the site and the Chicago and Northwestern Railroad tracks approximately 0.8 miles due west of the plant location and is light in nature. There is also a warehouse located in this industrial area.

There are no schools or hospitals within one mile of the station.

The site is bordered on the north and the south by the Illinois Beach State Park.

The centers of the communities of Zion and Winthrop Harbor are located 1.6 and 2.5 miles, respectively, from the plant location.

According to the Lake County Regional Planning Commission, commercial fishing is almost nonexistent in this portion of Lake Michigan due to the migration northward of the Lake Trout. Sport fishing has increased in popularity since the introduction of salmon and trout in the lake.

2.2.2.2 Military Facilities

The major military installation in the vicinity of the Zion site is the Great Lakes Naval Training Station.

The Great Lakes Naval Training Station has a small arms practice range utilizing a small area of Lake Michigan 10 miles south of the Zion site.

There is no active vessel of the Navy on Lake Michigan. The U.S. Coast Guard operates surface vessels and aircraft on the lake.

It is concluded that military installations and operations in the vicinity of the Zion site do not pose any threat to safe facility operation.

2.2.2.3 Waterways

Commercial barges and ships do not ordinarily operate within five miles of the Zion site, and the majority of commercial traffic on Lake Michigan does not approach within twenty miles of the site. All barge traffic north of the Chicago area is limited to the summer months due to waves or ice on the lake. Explosives and toxic gases are carried only aboard oceangoing vessels which do not closely approach the site.

2.2.2.4 Airports

Waukegan Regional Airport is the closest airport to the station and is the only one within 10 miles of the plant. It is located 3.14 miles southwest of the site. The station is located 0.76 miles from the extended centerline of the longest runway (5/23). Figure 2-4 shows the general airport layout.

2.2.3 Evaluation of Potential Accidents

A probabilistic risk evaluation has been performed circa 1989 which estimates the potential for an aircraft accident resulting in a post-crash fire within sufficient proximity to Zion Station to present a hazard (References 6 and 7). The evaluation concluded that the probability of occurrence of the event was below 1.0×10^{-7} per year, and would remain below this value even to the year 2008. The NRC reviewed and accepted this evaluation via Reference 8. The NRC's conclusion is stated below:

"The overall probabilities of an aircraft crash leading to a fire near the ventilation intakes of the Zion plant meet the acceptance criteria of Section 3.5.1.6 of the Standard Review Plan. Accordingly, the technical specification for aircraft fire detection is not required."

The Zion Station can withstand any fire or explosion which could result from an accident in the normal shipping lanes on Lake Michigan. The release of toxic gases on the lake could affect the environs of the station, but would not cause the Control Room to become uninhabitable.

2.3 METEOROLOGY

2.3.1 Regional Climatology

2.3.1.1 General Climate

The climate of the region around the site is primarily continental, with characteristic cold winters and warm summers. There is no dry season; precipitation occurs with some uniformity throughout the year. Average annual precipitation is about 33 inches, average annual snowfall is about 40 inches, and the mean annual temperature in the area is near 50°F.

Winds over 70 miles per hour are not expected to occur more than once every 50 years. Tornadoes occur with relative high frequency in Illinois, but are mostly found in the southern half of the state.

Northern Illinois is well-ventilated, with infrequent periods of calms. Most frequent wind direction occurrences are southwest and northeast during the warm months of the year, and southwest and northwest during the cool months. The lake breeze effect is an important factor in wind direction during the summer months. The longest duration of uninterrupted winds blowing from one direction was 39 hours from the northwest.

Some extremes of meteorological variables are listed in Table 2-3.

Data and analyses in Section 2.3 are based on: five years of hourly observations from Milwaukee, Wisconsin and Chicago (O'Hare); wind summaries from Waukegan, Illinois (Reference 9); summaries of climatological data from Wisconsin and Illinois; and other reference data of a more specific nature. Data presented from the Milwaukee, Waukegan, and O'Hare airports was that five-year period which was available on magnetic tape from the National Weather Records Center.

2.3.2 Local Meteorology

2.3.2.1 Normal and Extreme Values of Meteorological Parameters

2.3.2.1.1 Climate

The climate of the Zion region is illustrated on Figure 2-5 which shows average and extreme temperatures and precipitation for 30 or more years of record at Chicago and Milwaukee.

The climate of the site region is influenced by the general storms which move eastward along the northern tier of the United States and by those which move northeastward from the southwestern part of the country to the Great Lakes. This continental type of climate is modified by Lake Michigan. Wind shifts from westerly to easterly directions produce marked cooling of the day time temperatures in spring and summer. In autumn the relatively warm water of the Lake prevents night time temperatures from falling as low as they do a few miles inland from the shoreline. Summer time temperatures seldom rise above 90°F along the Lake shore, and sub-zero temperatures occur only about twelve days during the winter months. Rainfall averages around 33 inches per year, with the largest proportions falling during the growing season. Extreme winds for design purposes are described below.

Results are from a special study done by the Weather Bureau for winds at 30 feet elevation. Extreme-mile winds are: 50 mph with probability of 0.50 and a recurrence interval of once in 2 years; and a 50-year recurrence interval is associated with a 70 mph wind with a probability of 0.02. (The extreme-mile wind speed is defined as the 1-mile passage of wind with the highest speed for a day.)

An annual stability wind rose table for 1980 was generated using the Zion meteorological tower data (Table 2-4). The 35-ft wind speed and wind direction data and the 250-35 ft differential temperature data were used in the comparison. The modal wind speed for this period was the 4-7 mph class (41.80%). The prevailing wind direction was northwest (9.75%) followed by west (9.24%). Stability classes were weighted towards the neutral-slightly-stable classes (44.42%).

2.3.2.1.2 <u>Wind Direction</u>

Average annual wind roses are shown on Figure 2-6 for Milwaukee, Waukegan, and Chicago (O'Hare). The wind regimes at all three locations are quite similar, except that the results from Chicago (O'Hare) show considerable observer bias in favoring the octant points of the compass. At all three locations, the warm weather lake breeze effect is reflected in a definite spike of higher wind frequencies from the northeasterly direction. Calm conditions at these three sites are reported to range from about 1% to 6% on an annual bases. There are no major dissimilarities between the three wind roses. Data from Milwaukee were selected as being reasonably free from observer bias and representative of the west coastal areas along Lake Michigan, and have been used in the preliminary determination and analysis of Zion site meteorological factors. Figure 2-7 shows the average wind rose for the Zion site based on limited onsite data. No major differences are noted between the two figures. These wind roses were used in evaluating the meteorological factors for initial licensing.

Table 2-5 presents the stability wind rose data obtained from the Zion Meteorological Tower for the period of January 1, 1972, through December 31, 1980. These roses are based on the 35 ft wind speed direction and the 250-35 ft differential temperature. The prevailing wind direction for this period is west (9.73%) followed by southwest (9.52%). The modal wind speed class for this period was 4-7 mph (44.98%) followed by the 8-12 mph class (29.73%). Wind speeds less than 4 mph occurred 7.23% of the time. For the period, the stability distribution was weighted toward the neutral-slightly stable classes (59.70%).

The information provided for the Zion Meteorological Tower is used in evaluating the Zion site meteorological factors.

2.3.2.1.3 <u>Wind Direction Persistence</u>

Wind direction persistence at Milwaukee and Chicago (O'Hare) for the five year period of record are presented in Figure 2-8 and Figure 2-9, respectively. For each direction, the duration in hours, the number of occurrences, the data of the beginning hour and a summary of the stability class spectrum is given on the plots. Maximum persistence winds follow the wind rose patterns shown previously in Figure 2-6. Most persistent winds at Milwaukee were from the SSW for 32 hours under neutral (Pasquill Class "D") and slightly stable (Pasquill Class "E") conditions; from NW for 30 hours all under neutral stability; and from NNE for 29 hours under neutral and slightly stable conditions.

The most persistent winds at Chicago were from the NW for 39 hours (twice) under slightly stable conditions, from the NNE for 38 hours under neutral conditions, from the SW for 36 hours under stable and neutral conditions, and from the S for 32 hours under neutral conditions. In general, flow from Lake Michigan over land occurs under neutral conditions.

Based on the five years of data from O'Hare and Milwaukee, a wind direction persistence frequency distribution has been constructed (see Figure 2-10). For one-sector persistences, O'Hare would exceed an 80-hour duration with a probability of 10^{-4}, while Milwaukee would exceed a 38-hour duration at the same probability level.

Table 2-6 identifies the Pasquill stability classifications versus the temperature lapse rate. Tables 2-7 through 2-9 present the hourly joint frequency distributions of wind speed and direction by stability classifications.

2.3.2.1.4 Atmospheric Stability

Assessments of atmospheric stability at General Mitchell Field, Milwaukee, and O'Hare Field, Chicago, were made based on five years of data. These data were analyzed by techniques described by Turner (Reference 10) based on work done by Pasquill (Reference 11) and formulated into a computer code (WINDIF)* by NUS Corporation.

Hourly surface observations were analyzed for seasonal stability, dispersion (χ/Q) calculations and persistence including:

1. Hourly stability index distribution in percent of total observations and in percent of each hourly observations;

2. Day-night stability index distribution in percent of total observations;

3. Average wind speed for each stability index in knots;

4. Wind rose for each stability index in percent of each index total;

5. Average wind speed for each stability index and each of 16 wind directions;

6. χ/Q as a function of release height, wind direction, and downwind distance weighted by stability class and wind rose frequencies; and

7. Seasonal wind persistence calculations which include frequency of wind persistence by wind direction in percent of total number of observations for one sector, centerline plus and minus one sector, and centerline plus and minus two sectors. Stability variation for each hour of pre-selected magnitude of wind direction persistence.

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* Tabulation of data is shown in Appendix 2A. Zion tabulation based on limited data is shown in Appendix 2B.

Results of the stability class distribution along the wind rose for both Chicago (O'Hare) and Milwaukee are shown in Figures 2-11 and 2-12, respectively, for average annual and seasonal wind roses. On each direction ray the distance between the symbols for each stability class measured from the calm circle is the frequency of occurrence of each stability class in percent of total observations for five years of data.

Routine releases of radioactive gases will be made intermittently from the vent discharge pipe near the top of the Containment structure. Atmospheric dispersion of these gases may be described by various analytical expressions such as the Gaussian formulation described by Gifford, (Reference 12) as modified for the building wake effect. The basic expression for diffusion is as follows:

$$\chi / Q = \frac{\bar{\mu}}{(\pi \sigma_y \sigma_z + cA)}$$

where:

χ	=	concentration (units/m ^{3})
Q	=	release rate (units/sec)
μ	=	mean wind speed (m/sec)
σ_y and σ_z	=	respectively the lateral and vertical dispersion (Reference 13) coefficients(m)
c	=	building wake factor (dimensionless)
A	=	area of Containment $(m)^2$

For distances out to the exclusion boundary, the predominant dispersion mechanism is that due to aerodynamic turbulence in the wake of the Containment structure as contrasted with releases from a tall stack with no local interferences.

An overlay plot of the annual average χ/Q results for ground level release of waste gases corrected for initial dilution by the building wake model (Reference 13) is shown superimposed on the aerial photograph of the site in Figure 2-13. Based on Milwaukee data, the annual average diffusion factor (χ/Q) is about 2×10^{-6}sec/m^3 at approximately 2000 feet to the North of Unit 2. Figure 2-14 presents the χ/Q isopleths results for a ground level release based on available Zion site data.

2.3.2.1.5 Severe Weather

Northern Illinois experiences about 36 thunderstorms per year, with the largest number occurring from May through August. Most of these thunderstorms are of light or moderate intensity; but occasionally, severe thunderstorms, accompanied by high winds, hail, and heavy rainfall, can cause extensive damage to crops.

Based on work by Thom (Reference 14), highest expected winds were determined for the Zion site and are listed in Table 2-10.

The value of the highest gust of wind with a mean recurrence interval of 100 years is approximately 104 miles per hour, and for a 50-year interval, approximately 91 mph. The above estimates of highest gusts are based on work performed by Huss (Reference 15).

Since 1871, only three tropical storms have moved far enough inland to have passed near the Zion site. The tropical storms, which passed within about fifty miles of the site, occurred on October 6, 1949; June 28, 1960; and June 26, 1968. All were in a state of well-advanced dissipation and did not cause any significant damage to northeastern Illinois.

In the period from 1959 to 1969, thirty-four tornadoes have been recorded in Weather Bureau records as having occurred inside a square 80 miles on a side with the Zion site in the center. These are listed in Table 2-11, with the occurrence recorded as to state, date, direction of movement, path length, and width. Most of the tornado activity in Illinois takes place in the southern half of the state, and relatively few cross the shoreline from land to water.

According to methods outlined in a paper by Thom, (Reference 16) estimates of the probability of tornado occurrence at a point within a one-degree square are possible. Using the median values of path width and length of Iowa tornado tracks, and the approximate area of the site, the probability of a tornado occurrence at the site has been calculated to be 1.29×10^{-4}. On the basis of the ten years of observations used in Thom's paper, the 95% confidence limits have been determined to be $\pm 4.07 \times 10^{-5}$ ($\pm 2.2\sigma$). A probability of 1.69×10^{-4} is thus determined at the 95% confidence level. This indicates a recurrence interval of approximately one tornado every 5900 years within the site boundaries.

An alternate method, using the value for a path area of 2.8209 square miles suggested by Thom, yields a probability of 9.0×10^{-4} for the 95% confidence limits. These result in a range of recurrence interval from 800 to 1600 years.

2.3.3 Onsite Meteorological Measurements Program

The meteorological measurements program at the Zion site consists of monitoring wind direction, wind speed, temperature, and precipitation. Two methods of determining atmospheric stability are used: delta T (vertical temperature difference) is the principal method; sigma theta (standard deviation of the horizontal WD) is available for use when delta T is not available. These data, referenced in ANSI/ANS 2.5 (1984), are used to determine the meteorological conditions prevailing at the plant site. Site specific information on instrumentation, calibration procedures, as well as the meteorological measurements program during a disaster can be found in the Generating Station Emergency Plan (GSEP) annex.

The meteorological tower is equipped with instrumentation that conforms with the system accuracy recommendations of Regulatory Guide 1.23 and ANSI/ANS 2.5 (1984). The equipment is placed on booms oriented into the generally prevailing wind at the site. Equipment signals are brought to an instrument shack with controlled environmental conditions. The shack at the base of the tower houses the recording equipment, signal conditioners, etc., used to process and retransmit the data to the end-point users.

In addition to the onsite meteorological tower, three 10-meter towers are located 2,5, and 15 miles to the west of the station. At each supplemental tower, wind speed, wind direction, and ambient temperature equipment are installed to measure the inland extent of lake breezes off Lake Michigan.

Recorded meteorological data are used to generate wind roses and to provide estimates of airborne concentrations of gaseous effluents and projected offsite radiation dose. Instrument calibrations and data consistency evaluations are performed routinely to ensure maximum data integrity. Data recovery objective is to attain better than 90% from each measuring and recording system. Data storage and records retention are also maintained in compliance with ANSI/ANS 2.5 (1984).

2.3.4 Short-Term Diffusion Estimates

Short-term diffusion estimate data is contained in Appendix 2C.

2.3.5 Long-Term Diffusion Estimates

Long-term diffusion estimate data is contained in Appendix 2C.

2.4 HYDROLOGIC ENGINEERING

2.4.1 Hydrologic Description

2.4.1.1 Site and Facilities

The plant's cooling water is drawn from Lake Michigan. All radioactive liquid waste generated at the plant is collected, treated, and either recycled or discharged. Those liquid wastes that are discharged are monitored to assure compliance with 10CFR20. Radioactivity levels will not exceed permissible concentrations at the cooling water outlet. The Lake County Public Water District operates a water intake about one mile north of the site and about 3,000 feet out in the Lake. This water intake is the closest source of potable water. Continuous release from the plant of cooling water will result in radionuclide concentrations below those permitted under 10CFR20.

Operation of the plant will not result in releases greater than 10CFR20 limits at the point of discharge and consequently normal operation should not result in significant radioactivity concentrations in drinking water. Interactions with contributions from other nuclear power stations are not considered significant since there are none located or currently announced within 66 miles of the Zion station.

The next nearest potable water intake which utilizes surface water from Lake Michigan is 6 miles south of the site at Waukegan. The Waukegan waterworks uses two intake aqueducts.

The crib of one is in 27 feet of water approximately 1250 feet southeast of the Waukegan Harbor entrance light. The crib of the second is in 35 feet of water approximately 3250 feet southeast of the first crib. The water is filtered and treated prior to distribution.

Potable water supplies from Lake Michigan are also located at Kenosha, Wisconsin, and North Chicago, Illinois, ten miles north and south, respectively, of the site. Others are located farther up and down the Lake shore. The municipal water system characteristics are summarized in Table 2-14 and are based on References 1, 4, and 17.

The topography of the site (see Figure 2-2) and its immediate environs is relatively flat with elevations varying from the Lake shoreline to approximately 20 feet above the level of the lake. Approximately two miles west of Lake Michigan is a topographical divide causing surface water drainage west of the divide to flow away from the lake while the east drainage flows toward the lake.

The site itself has very little slope and is relatively marshy in its western and central portions. However, the eastern portion of the site (next to the lake) on which the plant is located is not marshy and has good surface drainage toward the lake. Just behind the beach there is a low line of bluffs approximately 5 to 10 feet high.

2.4.1.2 Hydrosphere

Lake Michigan is one of the largest of the Great Lakes. It is 307 miles long from north to south and has an average width of 70 miles. It has a maximum depth of 923 feet, an average depth of 325 feet and covers an area of 22,400 square miles. The total volume of water in Lake Michigan is approximately 1,400 cubic miles. However, since an exchange of water occurs between Lake Michigan and Lake Huron through the Mackinac Straits, the water ultimately available for dilution is approximately 2,500 cubic miles.

The normal water level in Lake Michigan is approximately 582 feet above mean sea level (MSL). The maximum recorded water level is 584 feet above MSL, which occurred in June 1886, and the minimum recorded to date occurred in 1964 at 577.4 feet above MSL according to the United States Geologic Survey (USGS).

In the general vicinity of the site, the 30-foot depth contour of the lake is 1.2 miles, and the 60-foot depth contour is 2.0 miles from the shore.

The subsurface water table of the area is sloped to the east towards the lake. The shallow aquifers are the sand and gravel overburden and the underlying dolomite formations. The deep aquifers are in sandstone and dolomite formations with a strata of shale above them. The "free water" in the shallow aquifers over the six county northeast Illinois region is 4.72×10^{12} gallons and in the deep aquifers is 3.53×10^{14} gallons. However, the artesian pressure of the deep aquifers has dropped some 700 feet since 1864.

Since 1957, the cities of Zion and Winthrop Harbor, and the Illinois Beach State Park plus a number of retail establishments in unincorporated communities have obtained their water from the Lake County Public Water District. The supply is treated by coagulation, sedimentation and sand filtration, and is chlorinated prior to distribution.

2.4.2 Floods

The surface streams near the site are:

Kellogg Ravine -	1.25 miles north of the site; flows west-east.
Dear River -	3 miles south of the site; flows west-east.
Bull Creek -	0.2 mile south of the site; flows west-east

The first two are very short drainage streams extending 2 and 1 miles from Lake Michigan, respectively. Both contain negligible flows except during periods of high runoffs. Flooding by any of these streams would not involve the site.

The runoff, due to a probable maximum storm over the water shed of Bull Creek west of the plant site, was analyzed to examine the potential for flooding the power plant Class I structures. The significant and maximum (1%) wave effects of a coincident 45 miles per hour (mph) wind from the critical direction were superimposed on the maximum water level corresponding to the probable maximum flood conditions. This was done to determine the upper limit of the Bull Creek flood potential. Shown in Figure 2-15 are the locations of Zion Nuclear Power Station, Bull Creek drainage area, and the significant drainage structures, railway, and roadways.

Analyses and computations show the maximum water surface elevation in the vicinity of the power station, under probable maximum precipitation conditions over Bull Creek, is 590.1 feet above MSL. Superimposing the wave effects of a sustained 45 mph wind on the maximum water level, the calculated wave runup elevations corresponding to a significant wave and a maximum (1%) wave are 591.2 feet and 591.7 feet, respectively. The grade floor level of the power plant Class I structures is elevation 592.0 feet above MSL.

Results of the aforesaid analyses and computations and observations made in a field inspection of the Bull Creek water shed and plant site lead to the conclusion the occurrence of a maximum probable flood in Bull Creek and a coincident 45 mph wind from the critical direction would not result in flooding of the power plant Class I structures.

The marshy area of the site is classified by the Lake County Regional Planning Commission as a flood plain. However, this does not include the area of the plant location. The flooding is due to poor drainage and the presence of peat and muck which inhibits percolation of surface water into the sandy soil. Measures such as grading have been taken to drain the site adequately.

The high water level of Lake Michigan is 584 feet above MSL which is 8 feet below grade floor level of the plant (592 feet above MSL). Therefore, the occurrence of maximum wave conditions at the site is 6.7 feet, which, even at high water, would not result in flooding of the plant area. Section 2.4.5 discusses lake flooding in more detail.

2.4.2.1 Rainfall

Lakes Michigan and Huron are considered as a unity from the standpoint of drainage and water level since these two lakes are connected. The drainage basin for these two lakes comprises 115,700 square miles and has an average annual rainfall of about 31 inches. Table 2-15 lists the average and maximum precipitations recorded at various locations on the Illinois shore of southern Lake Michigan.

2.4.2.2 Flood Design Considerations

No special design features are required to accommodate the hydrological characteristics of the site. The station grade floor level is 2.1 feet above the theoretical maximum water level at the shoreline due to a 6.7 foot wave occurring simultaneously with the maximum high water level. In addition, the station floor grade level is 3.8 feet above the maximum expected seiche (5 feet) occurring simultaneously with maximum recorded high lake level. No consideration was given to the simultaneous occurrence of maximum high water level, maximum deep water waves and maximum seiche water levels because of the differing meteorological conditions required for the wave and seiche generation.

2.4.3 Probable Maximum Flood (PMF) on Streams and Rivers

Text for this section is not applicable to the Zion Station.

2.4.4 Potential Dam Failures, Seismically Induced

Text for this section is not applicable to the Zion Station.

2.4.5 Probable Maximum Surge and Seiche Flooding

2.4.5.1 Surge and Seiche Water Levels

A seiche may be caused by intense squall lines that move across the Southern Basin of Lake Michigan in a direction generally toward the southeastern quadrant. The accompanying pressure gradient and wind stress acting on the lake surface can produce an organized mid-lake disturbance which resembles a solitary wave. Upon arrival at the lake shore, this wave can create large changes of water level through the operation of shoaling effects. The highest surge (seiche) on the Chicago shore occurs at Montrose Harbor as the result of squall lines which have moved toward the southeast at about 55 knots. The surge travels with the squall line as it crosses the lake and thus, for the usual west to east motion, occurs on the eastern shore with the squall line, but must be reflected to reach the western shore. This means the west-shore seiche usually will occur at a time of meteorological quiet and thereby can catch people unaware unless they are alerted to the danger. Amplification of this discussion can be found in References 18 through 20. On June 26, 1954, the maximum recorded seiche occurred with a rise of eight feet at Montrose Harbor. The rise in level calculated to exist at Montrose Harbor and Zion under the conditions of June 26, 1954, is 6 feet and 2 feet, respectively. With the number of variables in such a calculation, the predicted value of 6 feet versus the observed value of 8 feet is considered a good correlation. The pertinent fact is the seiche at Zion will be less than any of Montrose Harbor by a factor of approximately one-half. This observation is supported by the "contours of amplitude" curves shown in Reference 19, published in the Monthly Weather Review, Vol. 93, Number 5, May 1965. These curves show the maximum seiche levels at Montrose Harbor and Zion are in a ratio of 8 to 5 under the worst conditions.

Therefore, the maximum seiche level that will occur at Zion is considered to be five feet.

Using the Platzman Theory (Reference 18), the storm surge that could occur at the site was found to be 8.8 feet due to the passage of a squall line with a pressure jump of 0.21 inches Hg and a wind speed of 65 knots. Adding this surge to the maximum monthly lake elevation of 583.24 feet above MSL results in a maximum water level of 592.05 feet above MSL. The surge height of 8.8 feet was based on an estimated deep water surge height of 2.92 feet with a shoaling factor of 3.0. The surge, in combination with waves in the height range of 1 to 2 feet, would result in overtopping of the crib house wall which extends to elevation 592.0 feet above MSL and would create water levels of 1 to 2 feet above plant grade (592.0 feet above MSL) for up to 20 minutes. This transient water level will not cause flooding which might impair the operation of any equipment important to the defueled condition of the plant.

An analysis of wave runup on the crib house wall showed waves breaking 100 feet offshore will runup to elevation 594.2 feet above MSL, overtopping the wall at elevation 592 feet above MSL by some 2 feet. The analysis was based on the assumption of an equivalent slope from the point of breaking to the top of the wall, as suggested in "Shore Protection Planning and Design," Third Edition, 1966, p. 190. The depth at this point is 11 feet and the breaking wave height 8.6 feet. The runup above design highwater is 11.8 feet. Wave setup is estimated at 0.17 feet. The amount of water overtopping the wall will be less than 1 cubic foot per second per foot of width and will not impair the operation of equipment important to the defueled condition of the plant.

Table 2-16 identifies the location, elevation, and type of use of all exterior above ground accesses below El 600' above MSL. There is no safety-related equipment located in the Turbine Building or in the Fuel Handling Building. All equipment previously considered safety-related is located in the Auxiliary Building, Crib House or in Containment. Water entering the Fuel Building cannot get into the Auxiliary Building, since there is no communication between these buildings below El 617'. The potential for flooding the diesel generator room, via a flow path through the Turbine Building, is minimal because the doors into the rooms are kept closed and latched.

The entrance at L-30 opens into the Vermiculite and Cement-Mixing Room, which is separated from the main portion of the Auxiliary Building by two sets of double doors. Any water entering by this path would be contained within the dry-active-waste storage and drumming station areas. It is conceivable a small portion could find its way down the stairwell at H-25 and eventually collect on El 542'. This small amount of water could be handled by the sump pumps (total capacity of 400 GPM) at this elevation.

In the event the Auxiliary Building door (L-10), which is a normally locked door, was left open, significant quantities of water could enter the Auxiliary Building under postulated maximum seiche conditions. The general areas house the motor control centers (MCCs), which are protected by 4 ft. tall flood walls. The amount of water required to cause initial flooding above the 4 ft. level, so as to affect the MCCs is approximately 240,000 gallons. Based upon the above flooding margin and the design provision discussed below, we have concluded the transient water level will not cause flooding which could impair the operation of any equipment important to the defueled condition of the plant.

In the event the other Auxiliary Building door (K-30) was left open, only a very small quantity of water could possibly enter due to the raised elevation of the sill (595' 10.5"). Any water entering this opening would be contained in the drumming station and dry-active-waste storage areas since there is a set of double doors separating this entrance from the main portion of the Auxiliary Building. The exterior louvered openings providing fresh air for the diesel generator rooms are at El. 592'-3". There are concrete barrier walls immediately behind the air intake louvers that provide all of the barrier requirements for the diesel generator rooms, including flooding protection. There is a small, normally closed and latched door designed into each of these walls that provides access for inspection. The bottom elevation of this door is approximately El. 593'-9". Because of the raised sill and the closed and latched door, the leakage of water through this opening from a postulated transient storm surge will be minimal. The other openings in the concrete plenum wall are above El. 606'. Grade floor level in the Crib House is 594 feet 0 inches and the service water (SW) pump motors are mounted 5 feet 6 inches above El 594'. While it is conceivable a small amount of water could slosh up through openings in the floor of the SW pump bay, the elevation of the pump motors precludes any effects from flooding.

2.4.5.2 Currents, Tides, Waves and Littoral Drift (References 21 and 22)

2.4.5.2.1 Wind Effects on Surface Currents

Surface currents in Lake Michigan are generated primarily by wind stress on the water surface. The lake's wind-driven currents have speeds averaging 1% to 2% of the wind speeds. Thus, an average wind speed of 15 mph over the lake would generate an average surface current of about 0.15 to 0.3 mph. Such currents may persist for several days after the wind has subsided. On large water surfaces, the wind-driven current is theoretically 45 degrees to the wind vector, due to the rotation of the earth. On the west side of Lake Michigan, the current is largely parallel to the shore and nearly 22 degrees to the right of the prevailing wind. Current velocities were measured three miles off the coast of Waukegan during July 1963 through June 1964 by the Great Lakes Illinois River Basin Study of the Federal Water Pollution Control Administration (see Reference 23). Measurements taken at a depth of 10 meters showed the flow to be from the south 60% of the time with greater than 40% of the current directions within 70 degrees centered on south.

Data on current speeds for the period July through November 1963 are representative of the entire period and are shown in Table 2-17.

Median current speed for the observed period is 9.2 cm/sec (0.3 ft/sec).

2.4.5.2.2 Wave Action Due to High Winds

The second phenomena is wave action due to local squalls and persistent high winds. Deep water wave heights in the general vicinity of the site due to storms, based on Corps of Engineers observations at Chicago and Milwaukee, can be expected to occur with a frequency as shown in Table 2-18.

Based on the deep-water wave heights in Table 2-18, the maximum elevation of wave runup and wind tide is estimated to be 6.7 feet above the normal water level (at an occurrence frequency of once in 500 years.) It is to be noted this 6.7-foot height is the maximum elevation at the shoreline.

Of the two phenomena, the seiche presents the greater hazard to the site. Although of greater height, the deep-water wave will be quickly dissipated as it overruns the shore and is therefore of little consequence to structures located at some distance from the shoreline. However, the seiche-generated wave will comprise a much greater quantity of water, and the rise in level will endure for longer periods of time.

Waves are responsible for most of the littoral drift on Lake Michigan. The predominant drift appears to be to the north.

During much of the winter season, portions of the lake are covered with ice, and fetch areas are limited considerably. In addition, for a somewhat greater portion of the winter season, the coast area of the lake is covered with ice. Even though waves are generated in offshore areas, they never reach the shore, being interrupted by the ice around the rim of the lake. No account of this effect of the ice was taken in the compilation of the above data.

2.4.5.3 Protective Structures

There is no equipment important to the defueled condition of the plant in the Fuel Handling Building, the Auxiliary Building, or the Turbine Building that can be adversely impacted by flooding. Even with this, several means are available to prevent excessive water intrusion into the Auxiliary Building from probable maximum surges. These include:

1. The two large doors in the Auxiliary Building are required by operating procedures to be normally closed.

2. The door into the Vermiculite and Cement Mixing Room opens outward and is provided with "dust-tight" seals at the sill and jamb which will restrict gross leakage of water.

3. None of the exterior doors in the Auxiliary Building are used for routine personnel access which will reduce the possibility of leaving the doors inadvertently open.

4. Motor Control Centers (MCCs) located at the Auxiliary Building elevation 542' are protected by 4 ft. tall flood walls built around them.

Waves cannot break directly on the Crib House since it is protected by sheet pile wall up to El 592' above MSL at maximum high water El 583.24' above MSL. The maximum water depth at the wall will be 7 feet. The offshore bottom slope at the wall is approximately 1:45. All other Class I structures are protected by the Turbine Building.

Assuming a wave period of 8 seconds, the maximum height of waves breaking on the wall is estimated at 6.7 feet. The corresponding deep-water wave height is 6.0 feet. This estimate is based on the assumption that waves breaking at a distance equal to seven breaker-heights offshore will strike the wall.

The runup at the wall is estimated at 2.8 times the deep-water wave height, or 17 feet. The wall will be overtopped.

The quantity of water overtopping the wall is estimated at less than one cubic foot per second.

Using Minikin's method, the peak pressure on the wall (static plus dynamic) is found to be 3310 psf and the thrust is 7.3 kips per foot applied at El 583.8' above MSL.

The concrete wall at the Crib House can withstand this loading without overstress.

The minimum water level of the lake is 575 feet. The depth of the trough (also height) of the surge wave is 2.92 feet in deep water. Considering the shoaling effect, the depth of the trough at the shoreline is 8.8 feet. The offshore location of the intakes will result in a trough depth somewhere between these values.

Assuming a linear increase (a conservative assumption) in trough depth from deep water at one mile from the shoreline to the shoreline, it is expected a surge wave depth of 5.8 feet would occur at the intake located one-half mile from the shoreline. This results in a minimum lake level at the intakes of approximately 569 feet and a minimum water level in the crib house forebay of 560 feet. This momentary low level will not adversely affect plant operation.

There is no conceivable combination of conditions which would result in an insufficient available suction head for the SW pumps. The minimum submergence required for continued safe operation of the SW pumps is 6 feet 0 inches. The SW pump intake bells are located at El 552' and the normal minimum water level in the forebay (at low lake level) is El 566'.

The lake intake bell is located at El 560.7' and, based on a low lake level of 575 feet coupled with a surge trough of 6 feet, the forebay will lower from El 566' to El 560'.

Under such circumstances the submergence on the SW pumps will be two feet more than recommended by the SW pump manufacturer. This level is well above that which could cause difficulty.

An earthquake-generated seiche in Lake Michigan has been considered by assuming the occurrence of the Design Basis Earthquake, a shallow focus Intensity VII event, near Lake Michigan. The magnitude of seiche effects at the site was estimated by methods proposed by Iida (Reference 25) and Wilson (Reference 26), and by research of historical data. The calculational methods indicate the seiche caused by the earthquake would be on the order of one foot or less. The research of historical data (Reference 27) indicates an Intensity VII earthquake would produce a barely perceptible surge at the site. On this basis, it is considered there would be no adverse effects on structures from this phenomenon, and wind-generated surge would be controlling at the site.

2.4.6 Ice Effects

The water intakes and discharges for Zion Station have been designed so as not to be obstructed by wind-driven ice. Design provisions include the following:

1. The top of the intake structure is approximately 13 to 6 feet under water (dependent upon monthly high and low water levels). Also, the intake is located 2600 feet from shore. At this distance from shore, and with the depth indicated, we do not expect windrows to cause a problem.

2. The top of the intake has 12 sides and, therefore, has a circular effect on any object floating at that level. In the unlikely event that a windrow extends down to the top of the intake, it would be deflected. The "circular" top acts to prevent total obstruction.

3. The intake is surrounded by a circular thawing box, which, under winter conditions, is used to recirculate a portion of the warmed effluent to the intake while the remainder of the water leaving the thawing box has a warming effect in the immediate vicinity of the intake. This water distribution will prevent the formation of frazil ice and will tend to melt floating ice in the immediate area. It should also melt down any windrow to some degree before it is deflected away.

4. In winter it is expected about one-half of the warm discharge water will leave the thawing ring as described in Item 3 above. The remainder of the effluent water will leave the conventional discharge, located 760 feet from shore at a depth of from 4 to 12 feet, dependent upon lake water level. The combination of the staggered discharge openings, the arrangement of the openings (most of which are oriented perpendicular to the shoreline), and the fact the water is leaving (not entering) the discharge openings will preclude the possibility of obstructing the discharge.

2.4.7 Dispersion, Dilution, and Travel Times of Accidental Releases of Liquid Effluents in Surface Waters

2.4.7.1 General

Water from Lake Michigan is extensively used for municipal and domestic water supplies. All liquid waste discharged will be less than permitted under 10CFR20 in the cooling water outfall. Thus, any radioactive releases from the site into the lake will be diluted below levels permitted under 10CFR20 for unrestricted areas before it reaches the nearest water supply intake. As previously stated, the nearest potable water intake is located about one mile north of the site and 3000 feet out in the Lake.

The cooling water is discharged through two discharge structures (1 per unit) located 308 feet apart, and 760 feet from shore. The design of the structures is shown on Figure 2-16. Outlets are located at 45° from the shoreline and in a direction to divert the water away from the inlet. The inlet is located between the two discharge structures. These discharge openings are located slightly above the bottom of the lake and discharge water at a velocity of approximately 8.5 feet per second. The diffusion studies made for Zion are presented in Section 2.3.3 of the Zion Environmental Report.

Radioactive contamination of the plant cooling water can occur in two modes. The first is by an intermittent controlled release of small amounts of activated corrosion products and fission products into the cooling water stream. The second type of radioactivity release is assumed to be an instantaneous discharge which could only result from a series of operating errors and equipment failures, the combination of which is not considered credible.

As described in Chapter 4, and supported by operating reactor plant data, the radioactive liquid waste treatment facility is capable of maintaining radionuclide concentrations in the effluent below those permitted under 10CFR20 for instantaneous and intermittent controlled releases.

2.4.7.2 Temperature Alterations

The effect of temperature alterations to Lake Michigan as a result of the circulating water discharge has been determined to be non-impacting to the lake ecology. Reference 28 discusses the exact effect upon the lake.

2.4.8 Groundwater

The groundwater table in the area is close to the ground surface, and has a flat gradient to the east and south.

Ordinarily there will be no municipal uses of potable groundwater in the Benton or Waukegan townships. Two older wells in Zion, with depths of 1025 feet and 220 feet, and one well in Winthrop Harbor, with a depth of 130 feet, are maintained on a standby basis to meet emergencies (Reference 17).

Zion's two deep wells are 1100 and 1025 feet deep, respectively; they derive water under artesian conditions from Trempealeau Dolomites. The radius of the core of their influence is estimated to be approximately 4,000 feet. These wells are located approximately 1½ miles west of the plant site. Winthrop Harbor's two shallow wells are 130 and 138 feet deep; they derive water from Niagaran Dolomites. The core radius of their influence is estimated to be approximately 500 feet. The wells are located approximately 12,000 feet away. The radius of the core of influence of other domestic wells drawing water from the upper 30 feet thick sand stratum is well within 500 feet. Table 2-19 and Figure 2-17 furnish the details of recorded wells within one mile of the site.

Considering the locations of the wells and the topographical divide which causes surface water to drain to the east, contamination of ground water supplies is unlikely. No pathways for radioactive materials such as wells, old unsealed bore holes, etc., were detected in a survey of the power plant area. Commonwealth Edison Company will monitor any plans for municipal water development in the area of influence.

Intermittent liquid effluents from the site will not affect ground water supplies in the adjacent area in excess of 10CFR20 due to local drainage patterns, release rates, and specific features of the sources of water supplies.

2.5 GEOLOGY, SEISMOLOGY AND GEOTECHNICAL ENGINEERING

2.5.1 Basic Geologic and Seismic Information

The site is located on the shore of Lake Michigan in the extreme eastern portion of the city of Zion, Illinois, and occupies portions of Sections 22, 23, 26 and 27 in Township 46 North, Range 23 East.

Marshy depressions and sand ridges comprise the principal surface features. The uppermost soils at the site consist predominantly of granular lake depositions. These sediments are underlain by glacial drift which consists of till, outwash, and lake deposits. Beneath the glacial soils, Paleozoic sedimentary rocks extend for several thousand feet to the depth of the crystalline Precambrian basement rock.

There are no cut and fill slopes at the Zion site.

There is no evidence of faulting closer than the Des Plaines disturbance, located approximately 25 miles southwest of the site. Other inactive faults exist at a distance of about 45 miles to the northwest and 75 miles to the southwest.

The geology of the area indicates that the strata underlying the site is capable of supporting loads at least as high as that required for the station structures. Consequently, no problems or restrictions beyond normal design practice were anticipated.

The region within 100 miles of the site is considered an area of minor seismic activity and has experienced a few earthquake events of moderate magnitude during the last 150 to 200 years. Structures built on adequate foundation materials at the site are designed for horizontal ground accelerations as defined in Section 2.5.2.2. Detailed studies performed to evaluate the probable ground accelerations and to prepare dynamic response criteria appropriate for the site are reported in Appendix B to the PSAR.

The principal sources of data are given in References 29 through 50.

2.5.1.1 Geological Program

A detailed geological investigation of the site has been performed. The scope of the geological program consists of:

1. A review of pertinent published literature and unpublished data, and discussions with local geologist, in order to describe the geology of the region and the site.

2. A test boring and laboratory testing program to identify predominant soil and rock types and to evaluate pertinent physical and chemical properties of the soils and rock.

3. Field observations to determine the depth and gradient of the groundwater table at the site.

4. An analysis to evaluate the ability of the geologic substrata to support the anticipated building loads.

The results of item 1 and 3, the test borings, and a portion of the laboratory testing listed under item 2 are presented in this report and Appendix B to the Zion PSAR.

The possibility of liquefaction of soil layers supporting Class I structures was evaluated in accordance with methods proposed by Seed and Idriss (Reference 51) which utilize standard penetration resistance as an index of soil relative density. Considering standard penetration resistance in excess of 30 blows per foot, water table at a depth of 5 feet, maximum ground surface acceleration during the Design Basis Earthquake (DBE) equal to 0.17g, and depth of susceptible soils equal to approximately 30 feet, it can be concluded that there is a significant margin of safety against liquefaction of soils below or adjacent to Class I structures.

The possibility of settlement due to the densification of soil strata supporting Class I structures during a DBE was also considered. Because of the high relative densities of the sand, as indicated by standard penetration resistance in excess of 30 blows per foot, as reported in the PSAR, essentially no settlement due to densification is anticipated.

2.5.1.2 Seismology Program

A seismological investigation of the site has been performed. The seismological program consists of:

1. An evaluation of the seismic history of the site.

2. A study of geologic faulting as related to earthquake activity.

3. The field and laboratory measurement of the dynamic response characteristics of soil and rock strata underlying the site.

4. The postulation of an Operating Basis Earthquake (OBE) and a DBE.

Data which pertains to the seismic history of the region are presented in this section. The results of the remainder of the seismological program are reported in Appendix B to the Zion PSAR.

2.5.1.3 Regional Geology

General

Bedrock in the region consists of Paleozoic sedimentary rocks which rest on the Precambrian basement rock. The thickness of the Paleozoic sedimentary rocks in northeastern Illinois is approximately 4,000 feet. The bedrock dips gently toward the east at a rate of about 10 feet per mile.

The bedrock surface in the northeastern Illinois region is covered by a thick mantle of glacial drift, formed when most of Wisconsin, Illinois, and the adjacent areas were subjected to repeated glaciation during the Pleistocene epoch. The advancing glaciers scoured major stream valleys and formed the large depressions now occupied by the Great Lakes. The glacial drift deposited by the glaciers consisted of till, outwash, and lacustrine deposits. Recent deposits in the region consist of unconsolidated sand, silt and peat.

2.5.1.4 Site Geology

Site Conditions

The site is located on a narrow strip of lake deposits which borders the Lake Michigan shoreline. Crossing the site is a series of low parallel, beach ridges separated by marshy depressions. The beach ridges are composed primarily of sand. In the depressions, organic materials have accumulated.

The subsurface conditions at the site were investigated by drilling seven exploration test borings at the locations shown on Figure 2-18. The test borings revealed that the site is blanketed by granular lake deposits which range in thickness from 24 to 33 feet. The granular lake deposits consist of fine, and fine to medium sand which contains variable amounts of coarse sand and gravel, and occasional pockets of peat and organic material. The granular lake deposits are underlain by Pleistocene glacial till, glacial outwash, and glacial lacustrine deposits. The glacial deposits consist essentially of silty clays, clayey silts, and silt, contain variable amounts of sand and gravel, contain pockets of granular outwash, and extend to depth ranging from approximately 102 to 116 feet below the existing ground surface. The glacial tills and glacial lacustrine deposits are firm to hard and are relatively impermeable. A detailed description of the subsurface conditions at the site is presented in Figure 2-19 through 2-25.

The Pleistocene soils rest unconformably on Niagara Dolomite of Silurian age. The Niagara Dolomite, penetrated by our test borings, is pitted, contains small solution cavities (vugs) and pyrite crystals, and is generally moderately fractured. The degree of fracturing varies and is indicated on the log of borings. Coraline fossils are abundant, and attest to the reef origin of a large part of the Niagara Formation in this area. Although no large solution cavities were encountered in the drilling program, they have been found elsewhere in the upper zones of this formation. These large solution cavities have usually been filled with clays and sand. The Niagara Dolomite was the only bedrock formation encountered within the depths of our drilling program at the site.

The Niagara Dolomite, at the site, is approximately 250 feet thick and dips gently to the east towards the Michigan Basin. The lower bedrock formations consist predominantly of sandstone and dolomite with subordinate layers of shale and siltstone, are several thousand feet in thickness, and are underlain by crystalline Precambrian basement rock. The thickness and age relationship of the various bedrock units and surficial deposits of the region are presented in Table 2-20.

Table 2-21 provides the elevations of all Class I structures relative to the elevations of different foundation soil levels at the site.

Groundwater

Groundwater is near the surface over much of the site area. Ground water levels at the boring locations are shown on the log of borings. The beach ridges project slightly above the water table, and most of the intervening depressions are marshy and are at or slightly below the water table. A very slight groundwater gradient trends to the east and south. A stagnant condition now generally prevails between the beach ridges.

Shoreline Modifications

An environmental characteristic of the site is minor shoreline modification. The rate of change in the position of the shoreline is due to lake level fluctuations, currents, wave actions, storm conditions and the nature of the shoreline sediments.

The shoreline of Lake Michigan along the east side of the Zion site has moved approximately 100 feet during the 83 years from 1872 to 1955. The movement of the shoreline is a result of a combination of approximately 50 feet of aggradation along the north half of the site and less than 100 feet of degradation in the form of shoreline erosion, in the south half of the site. The tendency during this period has been to "smooth-out" the irregularities of the shoreline to an equilibrium position. This equilibrium condition exists at the present time as evidenced by the minimal shoreline movement during the last 20 years.

The general movement of wind-driven current sand is from north to south. When Commonwealth Edison Company built a breakwater at its Waukegan Generating Station during the period 1928 to 1938, sand accretion built up the shoreline out into the lake as much as 1000 feet from its original position. The Zion shore, however, is not affected by artificial barriers and therefore will move little. Sand erosion has been easily stopped by the construction of groins or jetties, and by the use of rip-rap.

2.5.2 Vibratory Ground Motion

2.5.2.1 Seismicity

Northeastern Illinois is considered an area of minor seismic activity. King's distribution of epicenters contours the area as having approximately three epicenters per 10,000 square kilometers, a figure near the lower levels of his classification. The Seismic Zone Map of the United States prepared by the U.S. Department of Defense, dated 1966, also indicates that the area is a zone of minor seismic probability. The site itself is free of known seismic disturbance.

Since the beginning of the l9th century, two earthquakes with epicentral intensities of VII, Modified Mercalli Intensity Scale of 1931, are known within a distance of 60 miles of the site. The first of these earthquakes, near Fort Dearborn, Illinois, occurred in 1808 at an epicentral distance of approximately 35 miles from the site. The second occurred in 1909 north of the Illinois-Wisconsin border near Beloit, Wisconsin, at an epicentral distance approximately 60 miles from the site. Including the earthquakes described above, three earthquakes are known within a distance of 50 miles with epicentral intensities ranging from III to VII, and nine earthquakes have been recorded within 100 miles with epicentral intensities ranging from II to VII. In addition to these, a few very great, but distant earthquakes may have been felt at the site, but with very low intensity.

A tabulation of earthquakes having epicenters in Illinois and Wisconsin, together with certain out-of-state earthquakes felt in Illinois, is presented in Table 2-22. The regional earthquake events are shown on Figure 2-26. Earthquake intensities are described in terms of the Modified Mercalli Intensity Scale of 1931, which is explained in Table 2-23.

2.5.2.2 Design Basis Earthquake

Earthquake design is based on ordinary allowable stresses as set forth in applicable codes. See Chapter 3 for further information.

2.5.3 Surface Faulting

The site is located near the center of the Central Lowland Physiographic Province. The dominant structural feature of the area is the Kankakee Arch which separates the Michigan Basin to the northeast from the Illinois Basin to the south. The La Salle Anticline to the southwest of the site forms the northern side of the Illinois Basin and is believed to be Pre-Pennsylvanian in age.

A series of minor folds whose axes pitch eastward have been traced through all of the bedrock formations present. This system of folds which begins near the site and extends to the Sandwich fault area appears to be Silurian or younger in age.

Several faults are known in the region. The Sandwich Fault zone extends eastward into Will County from the town of Sandwich in De Kalb County. Faulting in the area is quite complex, but movement has been generally down on the north side of these structures. Twenty miles north of the Sandwich Fault and parallel to it, another fault has been inferred on the basis of dislocations of the lower Paleozoic sediments and the Precambrian basement. Near Des Plaines, approximately 25 miles southwest of the site, a highly complex faulted zone exists which appears to bear no relationship to the regional structure. The zone is roughly circular and covers an area of 25 square miles. Within the faulted zone, the bedrock generally has been upthrown. Some faulting also exists in southern Wisconsin and the closest known fault in southern Wisconsin is approximately 45 miles from the site and has a northeast orientation. There is no evidence of recent activity along any of the faults that are known in the area.

2.6 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The Radiological Environmental Monitoring Program (REMP) being conducted in the vicinity of the station has as its objectives:

1. Provide data on measurable levels of radiation and radioactivity in the environment and relate these data to radioactive emissions;

2. Identify changes in the use of nearby offsite areas to assure adequate surveillance and evaluation of doses to individuals from principal pathways of exposure;

3. Provide environmental surveillance in case of an unplanned release; and

4. Provide year round monitoring of principal pathways of exposure.

The REMP provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of members of the public resulting from the facility operation. This monitoring program implements Section IV.b.2 of Appendix I to 10CFR50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of effluent measurements and the modeling of the environmental exposure pathways.

The site specific annex of the Offsite Dose Calculation Manual (ODCM) describes the current REMP and presents the required detection capabilities for environmental sample analyses tabulated in terms of the a priori minimum detectable concentration (MDC). The a priori MDC is a before-the-fact limit representing the capability of a measurement system and is not an after the fact limit for a particular measurement.

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TABLE 2-1

POPULATION
WITHIN 10 MILES OF THE SITE

Radial Distances – Miles (From Center of Containment)	Local Censuses 1980
0 to 1	289
0 to 2	15,506
0 to 3	28,182
0 to 4	32,644
0 to 5	39,243
0 to 10	234,180
0 to 1	289
1 to 2	15,217
2 to 3	12,676
3 to 4	4462
4 to 5	6599
5 to 10	194,937

TABLE 2-2

POPULATION CENTERS OF 25,000 INHABITANTS
WITHIN 10 MILES OF THE SITE

Community	Distance to the Center and Direction From the Site	Population (1980 Census)
Waukegan, IL	7 miles S	67,653
Kenosha, WI	9 miles N	77,685
North Chicago, IL	7 miles S	38,774

TABLE 2-3

METEOROLOGICAL EXTREMES

VARIABLE	CHICAGO	MILWAUKEE
Highest Temperature	105°F (July 1934)	105°F (July 1934)
Lowest Temperature	-26°F (January 1982)	-25°F (January 1875)
Greatest Monthly Precipitation	14.17 in. (September 1961)	10.03 in. (June 1917)
Greatest 24-Hour Precipitation	6.24 in. (July 1957)	5.76 in. (June 1917)
Greatest Monthly Snowfall	42.5 in. (January 1918)	52.6 in. (January 1918)
Greatest 24-Hour Snowfall	23.0 in. (January 1967)	20.3 in. (February 1924)
Highest Wind Speed	NE 87 mph (February 1894)	SW 73 mph (March 1954)

TABLE 2-4 (1 of 2)
35 ft. Wind Speed and Direction (January 1, 1980 – December 31, 1980)

CECO ZION NUCLEAR POWER STATION   JANUARY 1, 1980 - DECEMBER 31, 1980
35 FT WIND SPEED AND DIRECTION   STABILITY BASED ON 250-35 FT DELTA T
NUMBER OF OBSERVATIONS = [illegible]

SPEED CLASS		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	EU	MU	SU	N	SS	MS	ES	TOTAL
1-3	EU	0.02	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.05	0.02	0.01	0.05	0.10	0.03	0.36	0.36							
	MU	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.02	0.01	0.01	0.06	0.15		0.15						
	SU	0.01	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.05	0.02	0.01	0.02	0.03	0.05	0.03	0.30			0.30					
	N	0.14	0.19	0.07	0.10	0.01	0.03	0.05	0.09	0.04	0.09	0.10	0.08	0.16	0.08	0.21	0.20	1.67				1.67				
	SS	0.18	0.16	0.08	0.14	0.15	0.17	0.14	0.14	0.21	0.35	0.10	0.24	0.19	0.12	0.57	0.12	3.60					3.60			
	MS	0.16	0.10	0.05	0.02	0.01	0.06	0.16	0.10	0.21	0.16	0.19	0.28	0.21	0.23	0.21	0.14	2.33						2.33		
	ES	0.07	0.01	0.05	0.01	0.02	0.05	0.03	0.03	0.04	0.23	0.09	0.07	0.15	0.21	0.09	0.07	1.29							1.29	9.78
4-7	EU	0.07	0.11	0.29	0.16	0.32	0.25	0.20	0.23	0.09	0.25	0.19	0.22	0.43	0.96	1.12	0.03	5.74	5.74							
	MU	0.09	0.07	0.11	0.09	0.03	0.05	0.12	0.15	0.09	0.09	0.12	0.13	0.11	0.28	0.46	0.34	2.39		2.39						
	SU	0.19	0.15	0.14	0.23	0.07	0.08	0.19	0.10	0.21	0.14	0.23	0.19	0.28	0.44	0.56	0.60	3.75			3.75					
	N	0.66	0.57	0.60	0.12	0.17	0.21	0.41	0.56	1.03	0.58	0.50	0.61	0.71	0.90	1.54	1.05	10.64				10.64				
	SS	0.84	0.61	0.21	0.28	0.23	0.24	0.39	0.35	1.60	1.24	1.02	0.60	0.69	1.06	1.34	0.57	11.39					11.39			
	MS	0.27	0.09	0.09	0.07	0.09	0.09	0.16	0.15	0.79	0.52	0.71	0.61	0.50	0.62	0.25	0.05	5.06						5.06		
	ES	0.09	0.01	0.02	0.01	0.03	0.07	0.07	0.08	0.69	0.42	0.21	0.31	0.38	0.10	0.12	0.00	2.83							2.83	41.80
8-12	EU	0.57	1.01	0.61	0.27	0.21	0.05	0.24	0.16	0.32	0.61	0.54	0.75	1.17	1.40	1.40	1.20	10.31	10.31							
	MU	0.25	0.29	0.71	0.03	0.08	0.07	0.02	0.16	0.09	0.22	0.14	0.19	0.27	0.27	0.16	0.52	2.97		2.97						
	SU	0.39	0.38	0.13	0.08	0.06	0.02	0.08	0.24	0.16	0.21	0.54	0.29	0.49	0.40	0.38	0.56	4.41			4.41					
	N	1.28	0.80	0.27	0.09	0.22	0.02	0.08	0.40	0.51	0.33	0.98	0.61	1.09	0.79	0.73	0.61	9.17				9.17				
	SS	0.19	0.27	0.08	0.05	0.08	0.08	0.06	0.28	0.35	0.21	0.31	0.47	0.69	0.10	0.05	0.03	3.55					3.55			
	MS	0.01	0.03	0.00	0.00	0.01	0.02	0.01	0.14	0.35	0.00	0.05	0.12	0.03	0.00	0.00	0.00	0.79						0.79		
	ES	0.01	0.01	0.00	0.00	0.02	0.01	0.00	0.01	0.20	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.29							0.29	31.89
13-18	EU	0.81	0.56	0.10	0.12	0.16	0.08	0.10	0.27	0.10	0.32	0.68	0.29	0.13	0.34	0.28	0.42	5.30	5.30							
	MU	0.21	0.19	0.12	0.03	0.01	0.02	0.01	0.14	0.10	0.08	0.11	0.06	0.06	0.05	0.02	0.07	1.47		1.47						
	SU	0.56	0.11	0.07	0.08	0.12	0.10	0.10	0.23	0.05	0.13	0.24	0.05	0.22	0.09	0.06	0.13	2.36			2.36					
	N	0.97	0.21	0.16	0.07	0.14	0.05	0.09	0.28	0.01	0.40	0.57	0.29	0.10	0.01	0.00	0.02	3.58				3.58				
	SS	0.06	0.09	0.01	0.01	0.03	0.01	0.07	0.07	0.03	0.01	0.01	0.09	0.03	0.00	0.00	0.00	0.45					0.45			
	MS	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.10						0.10		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	13.34
19-24	EU	0.14	0.24	0.15	0.15	0.05	0.25	0.00	0.06	0.02	0.15	0.08	0.03	0.17	0.05	0.01	0.06	1.55	1.55							
	MU	0.07	0.09	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.07	0.06	0.00	0.01	0.00	0.00	0.29		0.29						
	SU	0.10	0.06	0.01	0.00	0.00	0.01	0.00	0.03	0.00	0.03	0.03	0.01	0.02	0.00	0.00	0.00	0.30			0.30					
	N	0.06	0.01	0.01	0.03	0.00	0.02	0.00	0.03	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.28				0.28				
	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01					0.01			
	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	2.43
25-31	EU	0.06	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.26	0.26							
	MU	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.09		0.09						
	SU	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.07			0.07					
	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.42

TABLE 2-4 (2 of 2)
35 ft. Wind Speed and Direction (January 1, 1980 – December 31. 1980)

CECO ZION NUCLEAR POWER STATION JANUARY 1, 1980 - DECEMBER 31, 1980
35 FT WIND SPEED AND DIRECTION STABILITY BASED ON 250-35 FT DELTA T

SPEED	CLASS	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	FU	MU	SU	N	SS	MS	ES	TOTAL
	FU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
1	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
2	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
-	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
1	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
4	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.00
	FU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
3	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
5	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
-	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
4	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
6	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.00
	FU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
G	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
T	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
4	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
6	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.00
	FU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
C	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
A	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
L	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
M	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.00
	TOT	8.83	6.48	3.78	2.42	2.44	2.16	2.78	4.73	3.96	7.32	8.33	6.78	9.24	9.00	9.75	7.66	99.66	24.00	7.36	11.19	25.34	19.08	8.28	4.41	99.66
S	FU	1.70	2.01	1.22	0.72	0.76	0.64	0.54	0.92	0.53	1.33	1.54	1.30	2.54	2.80	2.91	2.54	24.00								
U	MU	0.65	0.65	0.49	0.14	0.18	0.14	0.15	0.46	0.27	0.41	0.59	0.47	0.55	0.62	0.65	0.94	7.36								
M	SU	1.75	0.73	0.37	0.40	0.26	0.23	0.33	0.63	0.43	0.56	1.06	0.58	1.09	0.96	1.05	1.32	11.19								
-	N	3.11	1.73	1.11	0.56	0.54	0.39	0.69	1.36	1.76	1.85	2.21	1.59	2.27	1.78	2.51	1.88	25.34								
T	SS	1.51	1.04	0.38	0.48	0.49	0.45	0.61	0.84	2.61	1.83	1.64	1.45	1.55	1.48	1.96	0.72	19.08								
O	MS	0.44	0.21	0.14	0.10	0.14	0.18	0.16	0.42	1.38	0.69	0.95	1.01	0.74	0.85	0.46	0.19	8.28								
T	ES	0.17	0.05	0.07	0.02	0.07	0.13	0.10	0.12	0.98	0.65	0.34	0.38	0.54	0.51	0.21	0.07	4.41								

TABLE 2-5 (1 of 2)
35 ft. Wind Speed and Direction (January 1, 1972 – December 31, 1980)

ZION NUCLEAR POWER STATION — JANUARY 1, 1972 - DECEMBER 31, 1980
35 FT WIND SPEED AND DIRECTION — STABILITY BASED ON 250-35 FT DELTA T

SPEED CLASS		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	EU	MU	SU	N	SS	[illegible]	[illegible]	[illegible]
	EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
1	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
7	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
-	N	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01				0.01				
3	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
8	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.01
	EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
3	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
9	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
-	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
4	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
6	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.00
	EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
G	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
T	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
4	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
6	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.00
	EU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00						
C	SU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			0.00					
A	N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				0.00				
L	SS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00			
M	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.00
TOT		6.02	7.24	4.21	3.00	2.85	2.70	3.57	4.39	7.97	7.51	9.52	8.79	9.73	7.95	8.43	6.11	100.05	14.99	3.98	6.83	31.49	28.21	9.07	5.48	100.05
S	EU	0.82	1.72	0.86	0.58	0.46	0.48	0.58	0.61	0.62	0.64	1.18	1.26	1.52	1.25	1.47	0.94	14.99								
U	MU	0.25	0.41	0.21	0.11	0.14	0.12	0.14	0.15	0.14	0.21	0.39	0.35	0.37	0.32	0.35	0.32	3.98								
B	SU	0.43	0.65	0.35	0.20	0.23	0.23	0.27	0.30	0.31	0.29	0.62	0.61	0.68	0.54	0.58	0.54	6.83								
-	N	2.11	2.59	1.67	1.70	0.98	0.82	1.00	1.37	1.66	2.06	3.04	2.83	3.06	2.26	2.57	2.05	31.49								
T	SS	1.74	1.54	0.88	0.65	0.78	0.69	0.99	1.34	2.80	2.61	2.79	2.29	2.58	2.22	2.49	1.76	28.21								
O	MS	0.11	0.25	0.15	0.15	0.17	0.21	0.18	0.42	1.34	1.03	1.00	0.93	0.86	0.76	0.66	0.43	9.07								
T	ES	0.12	0.08	0.09	0.11	0.09	0.15	0.21	0.20	1.10	0.61	0.50	0.52	0.66	0.60	0.11	0.07	5.48								

TABLE 2-5 (2 of 2)
35 ft. Wind Speed and Direction (January 1, 1972 – December 31, 1980)

ZION NUCLEAR POWER STATION JANUARY 1, 1972 - DECEMBER 31, 1980
35 FT WIND SPEED AND DIRECTION STABILITY BASED ON 250-35 FT DELTA T
NUMBER OF OBSERVATIONS = 71311

SPEED CLASS		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	EU	MU	SU	N	SS	MS	ES	TOTAL
.7-3	EU	0.02	0.02	0.01	0.02	0.02	0.02	0.07	0.00	0.02	0.01	0.01	0.02	0.01	0.01	0.07	0.04	0.16	0.16							
	MU	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.11		0.11						
	SU	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.00	0.01	0.01	0.03	0.01	0.17			0.17					
	N	0.09	0.07	0.07	0.07	0.01	0.02	0.06	0.05	0.08	0.10	0.06	0.06	0.10	0.07	0.13	0.09	1.15				1.15				
	SS	0.24	0.11	0.07	0.04	0.11	0.09	0.10	0.09	0.17	0.25	0.25	0.20	0.13	0.23	0.37	0.14	2.65					2.65			
	MS	0.08	0.06	0.03	0.07	0.02	0.05	0.10	0.09	0.13	0.15	0.15	0.20	0.17	0.19	0.17	0.10	1.70						1.70		
	ES	0.04	0.02	0.02	0.02	0.02	0.04	0.03	0.07	0.08	0.17	0.11	0.09	0.13	0.17	0.10	0.03	1.09							1.09	7.03
4-7	EU	0.10	0.20	0.29	0.25	0.26	0.29	0.40	0.29	0.30	0.16	0.17	0.27	0.38	0.44	0.62	0.31	4.73	4.73							
	MU	0.04	0.05	0.08	0.06	0.06	0.06	0.08	0.07	0.07	0.05	0.07	0.07	0.09	0.13	0.15	0.10	1.23		1.23						
	SU	0.06	0.12	0.14	0.09	0.09	0.11	0.16	0.11	0.14	0.09	0.11	0.16	0.15	0.17	0.23	0.22	2.15			2.15					
	N	0.57	0.69	0.56	0.33	0.34	0.35	0.57	0.65	0.81	0.64	0.74	0.80	0.91	0.93	1.26	0.78	10.97				10.97				
	SS	0.86	0.65	0.44	0.31	0.35	0.34	0.64	0.70	1.75	1.65	1.26	1.10	1.41	1.47	1.73	1.16	15.90					15.90			
	MS	0.21	0.14	0.09	0.09	0.10	0.12	0.23	0.19	0.85	0.83	0.79	0.69	0.63	0.55	0.40	0.33	6.30						6.30		
	ES	0.00	0.05	0.06	0.04	0.03	0.08	0.14	0.10	0.66	0.40	0.37	0.40	0.52	0.43	0.21	0.04	3.70							3.70	44.98
8-12	EU	0.20	0.69	0.39	0.19	0.11	0.08	0.14	0.72	0.25	0.22	0.45	0.54	0.64	0.56	0.62	0.40	5.78	5.78							
	MU	0.08	0.20	0.09	0.07	0.03	0.01	0.03	0.05	0.05	0.08	0.12	0.17	0.16	0.11	0.15	0.15	1.54		1.54						
	SU	0.14	0.28	0.12	0.04	0.05	0.04	0.07	0.12	0.10	0.09	0.27	0.24	0.29	0.26	0.25	0.22	2.58			2.58					
	N	0.89	0.94	0.43	0.29	0.26	0.22	0.27	0.48	0.55	0.71	1.14	1.19	1.21	0.90	0.93	0.87	11.26				11.26				
	SS	0.45	0.57	0.21	0.11	0.16	0.15	0.17	0.40	0.71	0.55	0.91	0.71	0.80	0.45	0.36	0.39	7.07					7.07			
	MS	0.02	0.04	0.02	0.07	0.04	0.03	0.05	0.12	0.34	0.05	0.05	0.07	0.06	0.02	0.01	0.00	0.94						0.94		
	ES	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.06	0.11	0.07	0.02	0.01	0.01	0.00	0.00	0.00	0.56							0.56	29.73
13-18	EU	0.32	0.67	0.12	0.07	0.06	0.05	0.02	0.08	0.04	0.16	0.41	0.36	0.40	0.20	0.16	0.17	3.24	3.24							
	MU	0.10	0.12	0.03	0.02	0.03	0.07	0.02	0.03	0.02	0.05	0.15	0.08	0.09	0.05	0.04	0.05	0.90		0.90						
	SU	0.16	0.17	0.05	0.04	0.05	0.05	0.03	0.06	0.04	0.07	0.17	0.16	0.19	0.09	0.07	0.09	1.49			1.49					
	N	0.62	0.61	0.40	0.26	0.21	0.17	0.08	0.15	0.16	0.49	0.85	0.62	0.64	0.12	0.23	0.29	6.12				6.12				
	SS	0.16	0.21	0.11	0.09	0.11	0.09	0.07	0.12	0.14	0.19	0.28	0.18	0.21	0.07	0.03	0.06	2.14					2.14			
	MS	0.00	0.01	0.01	0.02	0.01	0.01	0.00	0.03	0.02	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.13						0.13		
	ES	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.02	0.05	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.13							0.13	14.15
19-24	EU	0.08	0.16	0.04	0.03	0.01	0.04	0.00	0.02	0.01	0.09	0.10	0.05	0.07	0.02	0.00	0.02	0.74	0.74							
	MU	0.02	0.04	0.01	0.00	0.02	0.01	0.00	0.00	0.00	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.18		0.18						
	SU	0.05	0.07	0.02	0.01	0.01	0.02	0.00	0.00	0.02	0.02	0.04	0.04	0.04	0.01	0.00	0.00	0.37			0.37					
	N	0.18	0.21	0.17	0.18	0.09	0.05	0.02	0.04	0.04	0.11	0.21	0.16	0.14	0.04	0.02	0.02	1.70				1.70				
	SS	0.01	0.04	0.02	0.03	0.05	0.02	0.01	0.03	0.01	0.01	0.08	0.03	0.01	0.00	0.00	0.01	0.42					0.42			
	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	3.41
25-31	EU	0.02	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.00	0.00	0.00	0.14	0.14							
	MU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.02		0.02						
	SU	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.07			0.07					
	N	0.01	0.02	0.04	0.01	0.02	0.01	0.00	0.00	0.00	0.01	0.02	0.03	0.02	0.00	0.00	0.00	0.28				0.28				
	SS	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03					0.03			
	MS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00						0.00		
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							0.00	0.54

TABLE 2-6

PASQUILL STABILITY CLASSIFICATIONS VS TEMPERATURE LAPSE RATE

INDEX	RANGE (°c/100M)	DESCRIPTION
1(A)	$\Delta T < -10.3$	Extremely Unstable
2(B)	$-10.3 \leq \Delta T < -9.3$	Unstable
3(C)	$-9.3 \leq \Delta T < -8.3$	Slightly Unstable
4(D)	$-8.3 \leq \Delta T < -2.6$	Neutral
5(E)	$-2.6 \leq \Delta T < 8.9$	Slightly Stable
6(F)	$8.9 \leq \Delta T < 20.4$	Stable
7(G)	$20.4 \leq \Delta T$	Extremely Stable

TABLE 2-7 (1 of 3)

Wind Speed Distribution vs. Temperature Lapse Rate-Stability Class (1970)

COMM. ED. CO. ZION STATION (35 FT LEVEL) WIND DATA 1970

DIRECTION SSW

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.14	.02	.04	.04	.11	.02	0.00
3 TO 4	.07	.04	0.00	.16	.13	.09	.11
5 TO 6	.33	.04	.04	.13	.50	.24	.09
7 TO 8	.15	.07	.09	.29	.13	.02	.02
9 TO11	.71	.07	.11	.18	.11	.02	.04
12TO14	.49	.04	.04	.13	.02	.02	0.00
15TO18	.73	.20	.09	.11	.04	0.00	.02
19TO23	.33	.04	0.00	.07	0.00	0.00	0.00
GT 23	.11	.07	0.00	.02	0.00	0.00	0.00

DIRECTION SW

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.31	.02	.67	.67	.16	.07	.02
3 TO 4	.44	.62	.13	.20	.18	.16	.13
5 TO 6	.18	.07	.04	.36	.31	.20	.11
7 TO 8	.33	.07	.11	.31	.20	.04	.04
9 TO11	.51	.07	.11	.33	.11	.02	0.00
12TO14	.47	.13	.11	.29	.09	.02	0.00
15TO18	.67	.16	0.00	.04	0.00	.02	0.00
19TO23	.09	0.00	.02	0.00	0.00	0.00	0.00
GT 23	.04	0.00	0.09	0.00	.02	0.00	0.00

DIRECTION WSW

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.40	0.00	.67	.04	.02	.04	.04
3 TO 4	.31	.07	.02	.31	.18	.07	.09
5 TO 6	.46	.02	.11	.38	.40	.24	.09
7 TO 8	.38	.07	.02	.24	.18	.02	0.00
9 TO11	.64	0.00	.11	.60	.22	0.00	0.00
12TO14	.60	.02	0.00	.07	.07	0.00	0.00
15TO18	.58	.09	.04	.02	.09	.02	0.00
19TO23	.84	.02	0.00	0.00	0.00	0.00	0.00
GT 23	.09	0.00	.02	.07	.02	0.00	0.00

DIRECTION W

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.27	.02	.04	.04	.13	.09	.02
3 TO 4	.33	.12	.04	.09	.11	.07	.24
5 TO 6	.98	.97	.07	.11	.43	.11	.36
7 TO 8	.73	.09	.16	.62	.49	.16	.11
9 TO11	.95	.04	.77	.42	.31	.13	.42
12TO14	.49	.16	.04	.24	.13	0.00	0.00
15TO18	.44	.04	0.00	.11	[illegible]	.02	0.00
19TO23	.55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00
GT 23	.58	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 2-7 (2 of 3)

Wind Speed Distribution vs. Temperature Lapse Rate-Stability Class (1970)

COMM. ED. CO.. ZION STATION (35 FT LEVEL) WIND DATA 1970

DIRECTION WNW

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	[illegible]	0.00	.04	.07	.01	.02	.01
3 TO 4	.40	.47	.02	0.00	.14	.01	.22
5 TO 6	.73	.32	.04	.13	.22	.10	.22
7 TO 8	.07	.04	0.00	.11	.36	.09	0.00
9 TO 11	.95	.07	.02	.02	.07	.04	.04
12 TO 14	.58	.04	.04	.02	0.00	0.00	0.00
15 TO 18	.38	0.00	.02	0.00	0.00	0.00	0.00
19 TO 23	.31	0.00	0.00	.02	.02	0.00	0.00
GT 23	.04	0.00	0.00	0.00	0.00	0.00	0.00

DIRECTION NW

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.16	0.00	0.00	.07	.02	.02	.09
3 TO 4	.40	.11	.07	.09	.36	.13	.27
5 TO 6	.75	.02	.07	.29	.27	.10	.24
7 TO 8	.91	.02	.04	.04	.04	.04	.02
9 TO 11	.82	.13	0.00	.07	.02	.02	.02
12 TO 14	.75	.04	0.00	0.00	0.00	0.00	0.00
15 TO 18	.29	0.00	0.00	0.00	0.00	0.00	0.00
19 TO 23	.02	0.00	0.00	0.00	0.00	0.00	0.00
GT 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DIRECTION NNW

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.20	.02	0.00	.04	.02	.02	.09
3 TO 4	.47	.02	0.00	.07	.13	.04	.07
5 TO 6	.90	.04	.11	.22	.02	.09	.11
7 TO 8	.53	.04	.04	.11	.16	0.00	0.00
9 TO 11	.33	.02	.62	.04	.02	.02	.02
12 TO 14	.33	0.00	0.00	0.00	.02	0.00	.07
15 TO 18	.09	0.00	0.00	.07	0.00	0.00	0.00
19 TO 23	.04	0.00	0.00	0.00	0.00	0.00	0.00
GT 23	.02	0.00	0.00	0.00	0.00	0.00	0.00

DIRECTION N

WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.09	0.00	.04	.07	.07	.02	.04
3 TO 4	.18	.07	0.00	.13	.18	.04	.09
5 TO 6	.18	.04	.07	.16	.33	.02	0.00
7 TO 8	.44	.04	.11	.19	.13	.04	.02
9 TO 11	.73	.04	.04	.16	.09	.02	.04
12 TO 14	.44	0.00	.07	.22	[illegible]	0.00	0.00
15 TO 18	.71	.07	.02	.04	.04	0.00	.04
19 TO 23	.11	.02	0.00	.02	0.00	.02	.04
GT 23	.24	.07	.07	.07	0.00	0.00	0.00

TABLE 2-7 (3 of 3)

Wind Speed Distribution vs. Temperature Lapse Rate-Stability Class (1970)

WIND SPEED DISTRIBUTION, PERCENT

CALM	1 TO 2	3 TO 4	5 TO 6	7 TO 8	9 TO11	12TO14	15TO18	19TO23	GT 23
3.26	5.97	11.55	14.46	17.99	17.26	10.65	8.42	3.07	1.98

****

SUMMED OVER ALL DIRECTIONS
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	[illegible]	0.00	0.00	0.00	0.00	0.00
1 TO 2	2.62	.15	.51	.64	1.11	.40	.73
3 TO 4	4.49	.51	.62	1.46	2.18	.82	1.78
5 TO 6	6.72	.69	1.07	3.06	3.71	1.71	1.55
7 TO 8	9.46	.99	1.13	3.09	3.11	.67	.36
9 TO11	10.19	.95	1.03	2.91	1.86	.51	.33
12TO14	7.52	.75	.55	1.29	.73	.07	.09
15TO18	6.59	.63	.44	.35	.33	.07	.11
19TO23	2.75	.11	.09	.11	.02	.02	.06
GT 23	1.31	.13	.23	.13	.07	0.00	0.00

****

SUMMED OVER ALL TEMP. LAPSE RATE STABILITIES
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.36	.22	.20	[illegible]	.22	.18	.42	.47	.42	.71	.62	.67	.27	.36	.40	.33
3 TO 4	.91	.64	.40	.39	.47	.40	.49	.78	.60	1.31	1.04	.91	.91	1.42	.80	.69
5 TO 6	.57	1.04	.39	[illegible]	.78	.95	1.24	1.93	1.53	1.27	1.64	2.09	1.55	1.02	1.40	1.42
7 TO 8	.40	[illegible]	.91	[illegible]	.40	.49	1.51	2.72	.69	1.11	.93	2.35	1.47	1.13	.09	.98
9 TO11	.87	1.22	.91	.43	.71	.62	.89	2.46	1.24	1.15	1.50	2.09	1.22	1.09	.49	1.13
12TO14	.39	.64	.47	.44	.40	.29	.73	.69	.86	1.11	.75	1.42	.69	.80	.42	.98
15TO18	.53	.55	.29	.11	.11	.11	[illegible]	[illegible]	1.28	.49	.04	.58	.40	.29	.16	.93
19TO23	.22	.33	.13	.26	.17	[illegible]	.11	[illegible]	.40	.11	.07	.60	.34	.02	.04	.22
GT 23	.18	.29	.04	0.00	0.00	0.00	0.00	.07	.20	.07	.16	.58	.04	0.00	.02	.40

TABLE 2-8 (1 of 2)

Wind Speed vs. Direction-Stability Class (1970)

COMM. ED. CO., ZION STATION (35 FT LEVEL) WIND DATA 1970

TEMP. LAPSE RATE STABILITY CLASS A
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1 TO 2	.22	.11	.07	[illegible]	.07	[illegible]	.24	[illegible]	.16	.31	.40	.27	.04	.16	.20	.09
3 TO 4	.09	.31	.13	.11	.15	.16	.20	.11	.07	.49	.31	.33	.40	.40	.47	.18
5 TO 6	.16	.47	.27	.44	.44	.44	.38	.71	.33	.18	.40	.98	.73	.75	.60	.78
7 TO 8	.44	.53	.51	.42	.53	.31	.56	1.24	.16	.33	.39	.73	.87	.91	.53	.44
9 TO 11	.71	.67	.44	.42	.33	.47	.49	1.60	.71	.51	.64	.95	.95	.82	.33	.73
12 TO 14	.38	.44	.27	.23	.31	.20	.49	.44	.49	.47	.60	.89	.56	.75	.33	.64
15 TO 18	.47	.42	.24	.20	.04	.11	.60	.53	.73	.67	.58	.40	.38	.29	.09	.71
19 TO 23	.20	.24	.11	.22	.07	0.00	.11	.24	.33	.09	.04	.55	.31	.02	.04	.11
GT 23	.69	.20	.04	0.00	0.00	0.00	0.00	.04	.11	.04	.09	.58	.04	0.00	.02	.24

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TEMP. LAPSE RATE STABILITY CLASS B
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1 TO 2	0.00	.02	0.00	.04	0.00	0.00	0.00	0.00	.02	.02	0.00	.02	0.00	0.00	.02	0.00
3 TO 4	.02	.07	0.00	.02	0.00	0.00	0.00	.07	.04	.02	.07	.02	.02	.11	.02	.07
5 TO 6	.02	0.00	.02	0.00	.02	.07	.09	.09	.09	.07	.02	.07	.02	.02	.04	.04
7 TO 8	.07	.04	0.00	0.00	.04	.04	.13	.11	.07	.07	.07	.09	.04	.02	.04	.04
9 TO 11	.02	.07	.07	.02	.07	0.00	.09	.13	.07	.07	0.00	.09	.07	.13	.02	.04
12 TO 14	0.00	.01	.02	.04	0.00	.02	.04	.07	.09	.13	.02	.16	.04	.04	0.00	0.00
15 TO 18	.02	.12	0.00	0.00	0.00	0.00	.02	.07	.20	.16	.09	.04	0.00	0.00	0.00	.07
19 TO 23	0.00	.02	0.00	.02	0.00	0.00	0.00	0.00	.04	0.00	.02	0.00	0.00	0.00	0.00	.02
GT 23	.02	.02	0.00	0.00	0.00	0.00	0.00	0.00	.07	0.00	0.00	0.00	0.00	0.00	0.00	.02

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TEMP. LAPSE RATE STABILITY CLASS C
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1 TO 2	0.00	0.00	0.00	.09	.02	.02	.02	0.00	.04	.07	.07	.09	.04	0.00	0.00	.04
3 TO 4	.02	.02	.02	0.00	.11	0.00	.02	.13	0.00	.13	.02	.04	.02	.07	0.00	0.00
5 TO 6	.07	.02	0.00	.07	.04	.04	.20	.11	.04	.04	.11	.07	.04	.07	.11	.07
7 TO 8	.02	.02	.04	.04	.04	.04	.16	.18	.09	.11	.02	.16	0.00	.04	.04	.11
9 TO 11	.04	.23	.07	.07	.09	0.00	0.00	.13	.11	.11	.11	.07	.02	0.00	.02	.04
12 TO 14	0.00	.07	0.00	0.00	0.00	0.00	.07	.07	.09	.11	0.00	.04	.04	0.00	0.00	.07
15 TO 18	.02	.07	.02	0.00	0.00	0.00	.09	.07	.09	0.00	.04	0.00	.02	0.00	0.00	.02
19 TO 23	0.00	.02	.02	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	.02	0.00	0.00	0.00	0.00
GT 23	.04	.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	0.00	0.00	0.00	.07

****

TEMP. LAPSE RATE STABILITY CLASS D
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1 TO 2	0.00	.07	.02	.02	.02	.04	.07	0.00	.04	.07	.04	.04	.02	.07	.04	.07
3 TO 4	.16	.09	.07	.04	.04	.11	.04	.09	.16	.20	.31	.09	0.00	.09	.07	.13
5 TO 6	.22	.16	.02	.04	.09	.20	.22	.71	.13	.36	.38	.11	.13	.29	.22	.18
7 TO 8	.04	.22	.13	.02	.04	.15	.16	.51	.20	.31	.29	.42	.11	.04	.11	.18
9 TO 11	.04	.16	.22	.07	.13	.02	.11	.33	.18	.33	.60	.42	.02	.07	.04	.16
12 TO 14	0.00	.07	.02	.04	.04	.04	.09	.04	.13	.29	.07	.20	.02	0.00	0.00	.22
15 TO 18	0.00	.02	.02	.02	0.00	.02	.04	.02	.11	.04	.02	.11	0.00	0.00	.07	.04
19 TO 23	.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	0.00	.02	.02	0.00	0.00	.02
GT 23	.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	.02	0.00	0.00	0.00	0.00	.07

TABLE 2-8 (2 of 2)

Wind Speed vs. Direction-Stability Class (1970)

COMM. ED. CO., ZION STATION (35 FT LEVEL) WIND DATA 1970

TEMP. LAPSE RATE STABILITY CLASS E
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1 TO 2	.04	.02	.04	.02	.07	.07	.04	.14	.11	.16	.02	.13	.07	.02	.02	.07
3 TO 4	.11	.04	.11	[illegible]	.04	.04	.11	.22	.13	.18	.18	.11	.18	.36	.13	.18
5 TO 6	.09	.13	.02	.11	.13	.16	.13	.47	.40	.31	.40	.40	.22	.27	.02	.33
7 TO 8	.20	.13	.24	.11	.04	.09	.16	.34	.13	.20	.16	.60	.36	.04	.16	.13
9 TO 11	0.00	.13	.11	.09	.09	.11	.13	.24	.11	.11	.22	.31	.07	.02	.02	.09
12 TO 14	0.00	0.04	.16	.11	.02	.02	.04	0.00	.02	.09	.07	.13	0.00	0.00	.02	.04
15 TO 18	.02	.02	0.00	.07	0.00	0.00	.04	0.00	.04	0.00	.09	0.00	0.00	0.00	0.00	.04
19 TO 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	0.00	0.00
GT 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	.02	.02	0.00	0.00	0.00	0.00	0.00

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TEMP. LAPSE RATE STABILITY CLASS F
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1 TO 2	0.00	0.00	0.00	.02	.02	0.00	.02	.02	.02	.07	.04	.00	.02	.02	.02	.02
3 TO 4	.04	0.00	.02	.02	0.00	.04	.02	0.00	.09	.16	.07	.07	.07	.13	.04	.04
5 TO 6	.07	.04	.02	.09	.04	.04	.02	.11	.24	.20	.24	.11	.18	.18	.09	.02
7 TO 8	.02	0.00	0.00	.02	.02	.02	.04	.11	.02	.04	.02	.16	.09	.04	0.00	.04
9 TO 11	.02	0.00	0.00	.02	0.00	.02	.07	.09	.02	.02	0.00	.13	.04	.02	.02	.02
12 TO 14	0.00	0.00	0.00	0.00	.02	0.00	0.00	0.00	.02	.02	0.00	0.00	0.00	0.00	0.00	0.00
15 TO 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	.02	.02	0.00	0.00	0.00	0.00
19 TO 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02
GT 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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TEMP. LAPSE RATE STABILITY CLASS G
WIND SPEED VERSUS DIRECTION (IN PERCENT)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1 TO 2	.09	0.00	.02	.09	.02	.04	.02	.07	0.00	.02	.04	.02	.07	.09	.09	.04
3 TO 4	.07	.07	.04	.16	.09	.04	.09	0.00	.11	.13	.09	.24	.22	.27	.07	.09
5 TO 6	.04	.02	.02	.04	.04	0.00	0.00	.11	.09	.11	.09	.36	.22	.24	.11	0.00
7 TO 8	0.00	0.00	0.00	0.00	0.00	0.00	.02	.11	.02	.04	0.00	.11	0.00	.02	0.00	.02
9 TO 11	.02	0.00	0.00	0.00	0.00	0.00	0.00	.11	.04	0.00	0.00	.02	.04	.02	.02	.04
12 TO 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	0.00	0.00	0.00	0.00	0.00	0.00	.07	0.00
15 TO 18	0.00	0.00	0.00	.07	.07	0.00	0.00	0.00	.02	0.00	0.00	0.00	0.00	0.00	0.00	.04
19 TO 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.04
GT 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 2-9 (1 of 2)

Wind Speed vs. Temperature Lapse Rate-Stability Class (1970)

[illegible] ZION STATION (45 FT LEVEL) WIND DATA 1970

DIRECTION NNE
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.22	0.00	0.00	0.00	.04	0.00	.04
3 TO 4	.09	.02	.02	.16	.11	.04	.07
5 TO 6	.16	.02	.07	.22	.09	.07	.04
7 TO 8	.44	.07	.02	.04	.20	.02	0.00
9 TO11	.71	.02	.04	.04	0.00	.02	.02
12TO14	.38	0.00	0.00	0.00	0.00	0.00	0.00
15TO18	.47	.02	.02	0.00	.02	0.00	0.00
19TO21	.20	0.00	0.00	.02	0.00	0.00	0.00
GT 21	.09	.02	.04	.07	0.00	0.00	0.00

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DIRECTION NE
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.11	.02	0.00	.07	.02	0.00	0.00
3 TO 4	.31	.07	.02	.09	.09	0.00	.07
5 TO 6	.67	0.90	.02	.16	.13	.04	.02
7 TO 8	.53	.04	.02	.27	.13	0.00	0.00
9 TO11	.67	.07	.20	.16	.13	0.00	0.00
12TO14	.44	.07	.07	.07	0.00	0.00	0.60
15TO18	.42	.02	.07	.02	.02	0.00	0.00
19TO21	.29	.07	.02	0.00	0.00	0.00	0.00
GT 21	.20	.02	.07	0.00	0.00	0.00	0.60

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DIRECTION ENE
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.30	0.40	0.60	0.00	0.00	0.00	0.00
1 TO 2	.07	0.00	0.00	.02	.09	0.00	.02
3 TO 4	.15	0.00	.02	.02	.11	.02	.04
5 TO 6	.27	.02	0.00	.02	.02	.02	.02
7 TO 8	.53	0.00	.04	.13	.20	0.00	0.00
9 TO11	.46	.07	.07	.22	.11	0.00	0.00
12TO14	.27	.02	0.00	.02	.16	0.00	0.00
15TO18	.24	0.00	.02	.07	0.00	0.00	0.00
19TO21	.11	0.00	.02	0.00	0.60	0.00	0.00
GT 21	.04	0.00	0.00	0.00	0.00	0.00	0.00

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DIRECTION E
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.04	.04	.04	.02	.02	.02	.09
3 TO 4	.33	.12	0.00	.04	0.00	.07	.16
5 TO 6	.44	0.00	.02	.04	.11	.09	.09
7 TO 8	.42	0.00	.04	.02	.07	.02	0.00
9 TO11	.42	.02	.07	.07	.09	.02	0.00
12TO14	.20	.24	0.00	.04	.11	0.00	0.00
15TO18	.20	0.00	0.00	.02	.07	0.00	.02
19TO21	.22	.12	0.00	0.00	0.00	0.00	0.00
GT 21	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 2-9 (2 of 2)

Wind Speed vs. Temperature Lapse Rate-Stability Class (1970)

COMM. ED. CO.. ZION STATION (35 FT LEVEL) W. DATA 1970

DIRECTION ESE
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.67	0.00	.02	.02	.07	.02	.02
3 TO 4	.18	0.00	.11	.04	.04	0.00	.09
5 TO 6	.04	.02	.06	.09	.09	.04	.04
7 TO 8	.55	.04	.04	.07	.04	.02	0.00
9 TO11	.33	.07	.09	.13	.09	0.00	0.00
12TO14	.31	0.00	0.00	.04	.02	.02	0.00
15TO18	.64	0.00	0.00	0.00	0.00	0.00	.02
19TO21	.07	0.00	0.00	0.00	0.00	0.00	0.00
GT 21	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DIRECTION SE
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	0.00	0.00	.02	.04	.07	0.00	.04
3 TO 4	.16	0.00	0.00	.11	.04	.04	.04
5 TO 6	.44	.07	.04	.20	.16	.04	0.00
7 TO 8	.53	.04	.04	.16	.09	.02	0.00
9 TO11	.47	0.00	0.00	.02	.11	.02	0.00
12TO14	.29	.02	0.00	.04	.42	0.00	0.00
15TO18	.11	0.00	0.00	.02	0.00	0.00	0.00
19TO23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GT 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DIRECTION SSE
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.24	0.00	.02	.07	.04	.02	.02
3 TO 4	.20	0.00	.02	.04	.11	.02	.09
5 TO 6	.56	.09	.20	.22	.13	.02	0.00
7 TO 8	.84	.13	.16	.15	.16	.04	.02
9 TO11	.49	.09	0.00	.11	.13	.07	0.00
12TO14	.49	.04	.07	.09	.04	0.00	0.00
15TO18	.08	.42	.09	.04	.04	0.00	0.00
19TO23	.11	0.00	0.00	0.00	0.00	0.00	0.00
GT 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DIRECTION S
WIND SPEED DISTRIBUTION VERSUS TEMP. LAPSE RATE STABILITY CLASS (IN PERCENT)

	A	B	C	D	E	F	G
CALM	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 TO 2	.22	0.00	0.00	0.00	.16	.02	.07
3 TO 4	.31	.02	.13	.09	.22	0.00	0.00
5 TO 6	.78	.09	.11	.31	.42	.11	.11
7 TO 8	1.24	.11	.13	.51	.36	.11	.11
9 TO11	1.00	.13	.13	.13	.24	.09	.11
12TO14	.49	.07	.07	.04	0.00	0.00	.02
15TO18	.53	.17	.37	.02	0.00	0.00	0.00
19TO21	.74	0.00	0.00	0.00	0.00	0.00	0.00
GT 23	.04	0.00	0.00	0.00	.02	0.00	0.00

TABLE 2-10

HIGHEST EXPECTED WINDS FOR THE ZION SITE

Maximum Speed (mph)	Probability	Recurrence Interval (years)
48	0.50	2
60	0.10	10
69	0.04	25
70	0.02	50
80	0.01	100

TABLE 2-11
TORNADO OCCURRENCES**

ILLINOIS

DATE	DIRECTION OF MOVEMENT	PATH LENGTH (miles)	WIDTH (Yards)
9/21/59	NE	2	40
9/26/59	NNE	10	*
9/26/59	NE	10	*
10/8/59	NE	2	90
4/19/63	N	*	*
4/11/65	NNE	10.5	400
4/11/65	E	5.75	200
4/11/65	E	0.3	100
4/11/65	NE	0.1	250
5/26/65	ENE	15.5	70
6/23/65	*	0.1	10
4/19/66	NE	0.5	30-50
4/19/66	E	0.5	100
6/9/66	E	*	*
4/21/67	E	28	600-1200
4/21/67	E	*	*
4/21/67	NE	9	50-150
4/21/67	E	*	*
4/21/67	N	8	20
4/21/67	NE	16	100-200
4/21/67	N	0.25	10
7/26/69	E	5	35

WISCONSIN

DATE	DIRECTION OF MOVEMENT	PATH LENGTH (miles)	WIDTH (Yards)
6/12/59	*	2	1000
9/26/59	NE	4	*
9/26/59	E	15	50
10/8/59	NE	0	*
7/22/59	*	25	*
10/4/62	NE	*	*
7/9/63	SW	8	30
8/22/64	NE	2	400
4/11/65	NE	1	50
3/21/66	ENE	15	200
5/23/66	NE	5	50
5/26/68	N	1	100
6/29/69	ENE	10	100

* Not Available
** These occurrences are within a square 80 miles on a side with the Zion site at the center.

TABLE 2-12

ZION STATION
METEOROLOGICAL INSTRUMENT LOCATIONS AND ANALOG DATA RECORDING SYSTEMS

Measurement	Type	Digital System Accuracy	Threshold	Range	Elevation (Above Grade)	Recorder Type
Wind Speed/ Wind Direction	Teledyne Geotech 1564/1565	±1% / ±5°	0.28 mps/ 0.31 mps	0 to 44.7 mps/ 0 to 540°	35 ft	Esterline Angus L1102S
Wind Speed/ Wind Direction	Teledyne Geotech 1564/1565	±1% / ±5°	0.28 mps/ 0.31 mps	0 to 44.7 mps/ 0 to 540°	250 ft	Esterline Angus L1102S
Ambient Air Temperature	RDF 23789-4	±0.3°C	N/A	-40° to 48.9°C	35 ft	Esterline Angus MRL-244-0-RD-RC-64-MP
Differential Temperature	RDF-23789-4	±0.14°C*	N/A	-5.6° to 16.7°C	250-35 ft	Esterline Angus MRL-244-0-RD-RC-64-MP
Precipitation	MRI Model 302 Tipping Bucket	±0.25mm	N/A	0.0 to 25.4 mm	Shelter Roof	Esterline Angus MRL-244-0-RD-RC-64-MP

* ±0.14°C over the height differential on the tower is within the ANS 2.5 specified accuracy standard of ±0.15°C/50m

TABLE 2-13

ZION STATION (2, 5, & 15 Mile Supplemental Tower*)
METEOROLOGICAL INSTRUMENT LOCATIONS AND ANALOG DATA RECORDING SYSTEMS

Measurement	Type	Digital System Accuracy	Threshold	Range	Elevation (Above Grade)	Recorder Type
Wind Speed/ Wind Direction	Teledyne Geotech Series 50.1/ 50.2c	±1% / ±5°	0.33 mps/ 0.42 mps	0 to 44.7 mps/ 0 to 540°	33 ft	Esterline Angus L1102S
Wind Speed/ Wind Direction	EG & G Model 110S-M	±0.3°C	N/A	-31.7 to 37.8°C	33 ft	Esterline Angus MS401BB

* Equipment is identical at each of the three locations.

TABLE 2-14

NEARBY LAKE MICHIGAN WATER SUPPLY SYSTEMS

Community	Intake Distance From Site, Miles	Average Withdrawal, Million Gallons Per Day (MGD)	Storage Capacity, Million Gallons (MG)
Lake County, Illinois, Public Water District	1.1	2.5	4
Waukegan, Illinois	6	7.4	8.6
North Chicago, Illinois	10	6.5	5.0
Kenosha, Wisconsin	10	11	10.2
Great Lakes NTS, Illinois	13	5.8	4.5
Lake Forest, Illinois	16.5	1.6	2.9

TABLE 2-15

ANNUAL PRECIPITATION AT VARIOUS ILLINOIS LOCATIONS

Location	Mean Annual Precipitation Inches	Maximum Annual Precipitation Inches	Maximum 24-Hr. Rainfall Inches
Antioch	32.83	42.71	5.10
Waukegan	31.89	41.97	3.58
Chicago-WBAP	32.99	45.92	6.24
Chicago-WB, City	33.17	46.41	6.19
Marengo	32.89	40.77	9.08
Wheaton College	35.01	45.58	5.60
Aurora College	34.52	47.03	4.87
Park Forest	35.60	43.43	---
Chicago University	32.29	45.71	---

TABLE 2-16

DOOR LOCATIONS AND PRINCIPLE USE EXTERIOR ACCESSES BELOW ELEVATION 600' MSL

LOCATION	ELEVATION	TYPE OF USE (PRINCIPLE)
Aux. Bldg. (10-L)	592'0"	Equipment access
Aux. Bldg. (30-L)	592'0"	Material access to vermiculite and cement mixing room
Aux. Bldg. (30-K)	595'10-1/2"	Removal of solid waste from drumming station and dry active waste storage
Fuel Hand Bldg. (17-W)	592'0"	New and spent fuel access
Diesel Generator Bldg. (34-J, 33-J, 31-J, 9-J, 7-J, 6-J)	592'3" *	Ventilation and combustion air to diesels
Turb. Bldg. (38-G)	592'0"	Equipment access
Turb. Bldg. (37-G)	592'0"	Personnel access
Turb. Bldg. (38-C)	592'0"	Personnel access
Turb. Bldg. (22-A)	592'0"	Equipment and personnel access
Turb. Bldg. (2-C)	592'0"	Personnel access
Turb. Bldg. (3-G)	592'0"	Personnel access
Turb. Bldg. (2-G)	592'0"	Equipment access
Crib House (113-AA)	594'0"	Personnel access
Crib House (101-AA)	594'0"	Personnel access

* Elevation corresponds to bottom of air intake leuvers. Plenum access door elevation at approximately 593'-9".

TABLE 2-17

DATA ON SURFACE CURRENT SPEEDS FOR LAKE MICHIGAN
(July through November 1963)

Current Speed (cm/sec)	Current Speed (ft/sec)	Frequency (% of Time)
< 6	< 0.2	21.9
6 - 15	0.2 - 0.5	46.5
15 - 30	0.5 - 1.0	24.9
30 - 45	1.0 - 1.5	5.8
> 45	> 1.5	0.9

TABLE 2-18

FREQUENCY OF DEEP WATER WAVE HEIGHTS DUE TO STORMS

Frequency	Wave Height in Feet* (Reference 24) Full Year	Ice Free Period
Once each month	6.5	5
Once each 6 months	9.9	7.5
Once each year	11.4	8.5
Once each 2 years	12.6	9.4
Once each 5 years	14.3	10.8
Once each 10 years	15.7	11.8
Once each 25 years	17.4	13.6
Once each 500 years	22.0	20.3

* Crest to trough height.

TABLE 2-19
WELL DATA - ZION STATION (WITHIN ONE MILE OF STATION)

Well No.	Location (T46N) Rise	Surf Elev (MSL)	Depth	Mineral Analysis	Pump Rate (GPM)	Static Level (Below Grade)	Construction Report
W-1	320'S, 880'W Cent. Sec. 22		1500'	Partial			
W-4	200'S, 200'E Cent. Sec. 22		108'	Partial			
W-5	175'E, 1630'S Cent. Sec. 22		225'	Partial			
W-6	400'E, 1660'S Cent. Sec. 22		50'	Partial			
W-7	300'E, 1550'S Cent. Sec. 22		220'	Partial			
W-8	300'E, 1380'S Cent. Sec. 22		225'	Partial			
W-9	750'E, 500'N SW Cor. Sec. 22			Yes			
W-13	1150'E, 1800'S NW Cor. Sec. 22	615'	160'	----			
W-18	1500'N, 1500'E SW Cor. Sec. 14		123'	----	20	17 24*	Yes
W-19	1700'N, 1000'E SW Cor. Sec. 14		125'	----	30	19 25*	Yes
W-20	1800'N, 1200'E SW Cor. Sec. 14		180'	----	3	13 180*	Yes
W-21	50'S, 800'E NW Cor. Sec. 23		120'	----	20	14 50*	Yes
W-22	50'S, 1150'E NW Cor. Sec. 23		144'	----	2	9 142*	Yes
W-24	570'N, 510'N		1370'	Partial			

TABLE 2-20 (1 of 2)

GEOLOGIC FORMATIONS

Geologic Age	Geologic Name	Approx. Thickness In Feet	Description	Remarks
Quaternary	Recent Deposits	0 to 35	Unconsolidated sand, silt and peat	Largely Lake Michigan shore deposits. Present at site
	Pleistocene	80 to 150	Unconsolidated material ranging from clay to boulders deposited as till, outwash, loess and lake sediments	Largely from Wisconsin Glaciation. All but loess present at site
Silurian	Niagara Formation	0 to 465	Dolomite, vuggy, locally contains solution cavities, fossiliferous	Bedrock at site
Ordovician	Maquoketa Formation	0 to 250	Shale, grades locally to dolomite or limestone	Generally not water bearing
	Galena-Platteville Formation	220 to 350	Dolomite or limestone, shaly	Aquifer
	Glenwood-St. Peter Formation	100 to 650	Sandstone, fine to coarse grained	Aquifer
	Prairie du Chien Formation	0 to 340	Dolomite and sandstone	May not be present under the site

TABLE 2-20 (2 of 2)

GEOLOGIC FORMATIONS

Geologic Age	Geologic Name	Approx. Thickness In Feet	Description	Remarks
Cambrian	Trempealeau Formation	0 to 225	Dolomite and sandstone	
	Franconia Formation	45 to 175	Dolomite and sandstone	
	Ironton-Galesville Formation	105 to 270	Sandstone	Most important bedrock aquifer
	Eau Clair Formation	235 to 450	Shale and Siltstone	
	Mt. Simon Formation	2000	Sandstone with siltstone and shale	Aquifer
Precambrian	Undifferentiated	Unknown	Granites and associated intrusives	Principal basement rock

TABLE 2-21

ELEVATION OF CLASS I STRUCTURES WITH RESPECT TO VARIOUS FOUNDATION SOIL LEVELS

Class I Structure	Foundation Elevation	Granular Lake Deposits (Sand)	Glacial Till (Clay)	Glacial Lacustrine & Glacial Outwash (Sand, Silt & Clay)	Niagara Dolomite
Fuel Handling Building	571' & 587'	585'	555'	515'	486'
Auxiliary Building	537'	585'	554'	526'	481'
Diesel Generator (N)	562.5'	585'	556'	523'	483'
Diesel Generator (S)	562.5'	585'	554'	525'	476'
Reactor (Unit II)	521.5' & 548'	585'	554'	522'	483'
Reactor (Unit I)	521.5' & 548'	585'	555'	529'	480'
Crib House	530'	585'	554'	515'	486'

TABLE 2-22 (1 of 2)

REGIONAL EARTHQUAKE OCCURRENCES

Date	Intensity*	Locality	Epicenter Location N. Lat.	W. Long	Area Sq. Miles
1804 Aug. 20	VII	Ft. Dearborn	4.20	87.8	30,000
1811 Dec. 16	XII Felt throughout Illinois	New Madrid, Missouri	36.6	89.6	2,000,000
1812 Jan. 23	XII Felt throughout Illinois	New Madrid, Missouri	36.6	89.6	2,000,000
1812 Feb. 7	VII Felt throughout Illinois	New Madrid, Missouri	36.6	89.6	2,000,000
1883 Feb. 4	VI	North of Michigan – Indiana Border	42.3	85.6	8000
1886 Aug. 31	X Felt in Chicago	Charleston, S.C.	32.9	80.0	2,000,000
1895 Oct. 31	VIII Felt throughout Illinois and Wisconsin	Charleston, Missouri	37.0	89.4	1,000,000
1905 March 13	V	Menominee, Michigan	45.0	87.7	
1909 May 26	VII IV at Kenosha	N.E. Illinois	42.5	89.0	500,000
1912 Jan. 2	VI	N.E. Illinois	41.5	88.5	40,000
1917	VI	E. Missouri	38.1	90.6	200,000

* As defined in Table 2-23

TABLE 2-22 (2 of 2)

REGIONAL EARTHQUAKE OCCURRENCES

Date	Intensity*	Locality	Epicenter Location N. Lat.	W. Long	Area Sq. Miles
1923 Nov. 9	V	Cass County, Illinois			
1931 Oct. 18	VI	Madison, Wisconsin			
1933 Dec. 6	IV	Stoughton to Putland, Wisconsin			
1934 Nov. 12	VI	Rock Island, Illinois	41.5	91.5	
1935 Nov. 1	VI Felt in Wisconsin	Timiskaming, Canada	46.8	79.1	1,000,000
1939 Nov. 23	V III at Janesville, Wisconsin	Southern Illinois			
1943 Feb. 9	II	Thunder Mt., Marinette Co., Wisconsin			
1947 May 6	V	S.E. Wisconsin			
1947 Aug. 9	VI	So. Central Michigan	42.0	85.0	50,000
1956 July 18	IV	Oostburg, Wisconsin			
1956 Oct. 13	IV	Milwaukee-Racine, Wisconsin			
1968 Nov. 9	VII (III at site)	Southern Illinois	38	88.5	

* As defined in Table 2-23

TABLE 2-23 (1 of 2)

MODIFIED MERCALLI INTENSITY SCALE 1931
(Abridged)

I. Not felt except by a very few under especially favorable circumstances.

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibration like passing of truck. Duration estimated.

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed, walls make creaking sound. Sensation like heavy truck striking buildings. Standing motor cars rocked noticeably.

V. Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.

VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures, considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.

TABLE 2-23 (2 of 2)

MODIFIED MERCALLI INTENSITY SCALE 1931
(Abridged)

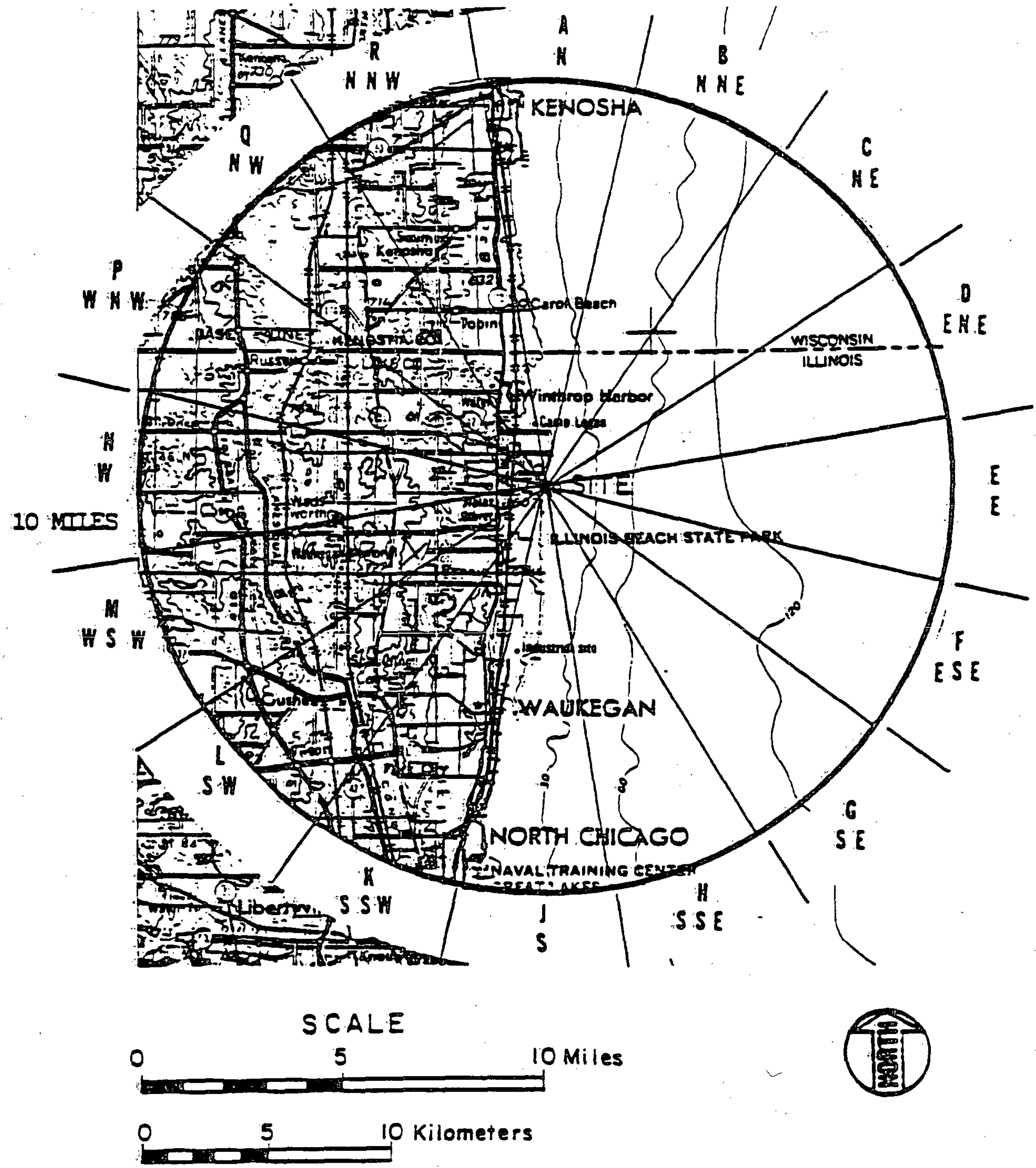
VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Disturbs persons driving motor cars.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

X. Some well-built wooden structures, destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipe lines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

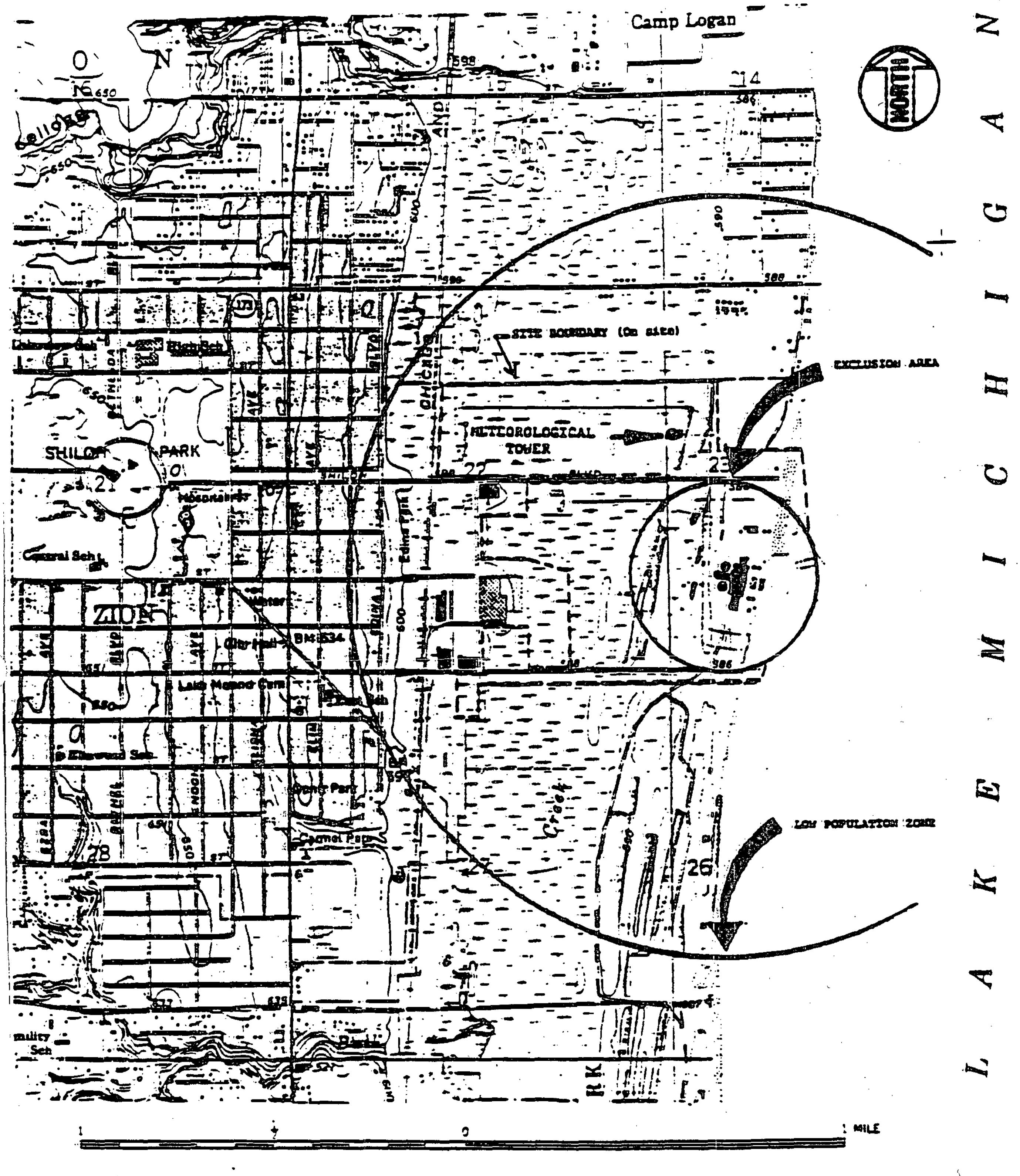
XII. Damage total. Waves seen on ground surfaces. Lines of slight and level distorted. Objects thrown upward into the air.



ZION STATION DSAR

Figure 2-1
TOPOGRAPHICAL FEATURES WITHIN A 10-MILE RADIUS OF THE ZION STATION

AUGUST 1998

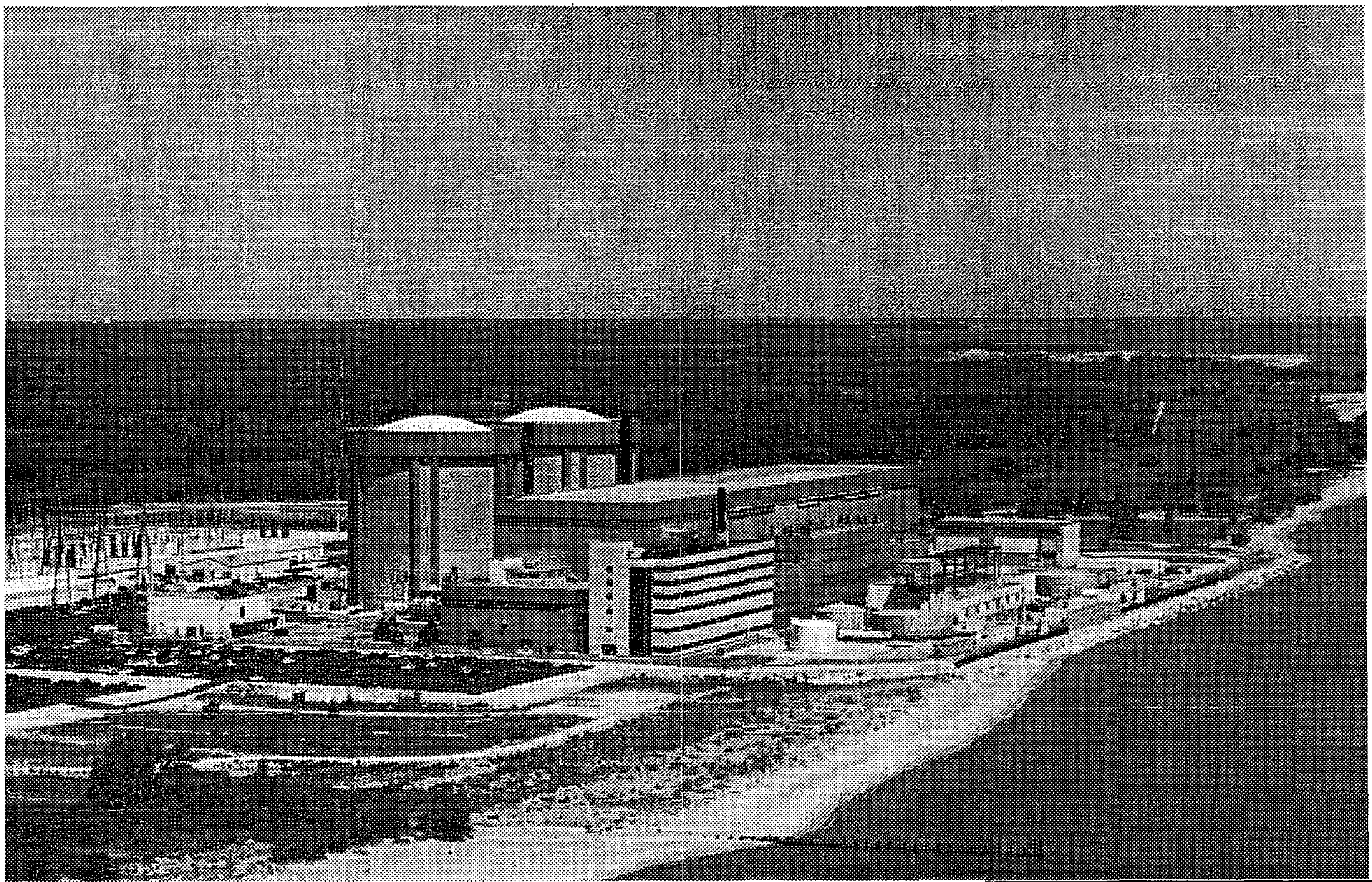


ZION STATION DSAR

Figure 2-2

MAP OF ZION STATION (LPZ AND EXCLUSION AREA)

AUGUST 1998

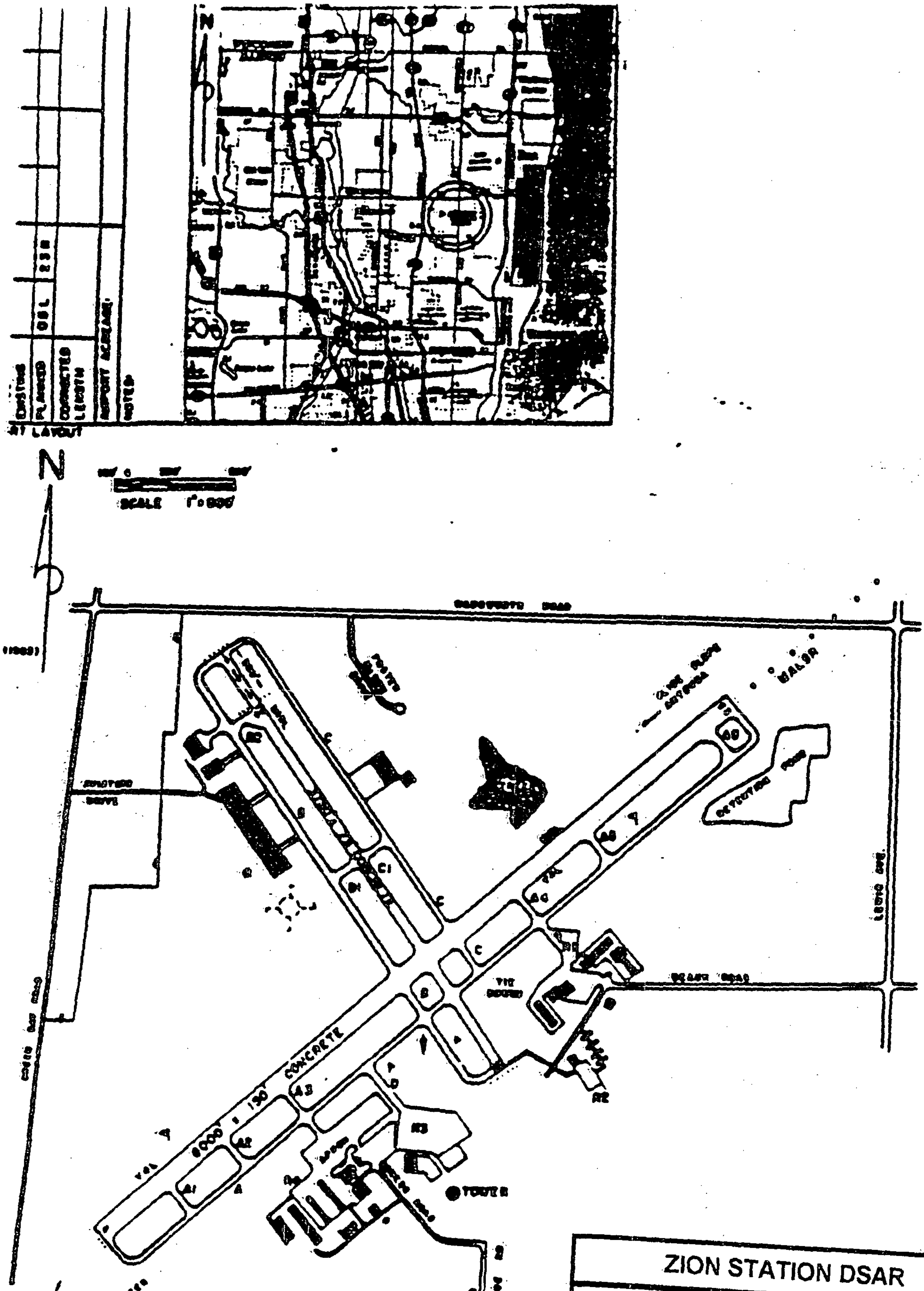


ZION STATION DSAR

Figure 2-3

SITE AERIAL PHOTOGRAPH

AUGUST 1998

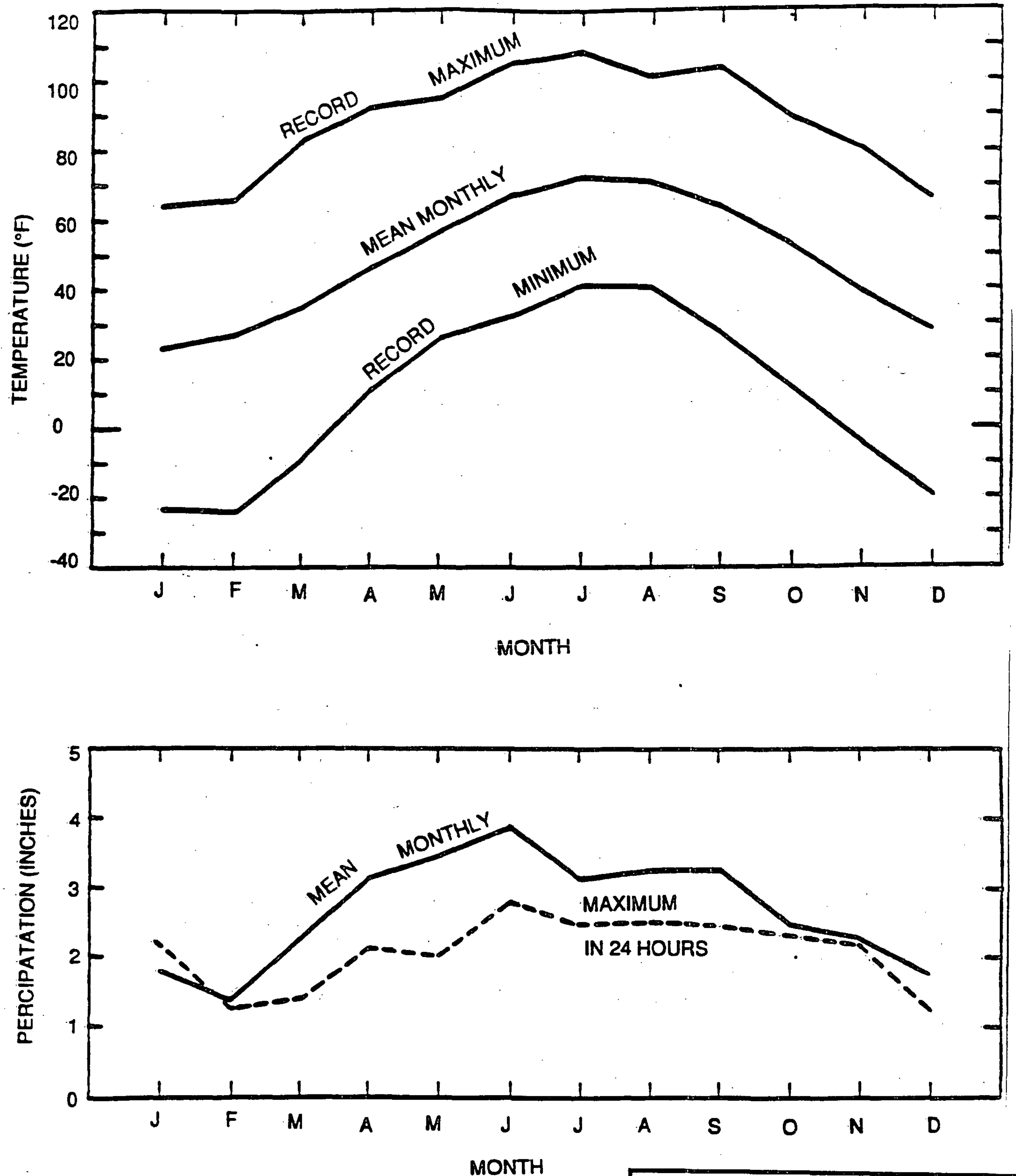


ZION STATION DSAR

Figure 2-4

GENERAL LAYOUT OF WAUKEGAN MEMORIAL AIRPORT

AUGUST 1998



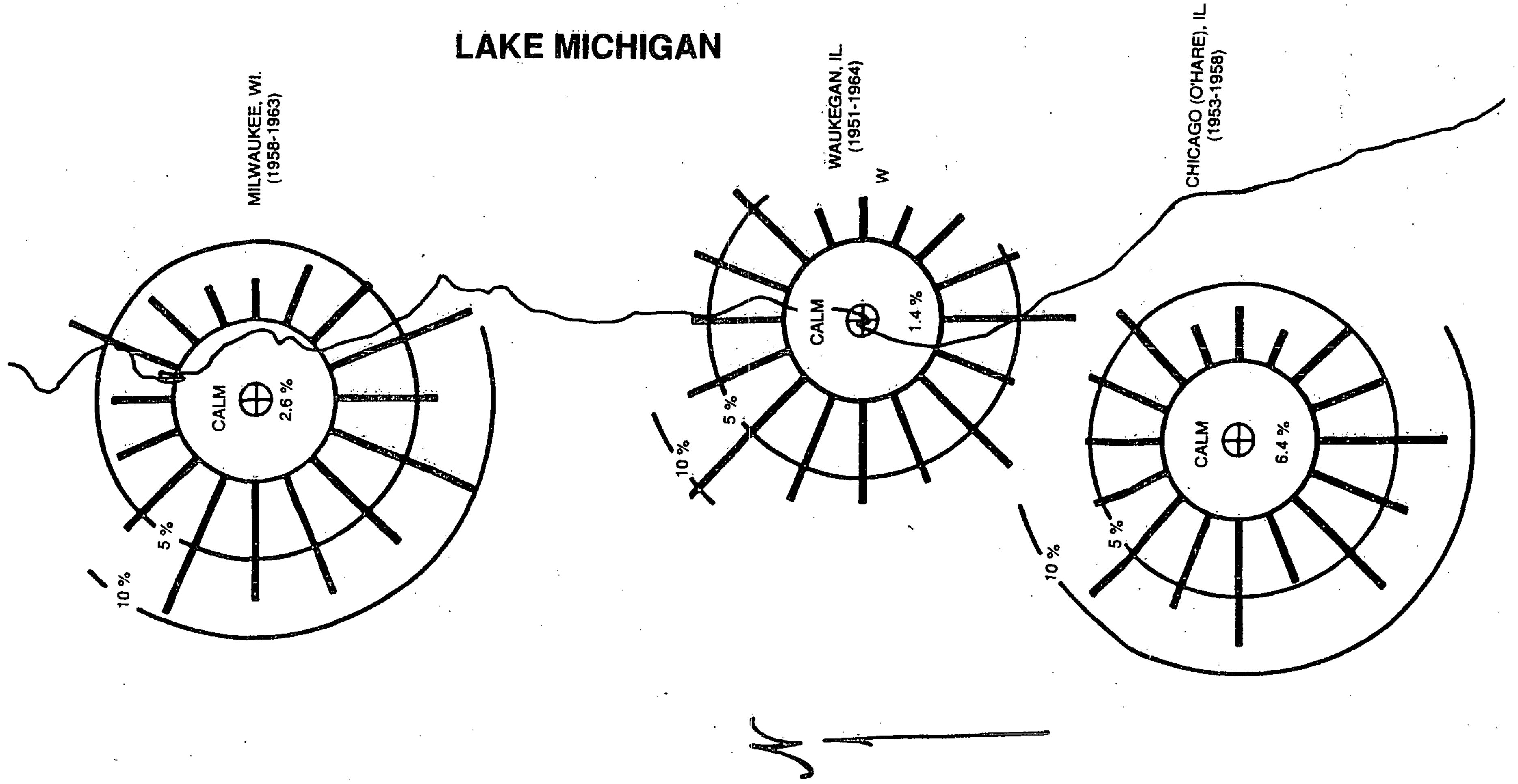
NOTE:
BASED ON WAUKEGAN DATA

ZION STATION DSAR

Figure 2-5

CLIMATE OF ZION REGION

AUGUST 1998

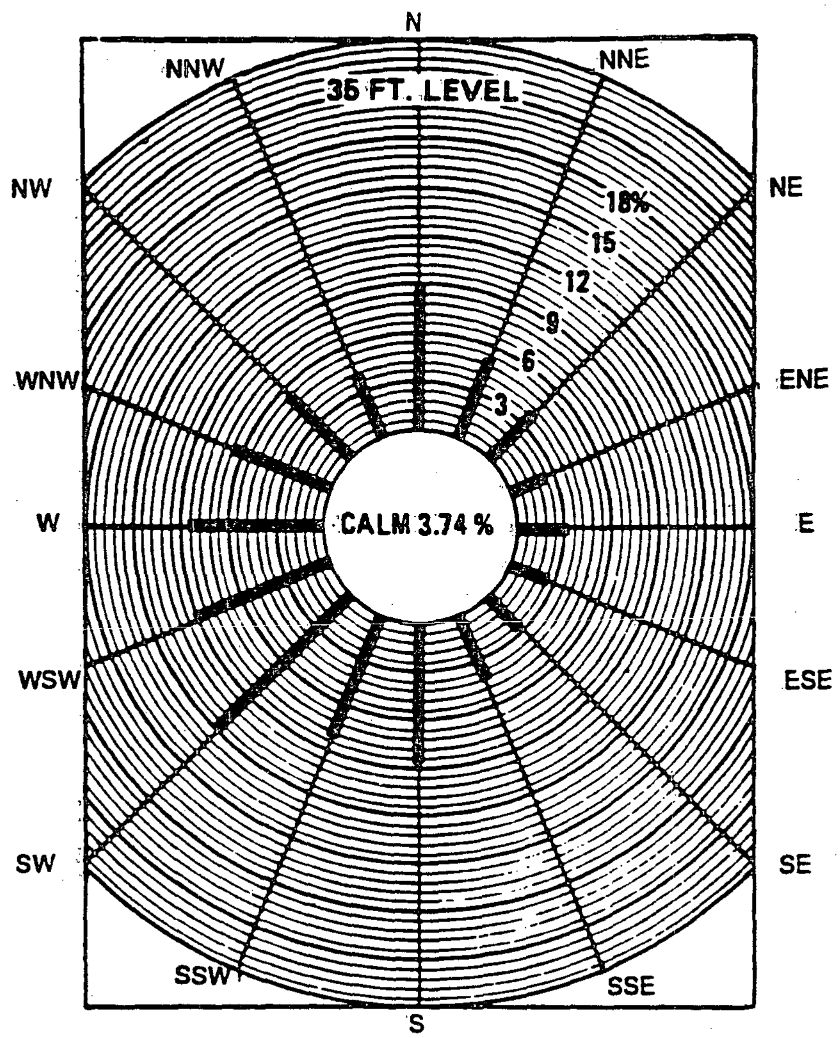


ZION STATION DSAR

Figure 2-6

**AVERAGE ANNUAL WIND ROSES
MILWAUKEE, WAUKEGAN,
CHICAGO (O'HARE)**

AUGUST 1998

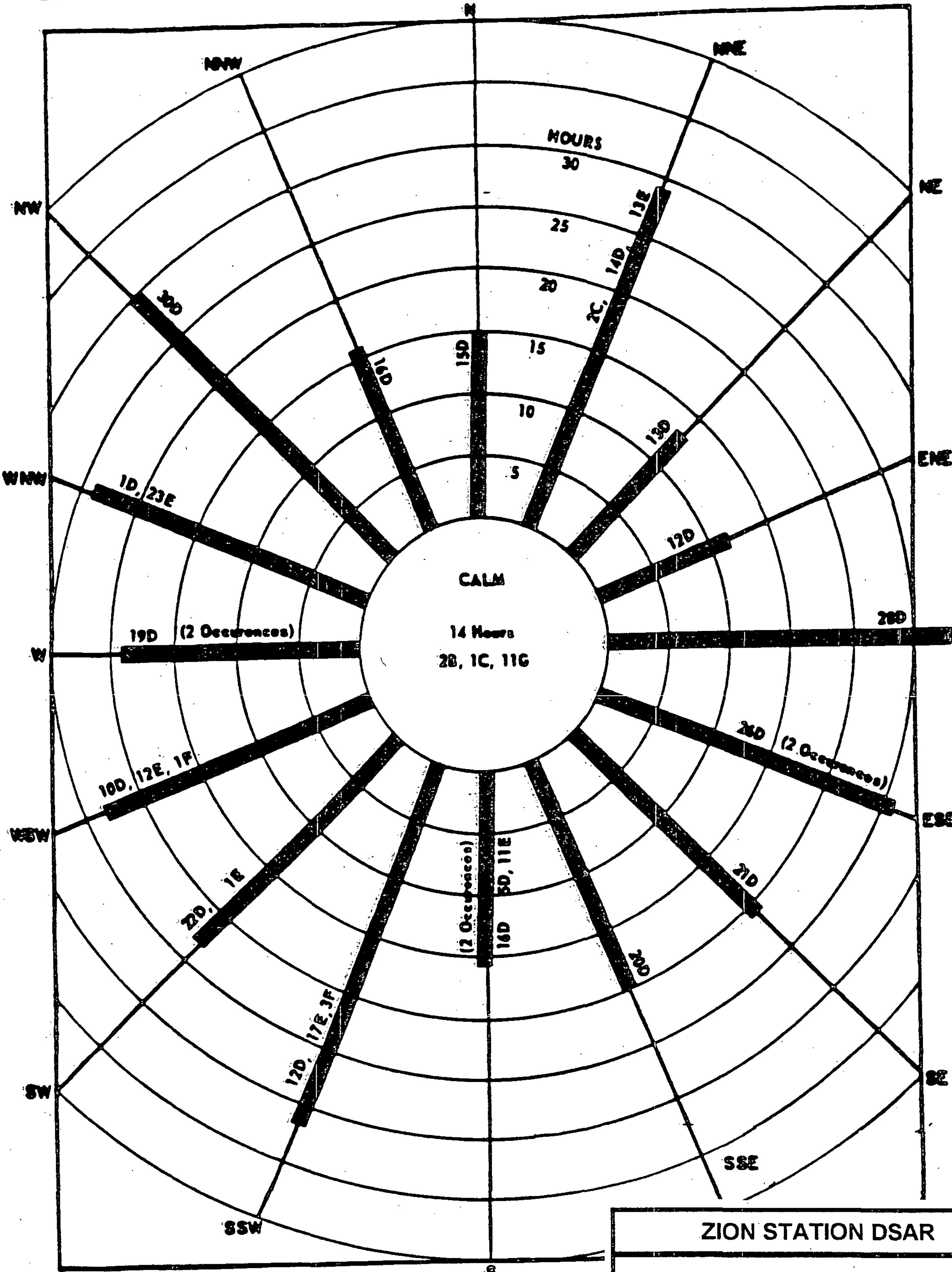


ZION STATION DSAR

Figure 2-7

AVERAGE WIND ROSE FOR THE ZION SITE

AUGUST 1998



Number Is Total Hours Of Each Stability

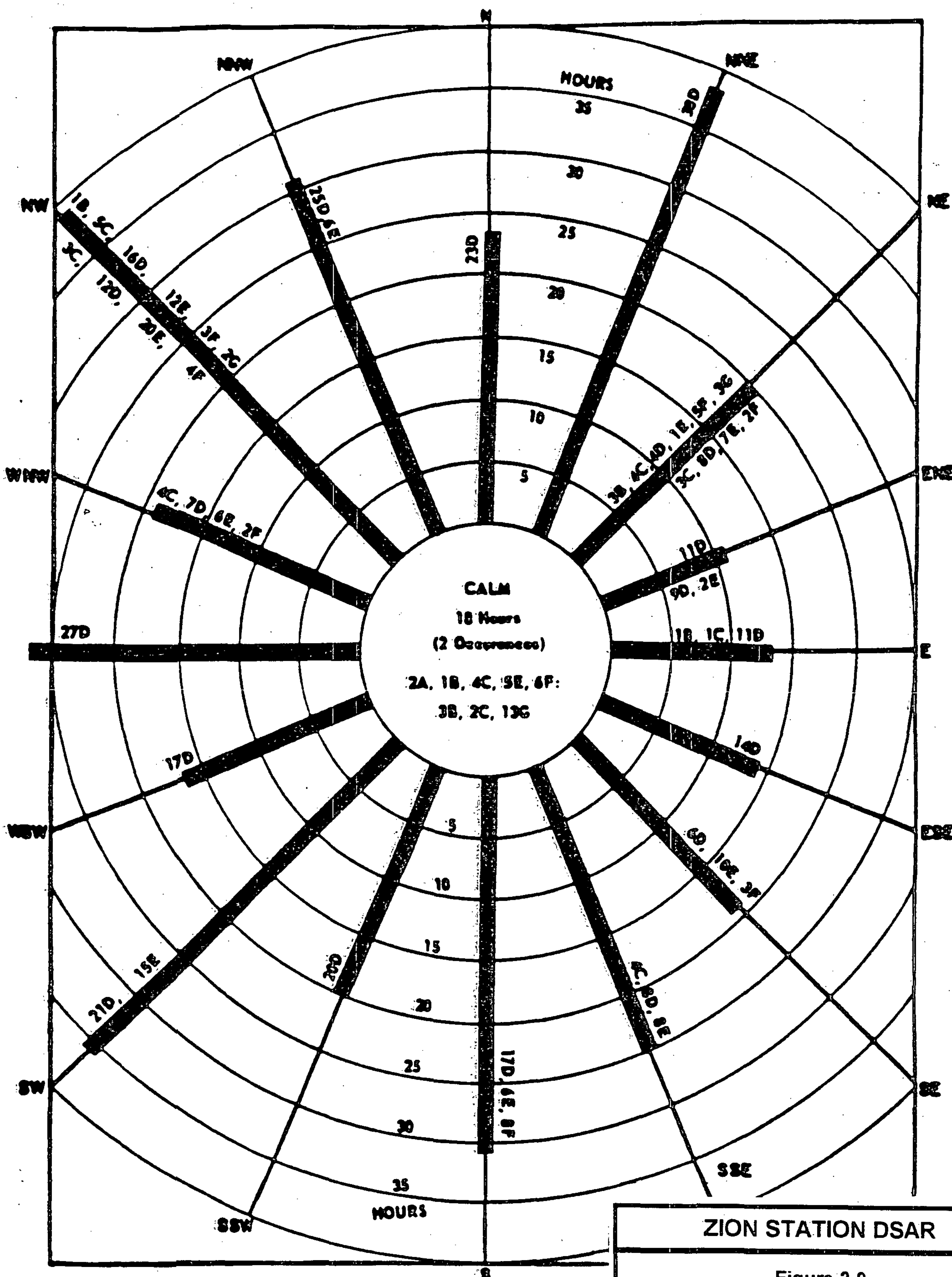
A. . . . . G – Pasquill Stability Class

ZION STATION DSAR

Figure 2-8

WIND DIRECTION PERSISTENCE AT MILWAUKEE

AUGUST 1998



Number Is Total Hours Of Each Stability

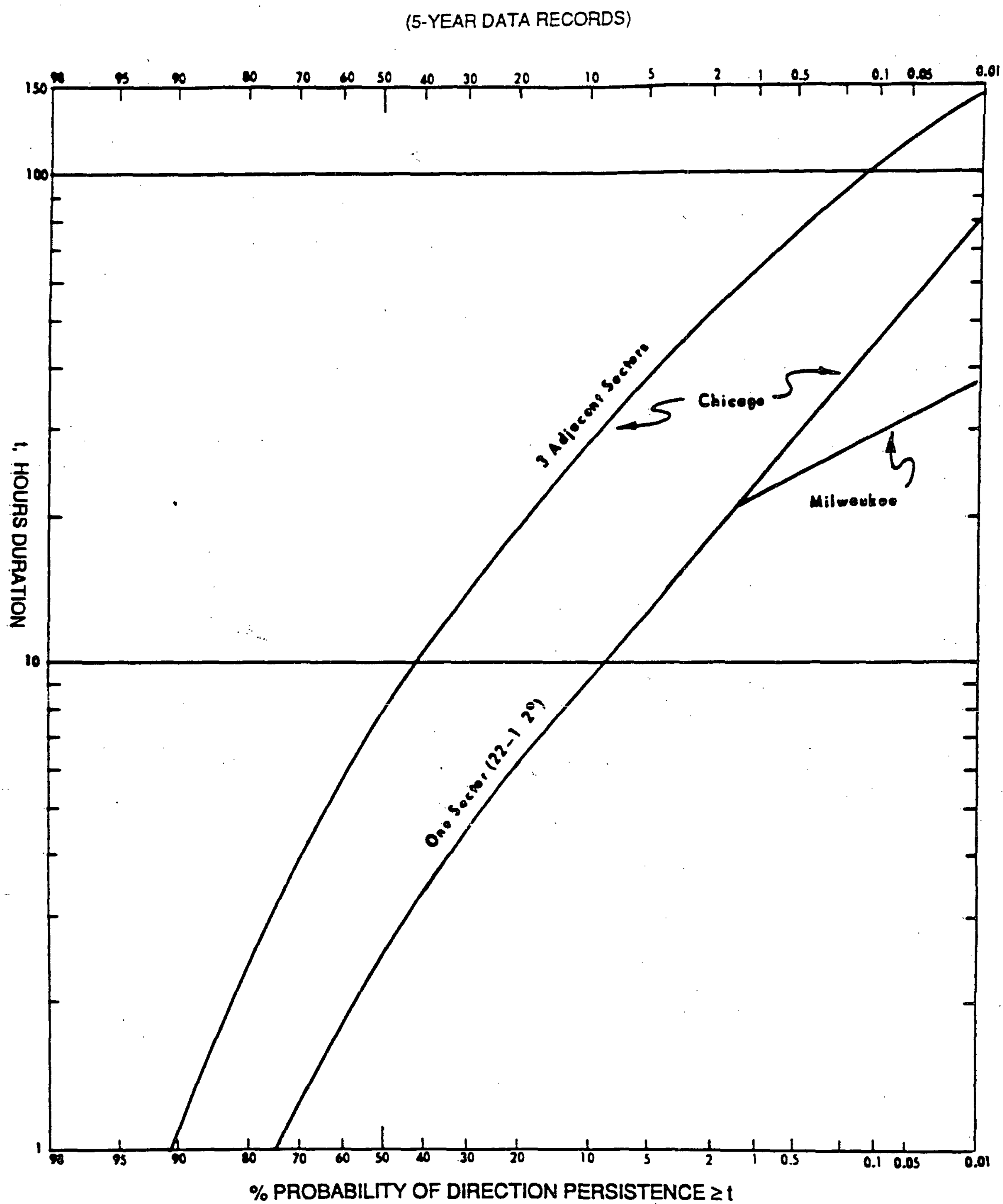
A. . . . . G – Pasquill Stability Class

ZION STATION DSAR

Figure 2-9

WIND DIRECTION PERSISTENCE AT CHICAGO (O'HARE)

AUGUST 1998

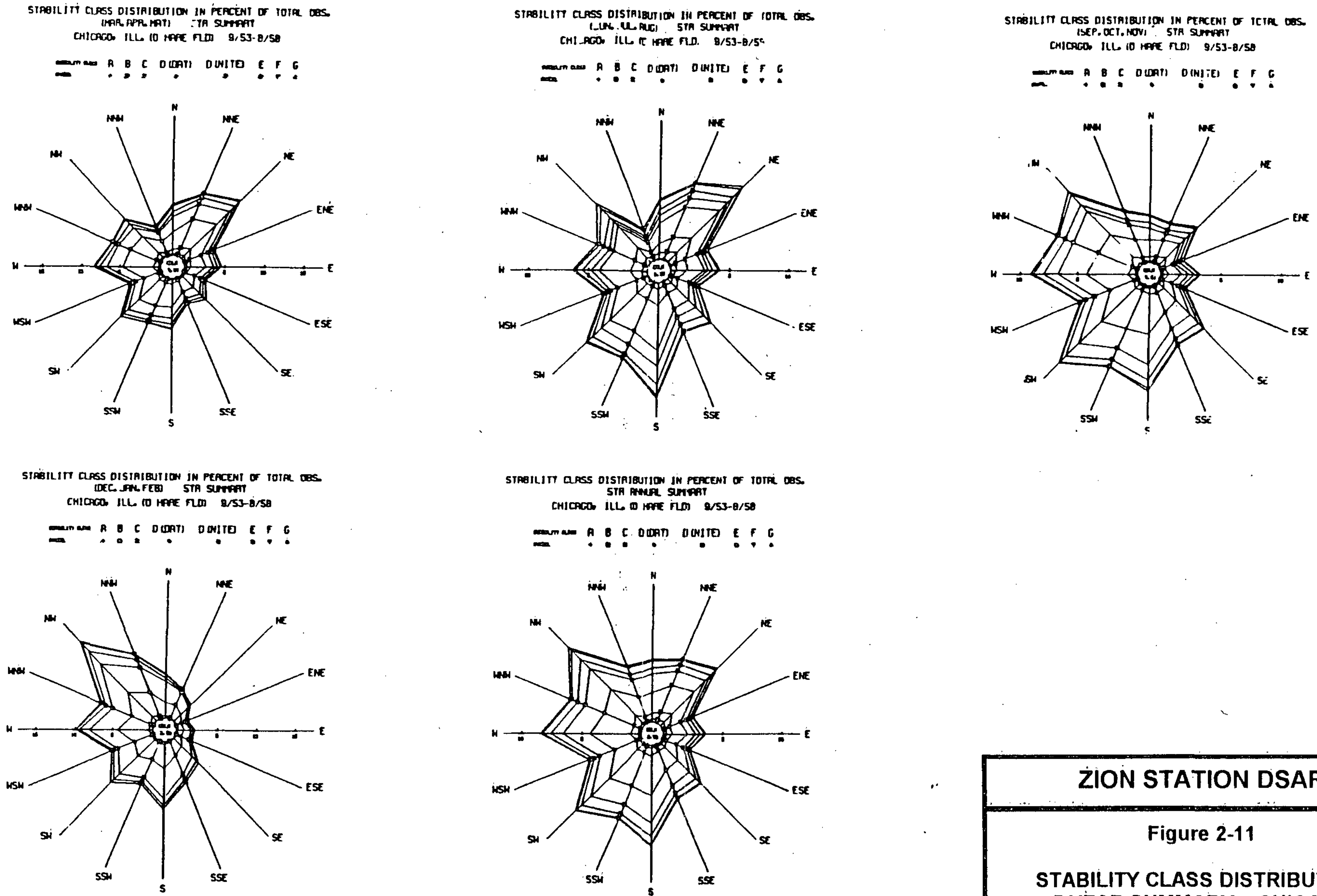


ZION STATION DSAR

Figure 2-10

WIND DIRECTION PERSISTENCE FREQUENCY DISTRIBUTION

AUGUST 1998

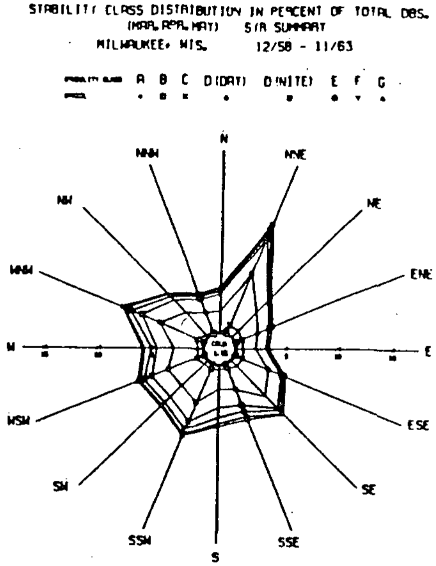


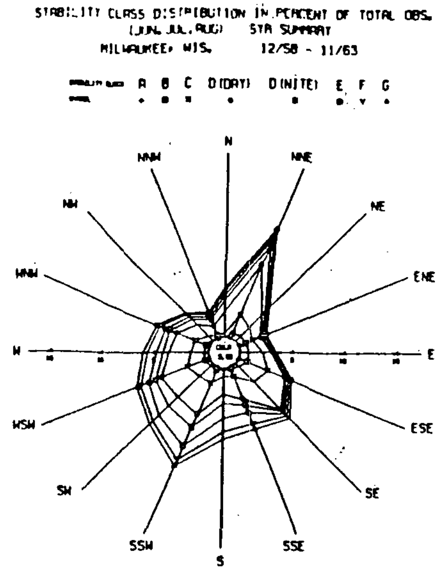
ZION STATION DSAR

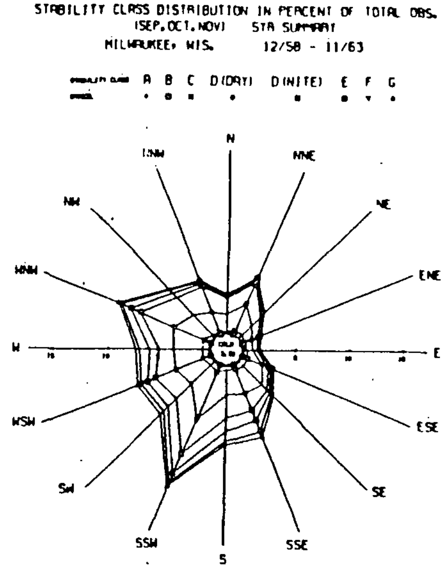
Figure 2-11

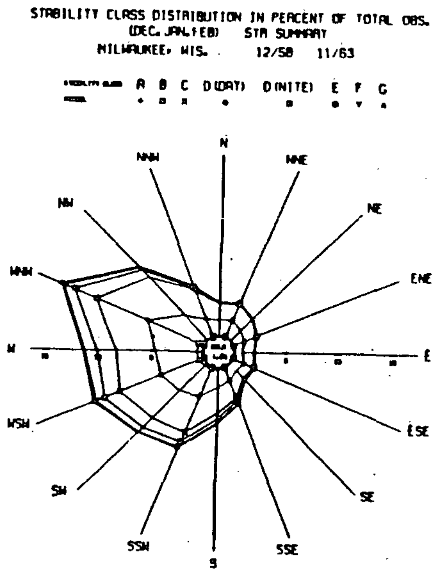
STABILITY CLASS DISTRIBUTION, 5 YEAR SUMMARY – CHICAGO

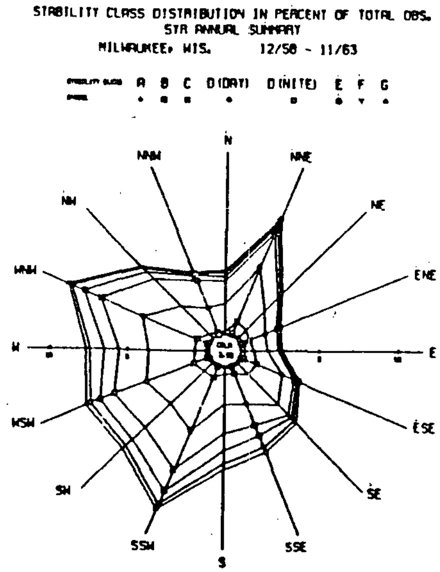
AUGUST 1998









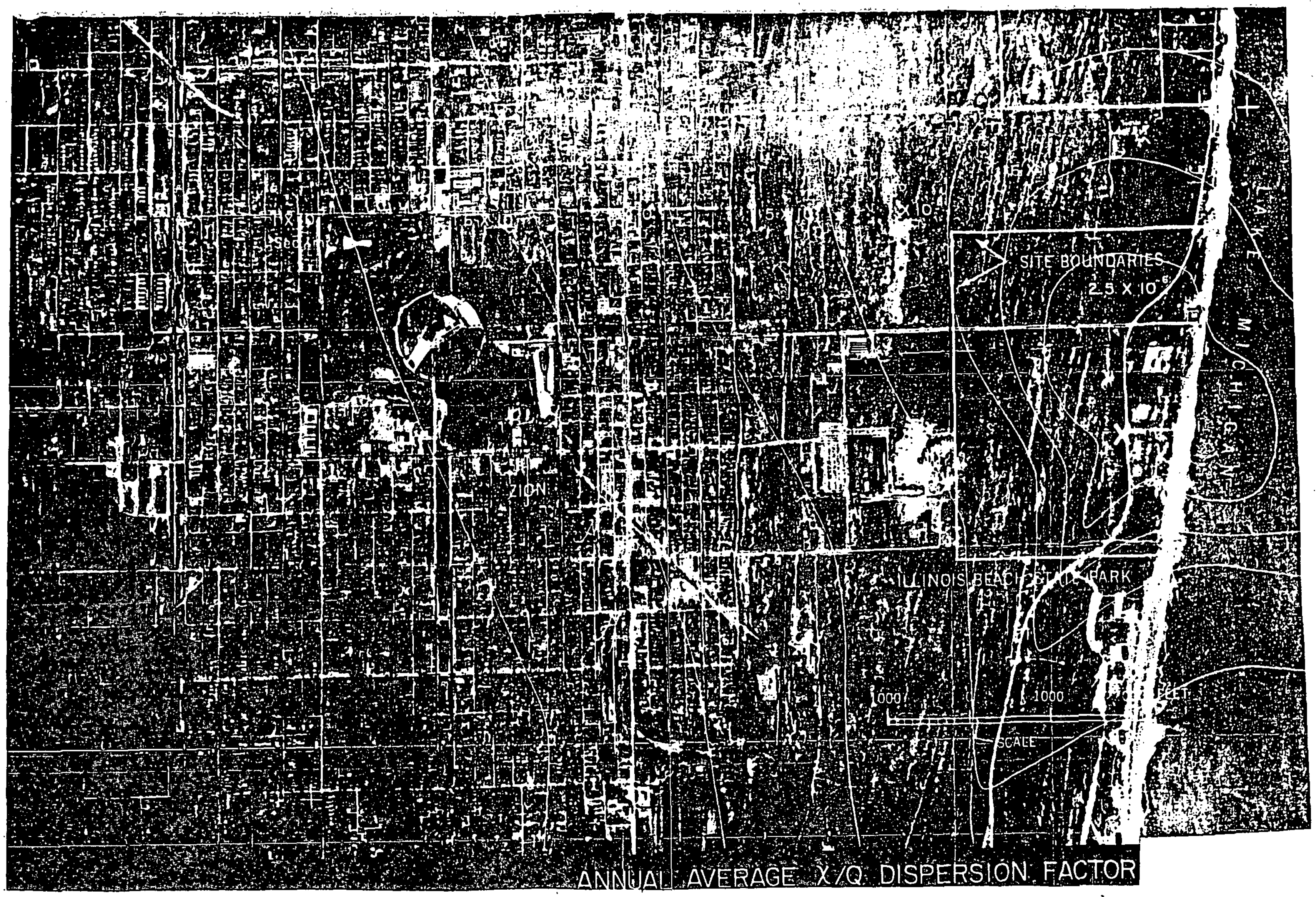


ZION STATION DSAR

Figure 2-12

STABILITY CLASS DISTRIBUTION, 5 YEAR SUMMARY – MILWAUKEE

AUGUST 1998

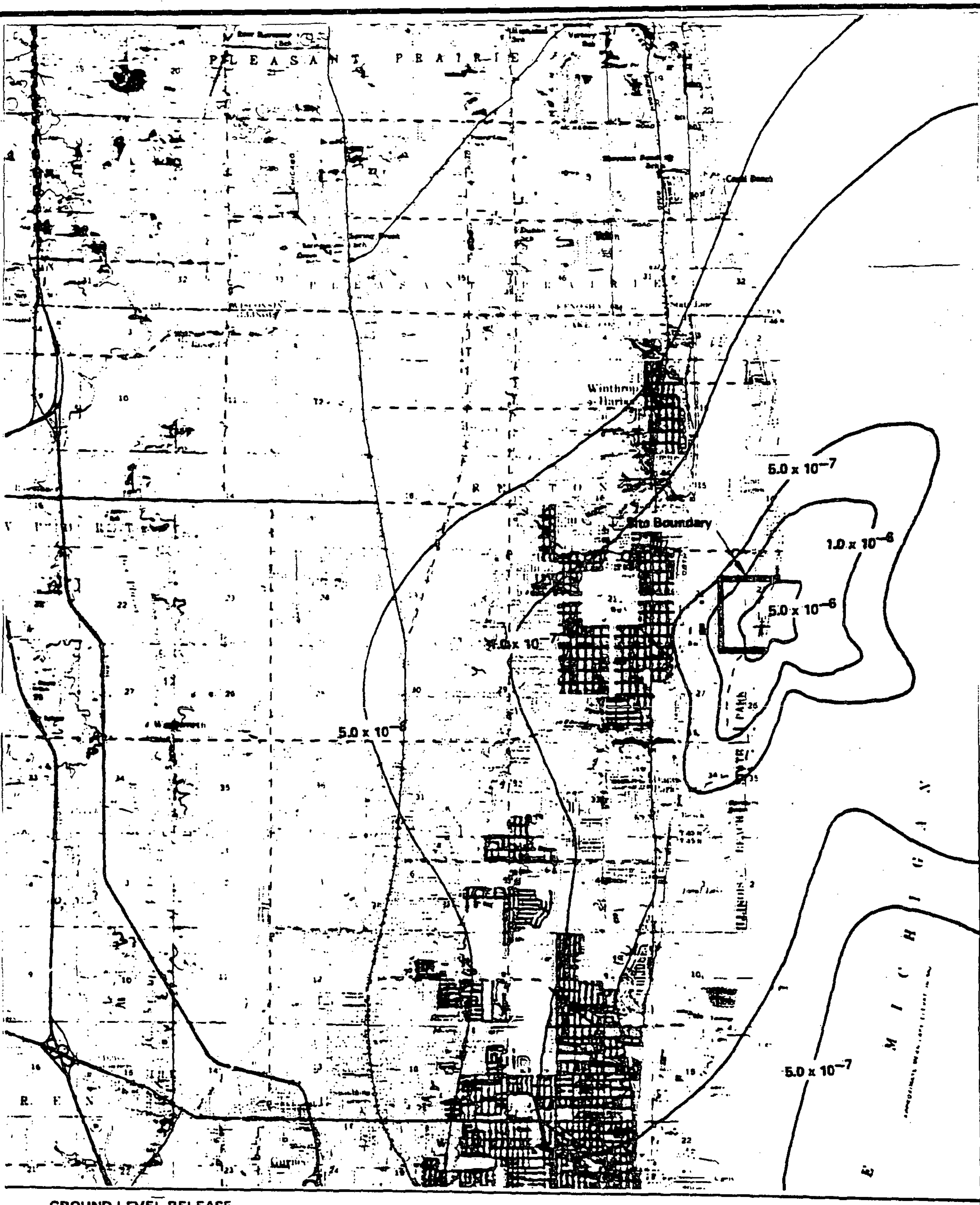


ZION STATION DSAR

Figure 2-13

ANNUAL AVERAGE χ / Q

AUGUST 1998



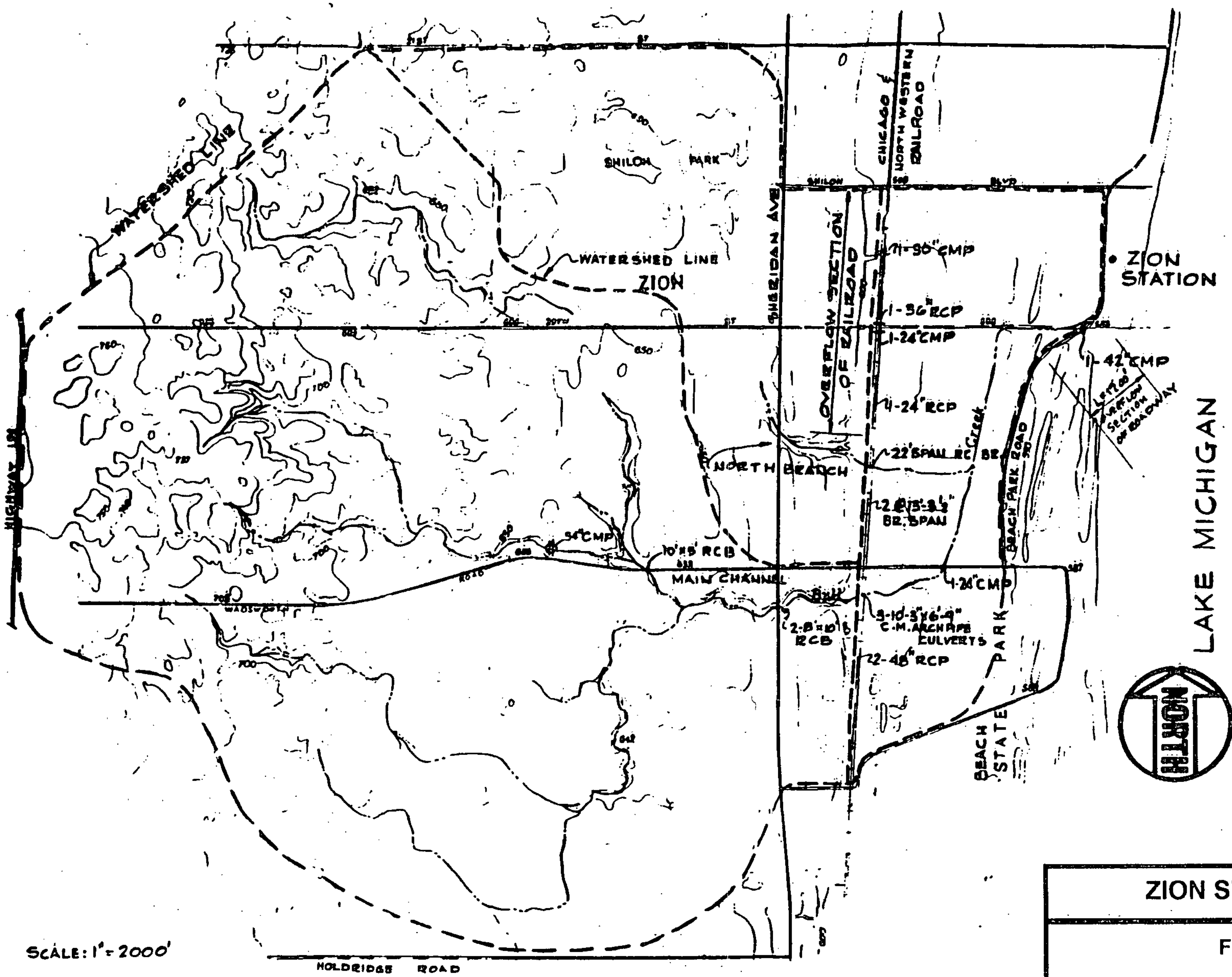
χ /Q ISOPLETHS (35 FT. LEVEL)
UNITS: sec/m^3
SEMI–ANNUAL AVERAGE

ZION STATION DSAR

Figure 2-14

χ / Q ISOPLETHS

AUGUST 1998

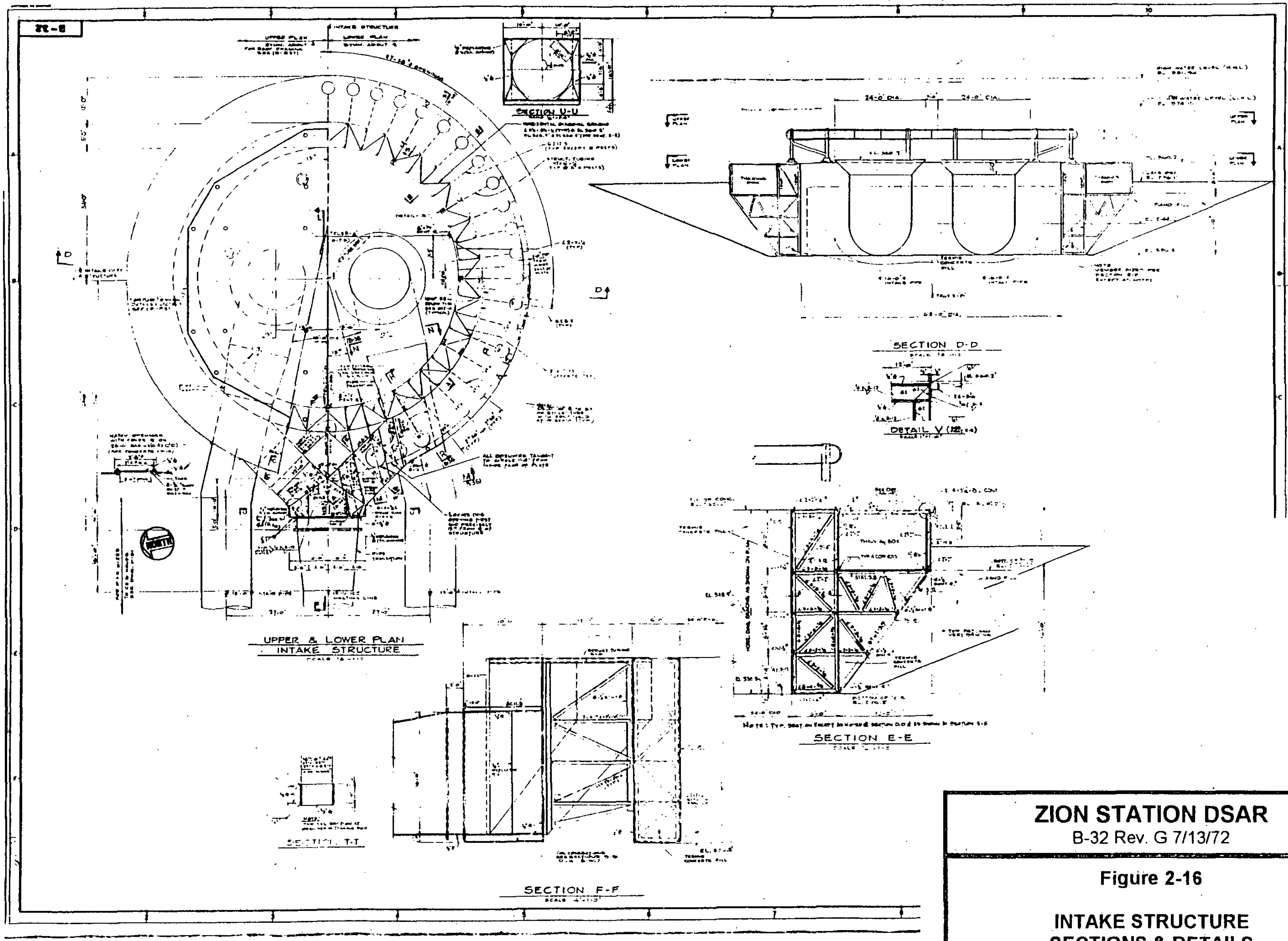


ZION STATION DSAR

Figure 2-15

LOCATION MAP – ZION NUCLEAR POWER STATION AND BULL CREEK DRAINAGE AREA AND STRUCTURES

AUGUST 1998



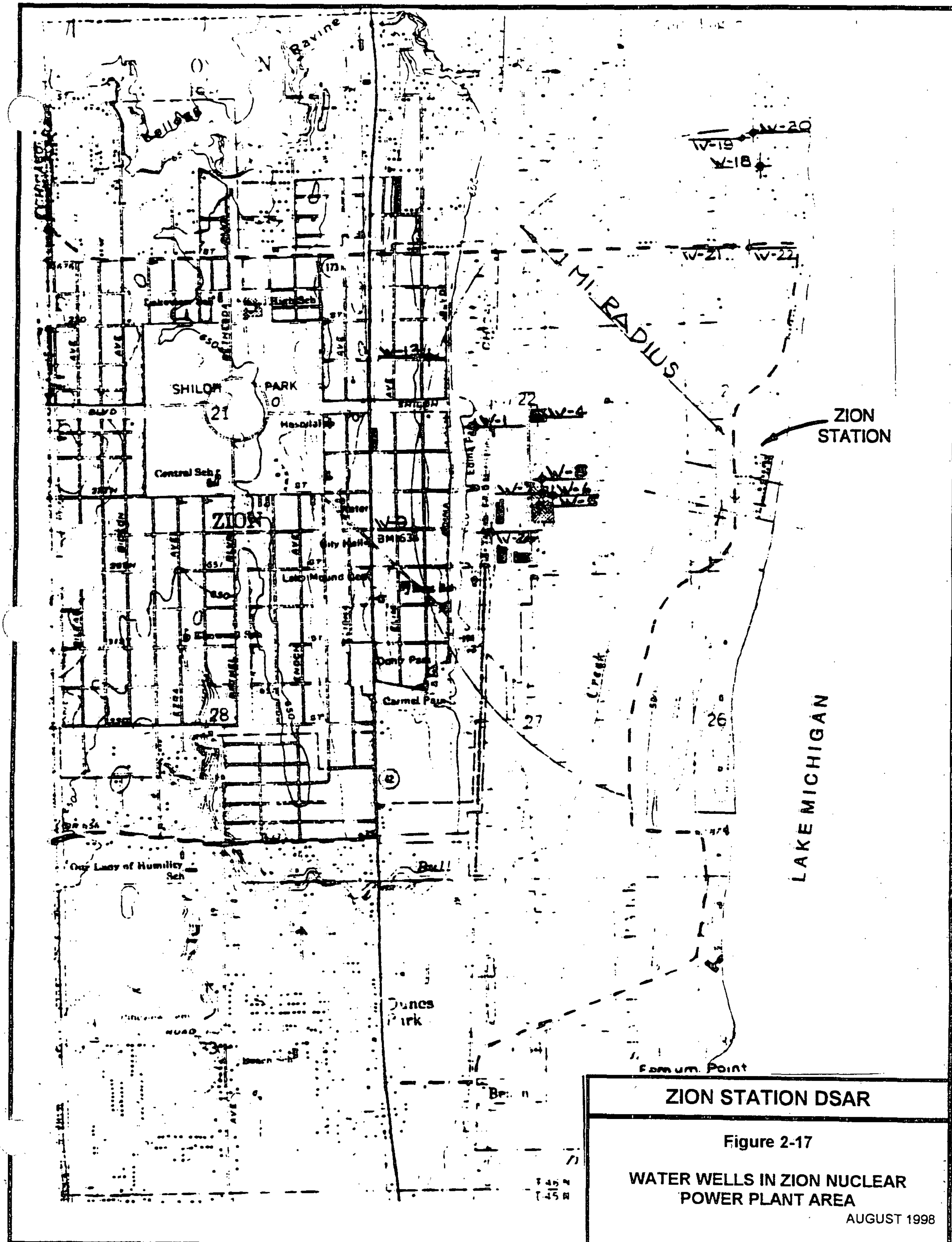
ZION STATION DSAR

B-32 Rev. G 7/13/72

Figure 2-16

INTAKE STRUCTURE SECTIONS & DETAILS

AUGUST 1998

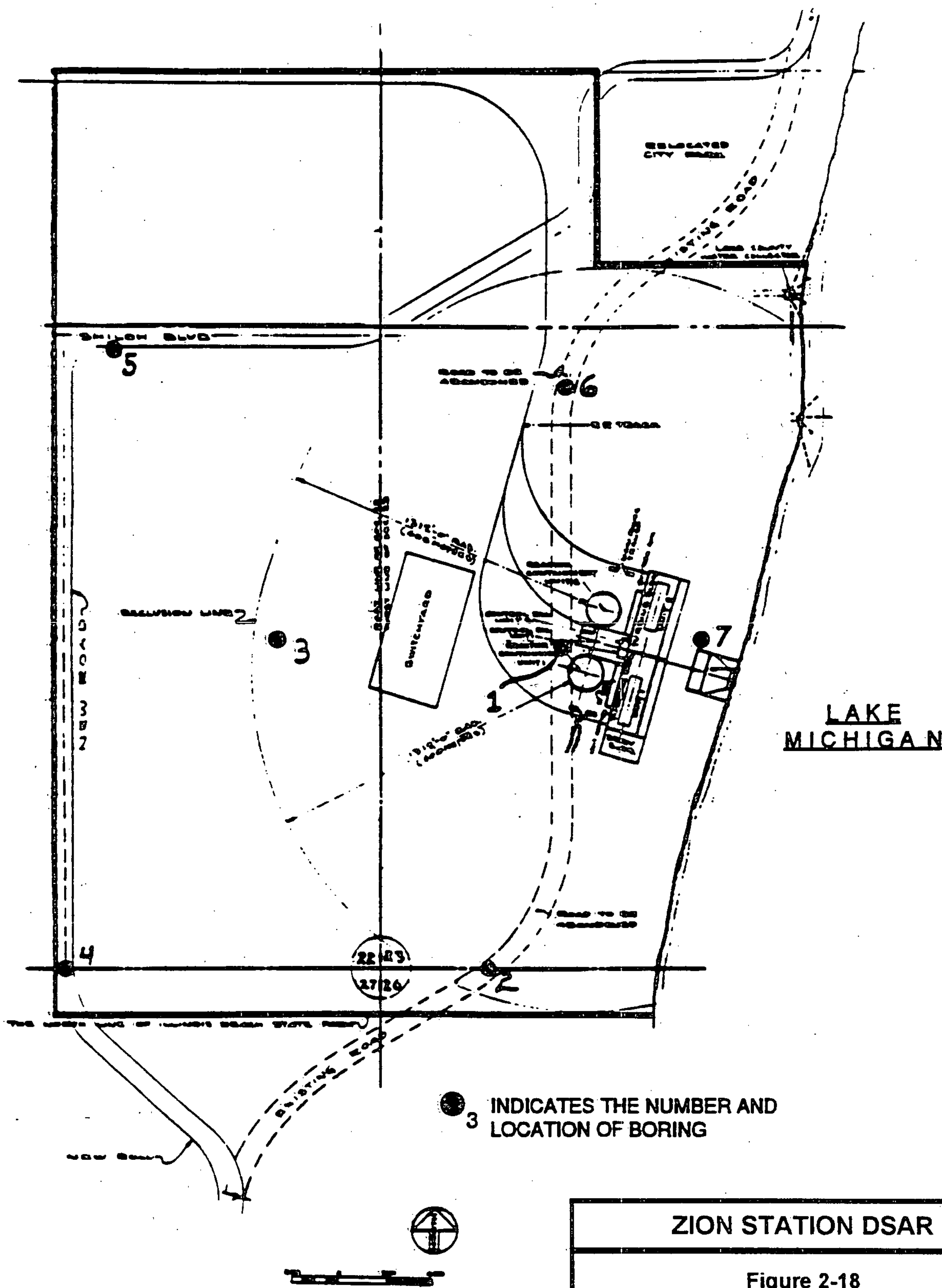


ZION STATION DSAR

Figure 2-17

WATER WELLS IN ZION NUCLEAR POWER PLANT AREA

AUGUST 1998

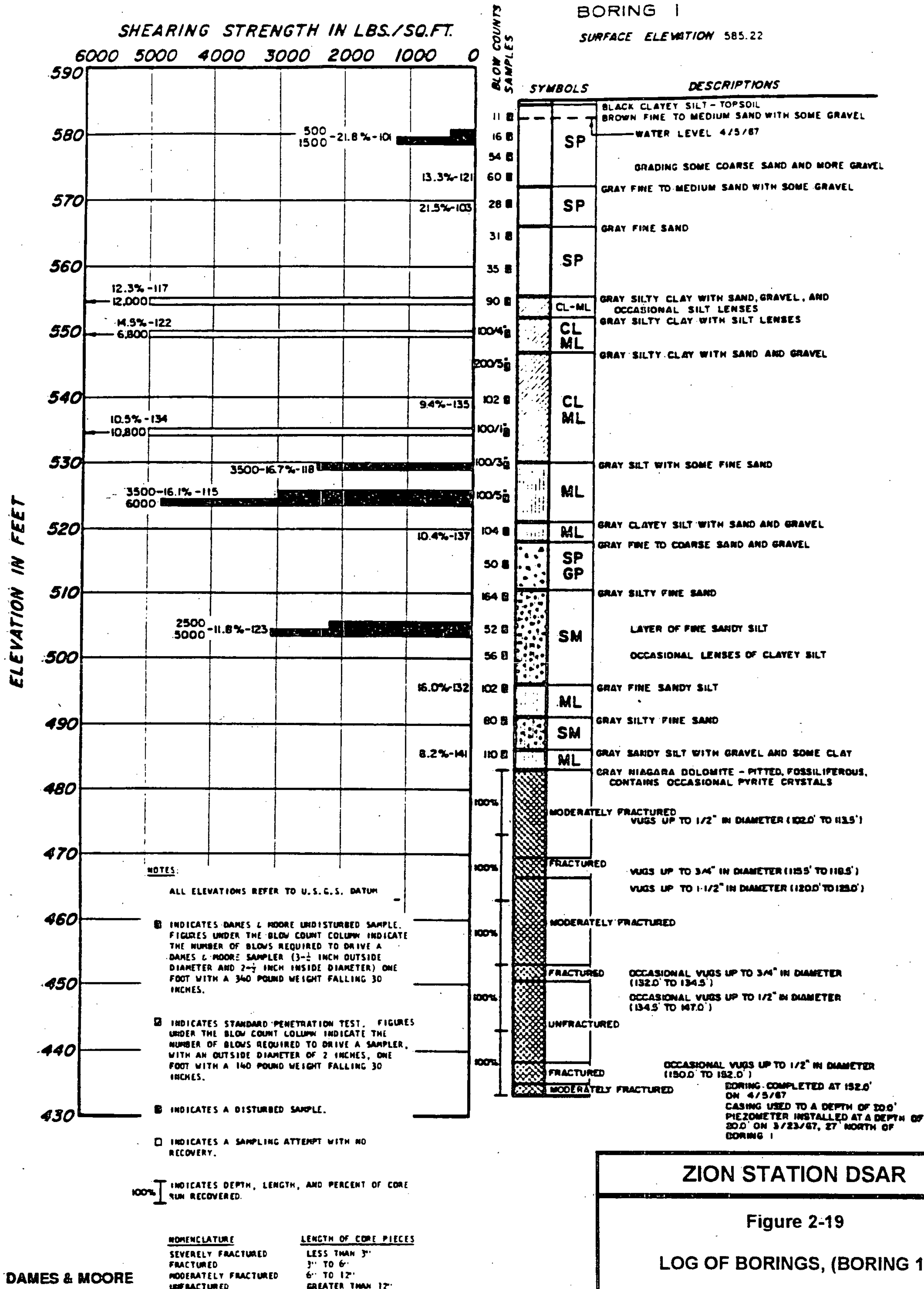


ZION STATION DSAR

Figure 2-18

BORING LOCATION MAP

AUGUST 1998

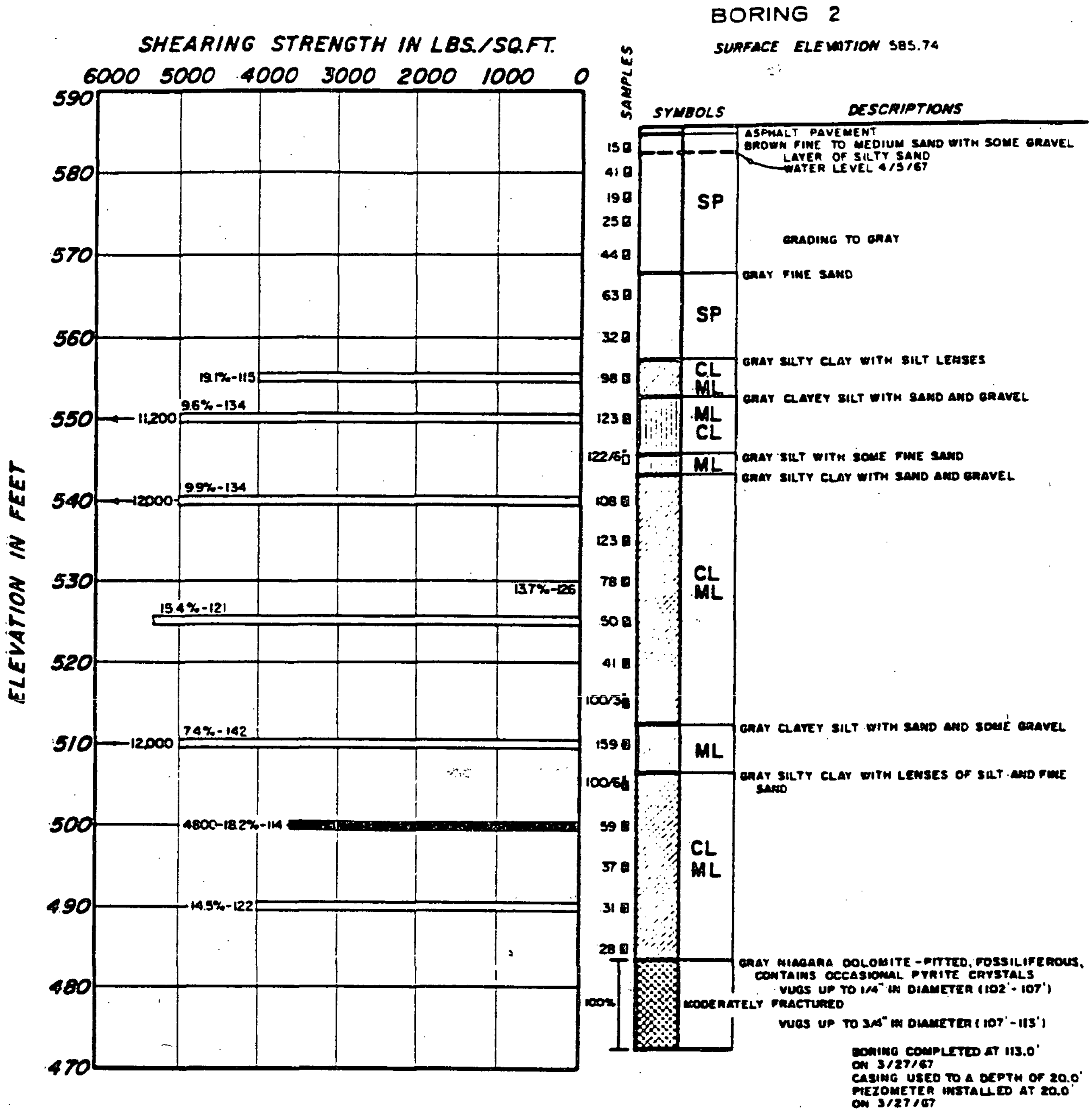


ZION STATION DSAR

Figure 2-19

LOG OF BORINGS, (BORING 1)

AUGUST 1998



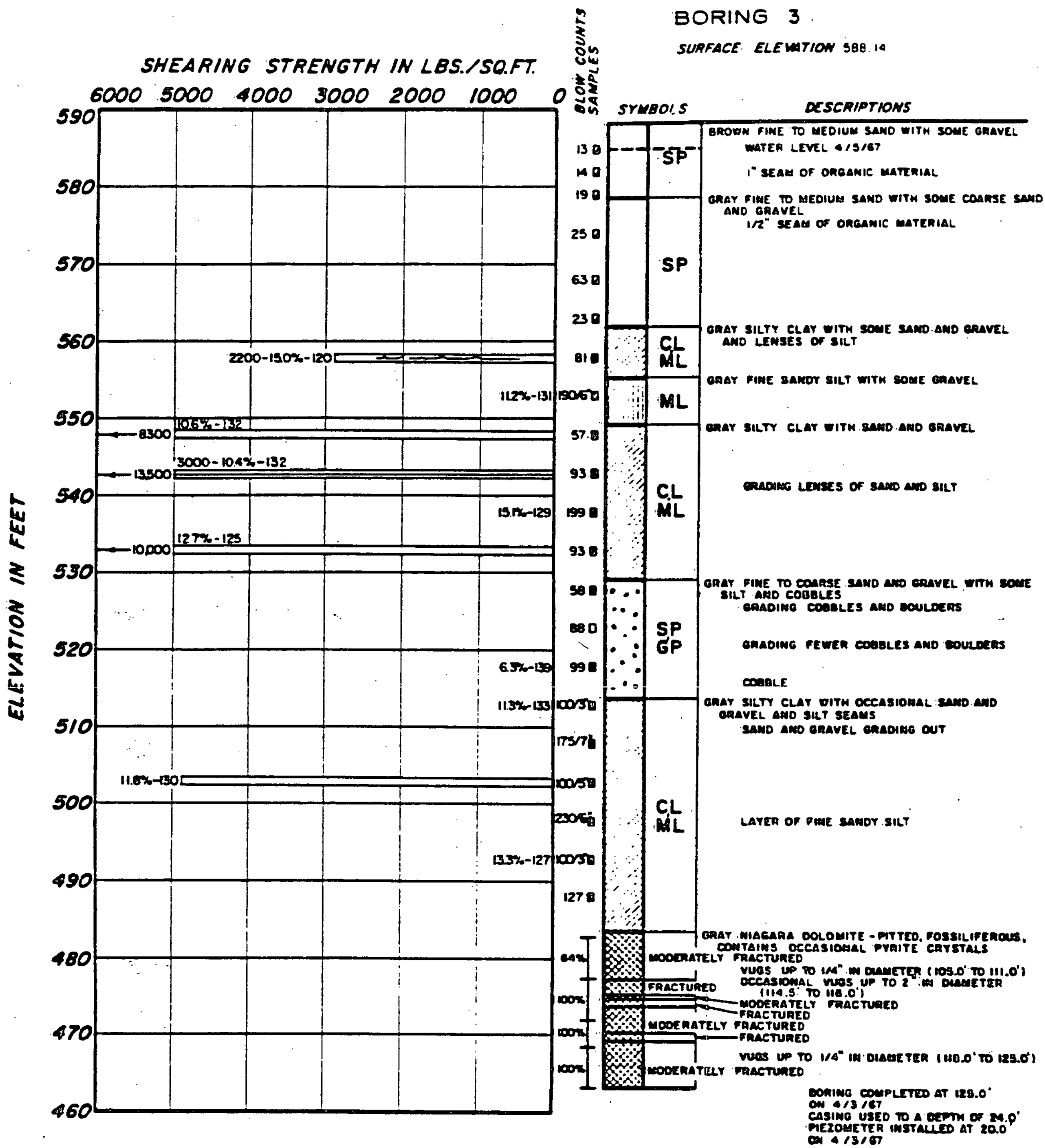
DAMES & MOORE

ZION STATION DSAR

Figure 2-20

LOG OF BORINGS, (BORING 2)

AUGUST 1998



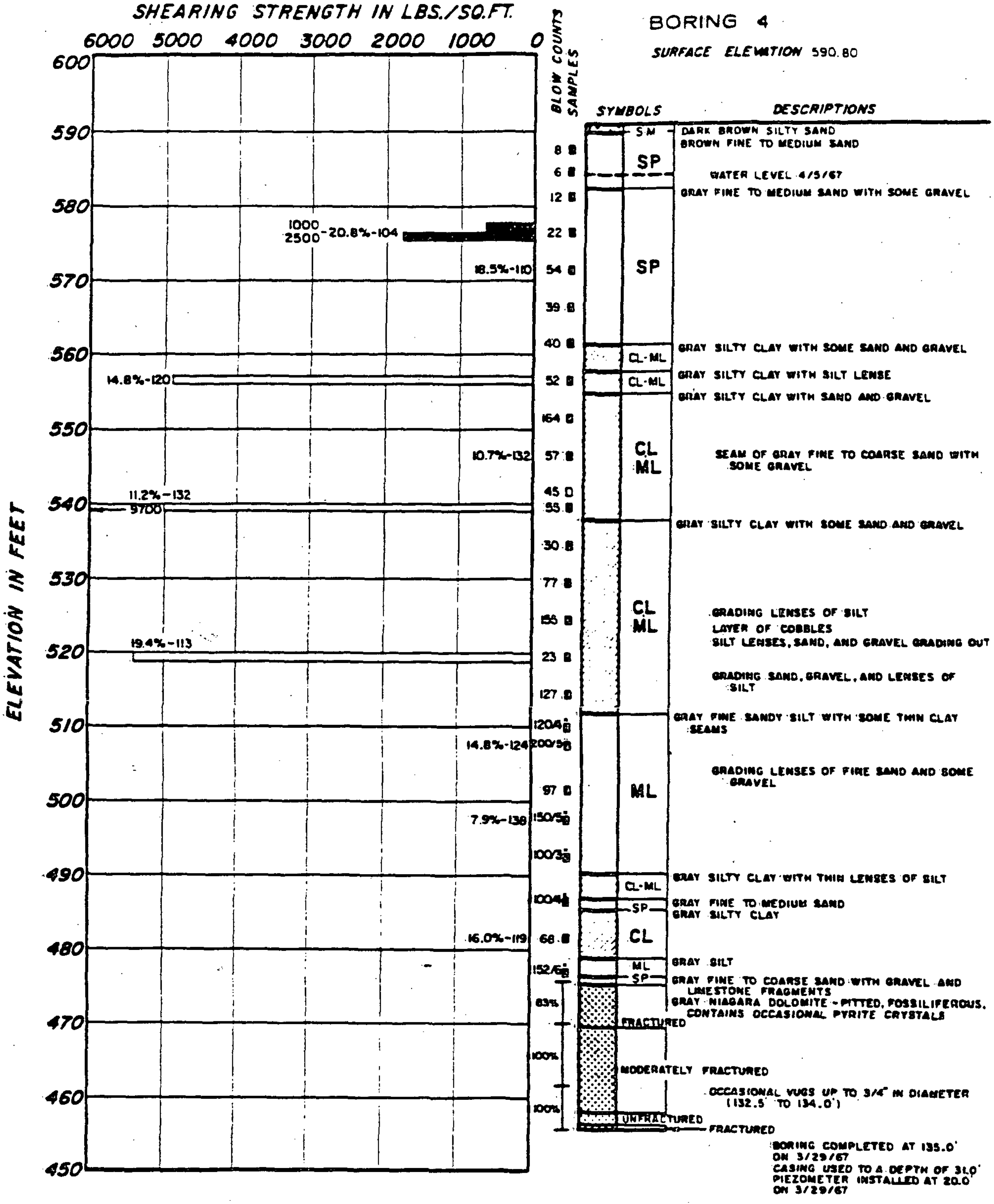
DAMES & MOORE

ZION STATION DSAR

Figure 2-21

LOG OF BORINGS, (BORING 3)

AUGUST 1998



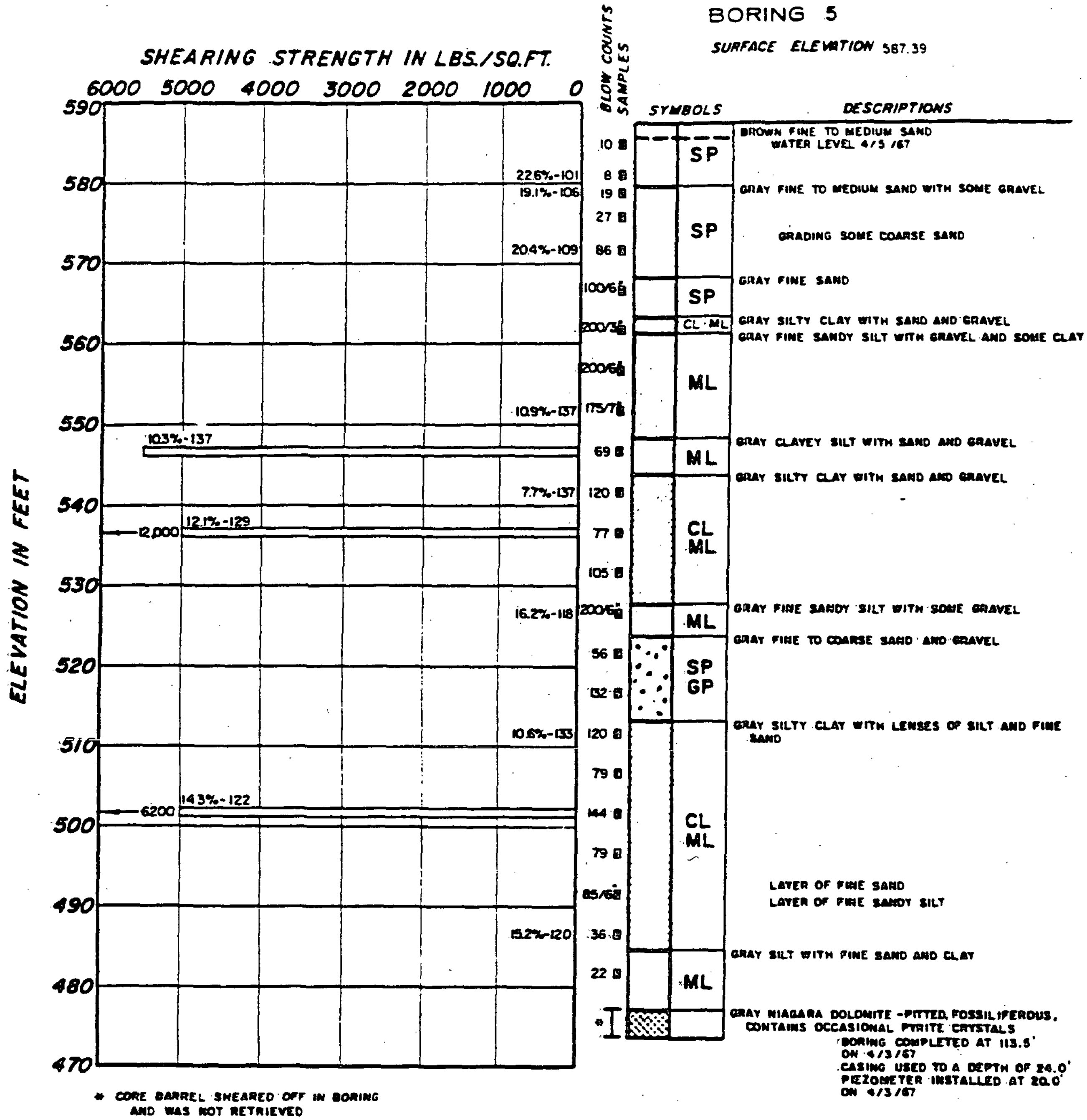
DAMES & MOORE

ZION STATION DSAR

Figure 2-22

LOG OF BORINGS, (BORING 4)

AUGUST 1998



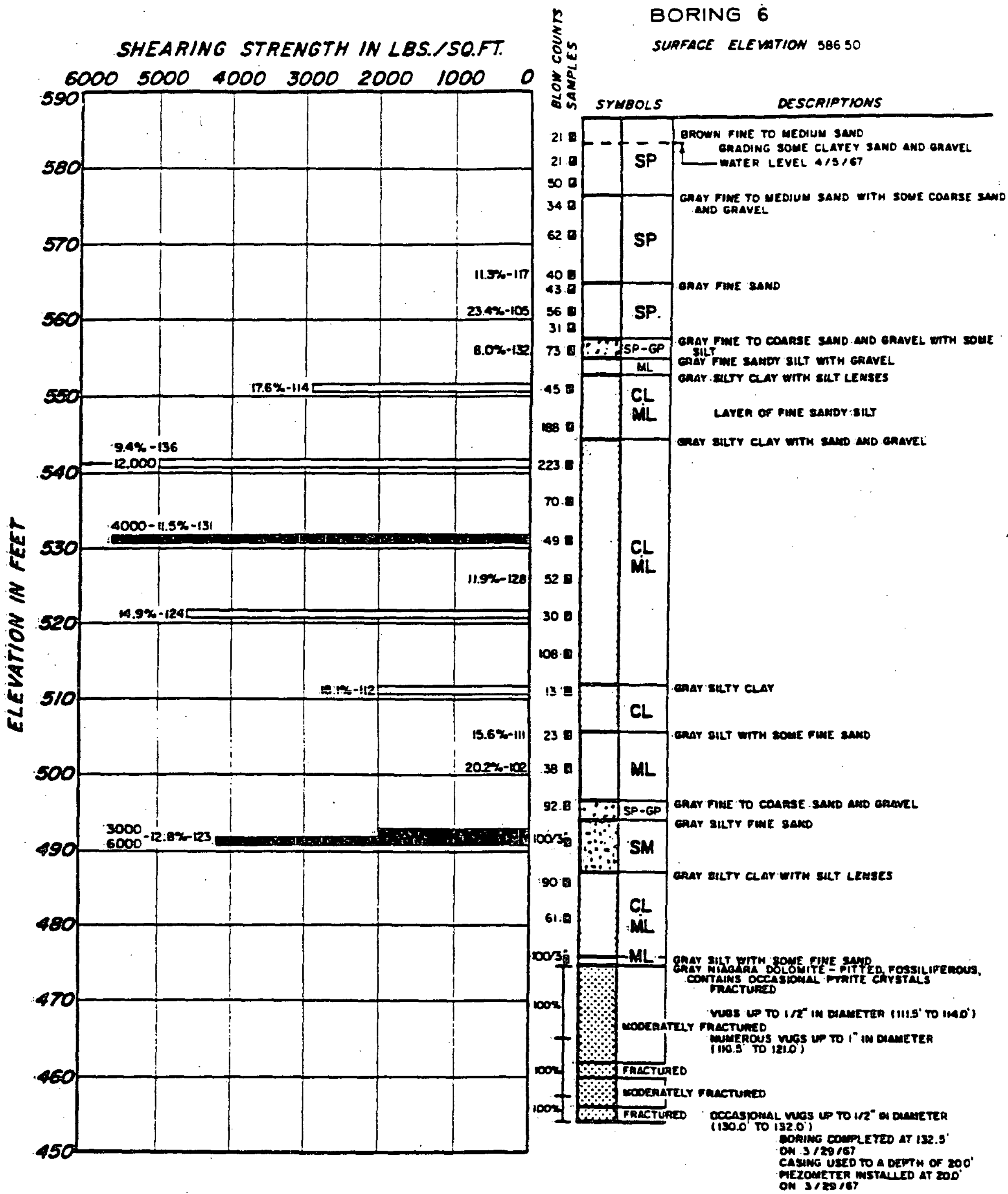
DAMES & MOORE

ZION STATION DSAR

Figure 2-23

LOG OF BORINGS, (BORING 5)

AUGUST 1998



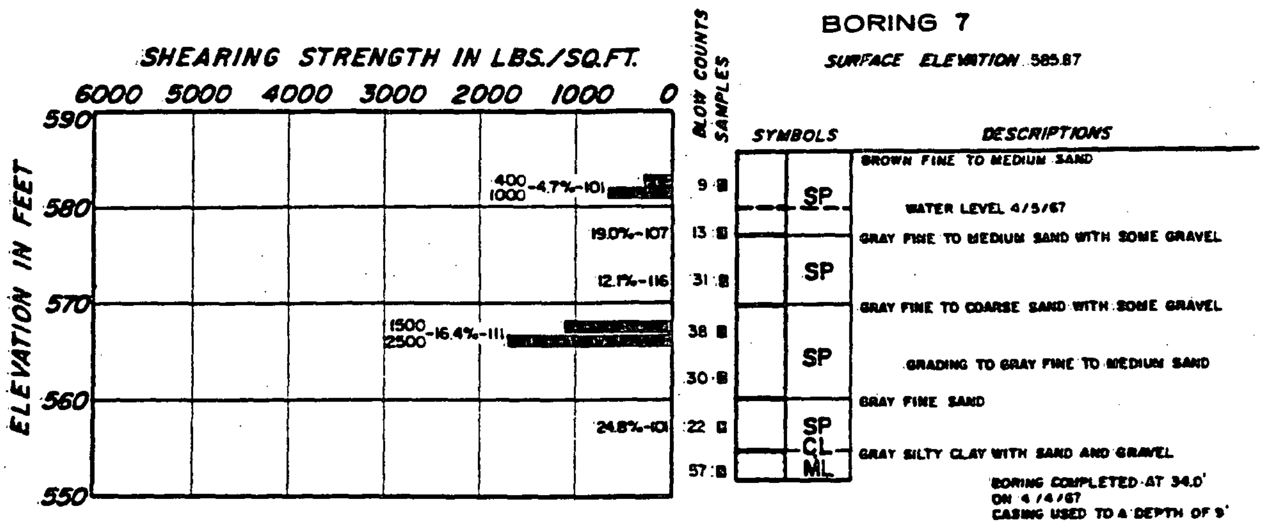
DAMES & MOORE

ZION STATION DSAR

Figure 2-24

LOG OF BORINGS, (BORING 6)

AUGUST 1998



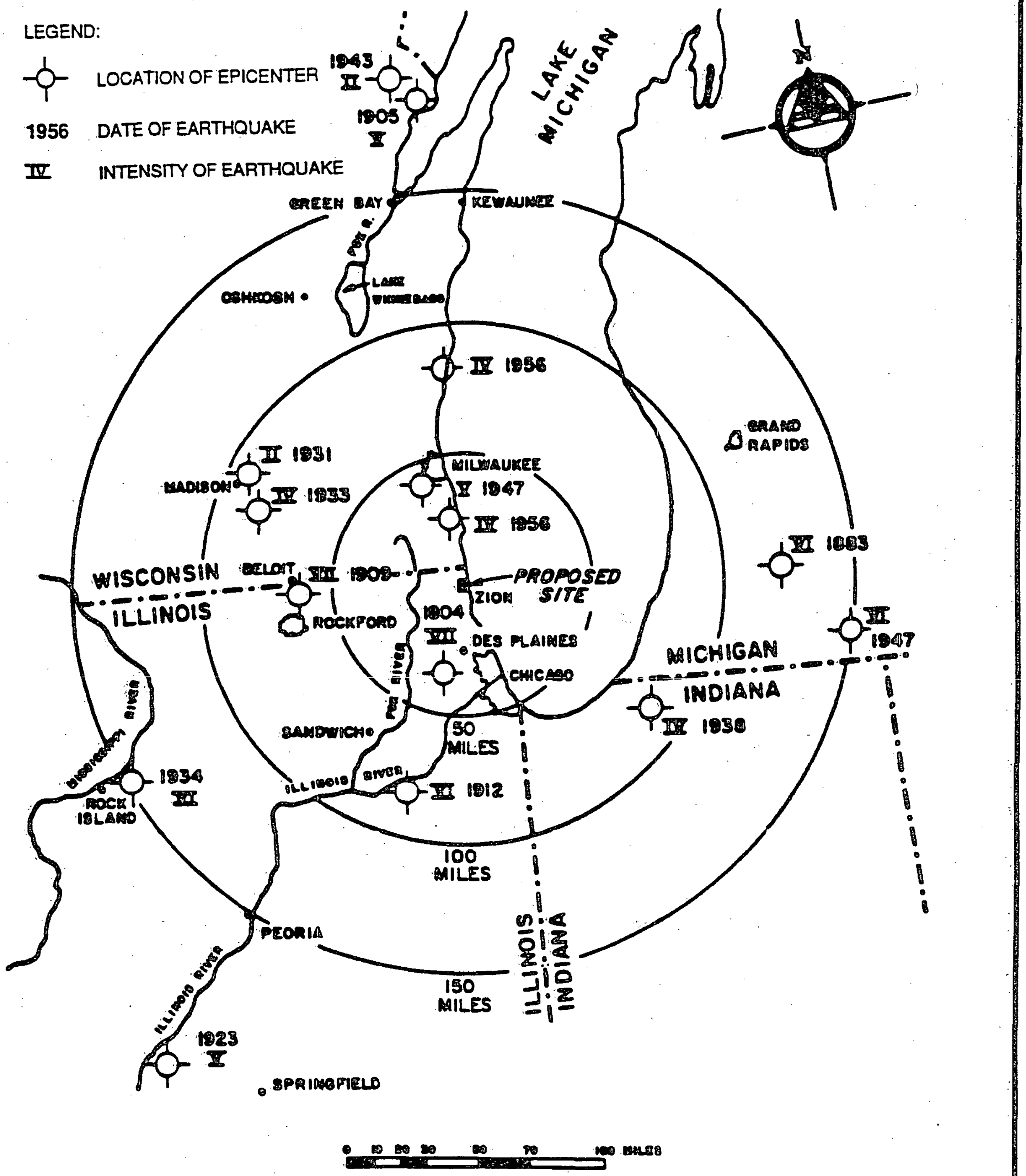
DAMES & MOORE

ZION STATION DSAR

Figure 2-25

LOG OF BORINGS, (BORING 7)

AUGUST 1998



REFERENCE:
VARIOUS RECORDS OF THE U.S.
COAST & GEODETIC SURVEY.

ZION STATION DSAR

Figure 2-26

REGIONAL EARTHQUAKE EVENTS

AUGUST 1998

APPENDIX 2A: FIVE-YEAR STABILITY DATA (WINDIF) FOR CHICAGO AND MILWAUKEE

NOTE: This document was retyped for clarity in the 1992 UFSAR Update.

**** ANNUAL AVERAGE **** * 5 YR DATA * CHICAGO, ILL. (O HARE FLD) 9/53-8/58

** HOURLY STABILITY INDEX DISTRIBUTION ** TOTAL NO OF OBS = 43821

HOUR INDEX	* IN PERCENT OF TOTAL OBS *							* IN PERCENT OF HOURLY OBS *						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
0	0.00	0.00	0.00	1.91	0.96	0.80	0.50	0.00	0.00	0.00	45.89	22.95	19.11	12.05
1	0.00	0.00	0.00	1.98	0.91	0.77	0.51	0.00	0.00	0.00	47.43	21.91	18.46	12.21
2	0.00	0.00	0.00	1.92	0.90	0.87	0.47	0.00	0.00	0.00	46.17	21.69	20.92	11.23
3	0.00	0.00	0.00	1.97	0.88	0.86	0.45	0.00	0.00	0.00	47.21	21.19	20.70	10.90
4	0.00	0.00	0.00	1.99	0.94	0.82	0.42	0.00	0.00	0.00	47.65	22.62	19.72	10.02
5	0.00	0.00	0.30	2.49	0.60	0.54	0.23	0.00	0.00	7.12	59.86	14.40	13.03	5.59
6	0.00	0.09	0.53	2.83	0.36	0.27	0.08	0.00	2.19	12.81	67.91	8.71	6.57	1.81
7	0.00	0.19	0.78	2.90	0.16	0.10	0.02	0.00	4.60	18.74	69.75	3.89	2.47	0.55
8	0.03	0.35	0.83	2.95	0.00	0.00	0.00	0.77	8.49	19.95	70.79	0.00	0.00	0.00
9	0.04	0.47	0.81	2.84	0.00	0.00	0.00	0.99	11.34	19.55	68.13	0.00	0.00	0.00
10	0.07	0.52	0.78	2.80	0.00	0.00	0.00	1.70	12.38	18.67	67.25	0.00	0.00	0.00
11	0.12	0.54	0.90	2.60	0.00	0.00	0.00	2.96	13.03	21.58	62.43	0.00	0.00	0.00
12	0.12	0.47	0.95	2.62	0.00	0.00	0.00	2.90	11.39	22.89	62.81	0.00	0.00	0.00
13	0.08	0.47	0.86	2.75	0.00	0.00	0.00	1.97	11.23	20.70	66.10	0.00	0.00	0.00
14	0.03	0.31	0.78	3.06	0.00	0.00	0.00	0.60	7.34	18.62	73.44	0.00	0.00	0.00
15	0.01	0.29	0.66	3.21	0.00	0.00	0.00	0.16	6.85	15.94	77.05	0.00	0.00	0.00
16	0.00	0.12	0.70	3.34	0.00	0.00	0.00	0.11	2.85	16.87	80.18	0.00	0.00	0.00
17	0.00	0.04	0.55	3.21	0.21	0.11	0.04	0.00	0.99	13.32	76.99	5.15	2.68	0.88
18	0.00	0.00	0.13	3.14	0.51	0.29	0.10	0.00	0.00	3.01	75.41	12.21	6.90	2.46
19	0.00	0.00	0.08	2.56	0.75	0.56	0.21	0.00	0.00	2.03	61.56	18.07	13.36	4.98
20	0.00	0.00	0.00	1.99	0.97	0.86	0.35	0.00	0.00	0.00	47.65	23.27	20.70	8.38
21	0.00	0.00	0.00	2.03	0.90	0.81	0.43	0.00	0.00	0.00	48.74	21.63	19.39	10.24
22	0.00	0.00	0.00	1.97	0.94	0.81	0.44	0.00	0.00	0.00	47.37	22.67	19.44	10.51
23	0.00	0.00	0.00	1.99	0.92	0.73	0.52	0.00	0.00	0.00	47.86	22.07	17.63	12.43

** DAY-NIGHT STABILITY INDEX DISTRIBUTION (IN PERCENT OF TOTAL OBS.) **

INDEX	1	2	3	4	5	6	7
DAY	0.51	3.86	9.66	36.22	0.00	0.00	0.00
NIGHT	0.00	0.00	0.00	24.84	10.94	9.21	4.76

** AVERAGE WIND SPEED FOR EACH STABILITY INDEX (IN KNOTS) **

INDEX	1	2	3	4(D)	4(N)	5	6	7
SPEED	2.1	4.7	7.1	11.5	10.8	7.3	4.2	1.2

** WIND ROSE FOR EACH STABILITY INDEX (IN PERCENT OF EACH INDEX TOTAL) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	5.41	5.41	3.15	3.60	1.35	1.35	1.80	2.70	1.35	4.95	2.70	3.15	1.80	4.95	2.25	3.60	50.45
2	6.86	11.52	5.02	6.21	2.54	5.67	3.96	5.85	3.84	5.50	3.84	5.67	4.26	7.57	4.08	5.56	12.06

**** ANNUAL AVERAGE **** * 5 YR DATA * CHICAGO, ILL. (O HARE FLD) 9/53-8/58

3	7.04	9.95	4.61	5.29	2.86	3.73	4.30	7.21	5.65	6.64	3.64	7.56	5.46	8.65	3.92	4.96	8.53
4(D)	6.73	7.18	2.73	3.52	2.39	4.15	4.60	8.98	8.36	9.33	5.64	9.37	7.72	8.42	4.88	4.79	1.21
4(N)	5.22	5.20	2.01	2.74	2.66	5.70	5.65	9.07	6.84	8.66	5.38	8.88	6.85	9.84	6.17	6.14	2.98
5	4.97	5.49	2.82	3.65	2.42	7.20	6.26	10.50	7.35	9.89	4.78	9.70	6.18	9.79	4.42	4.59	0.00
6	4.58	6.74	2.75	3.86	2.87	5.85	4.73	7.43	3.86	6.09	3.44	7.13	5.65	11.67	6.27	6.32	10.75
7	1.97	3.93	1.49	2.49	1.25	1.63	1.49	3.21	1.82	2.68	1.53	3.31	2.78	6.76	3.55	3.74	56.38

** TOTAL NO OF OBS = 43821 **

** GROSS WIND ROSE (IN PERCENT OF TOTAL OBS) **

NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
5.77	6.73	2.77	3.60	2.50	4.91	4.84	8.43	6.67	8.18	4.81	8.44	6.53	9.11	5.08	5.23	6.40

** STABILITY INDEX DISTRIBUTION FOR EACH WIND DIRECTION (IN PERCENT OF DIRECTION TOTAL) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.47	0.41	0.58	0.51	0.27	0.14	0.19	0.16	0.10	0.31	0.28	0.19	0.14	0.28	0.22	0.35	4.00
2	4.59	6.61	6.99	6.66	3.93	4.46	3.16	2.68	2.22	2.59	3.08	2.60	2.42	3.21	3.10	4.10	7.28
3	11.79	14.27	16.04	14.20	11.06	7.34	8.58	8.26	8.17	7.84	7.31	8.65	8.07	9.17	7.46	9.15	12.88
4(D)	42.30	38.63	35.61	35.45	34.64	30.62	34.43	38.60	45.37	41.31	42.52	40.20	42.85	33.46	34.79	33.13	6.85
4(N)	22.48	19.18	18.01	18.90	26.51	28.86	29.01	26.73	25.47	26.30	27.81	26.14	26.07	26.82	30.20	29.16	11.56
5	9.42	8.91	11.10	11.10	10.60	16.03	14.15	13.62	12.03	13.22	10.87	12.57	10.35	11.75	9.53	9.59	0.00
6	7.32	9.22	9.13	9.89	10.60	10.97	9.01	8.13	5.33	6.86	6.60	7.79	7.97	11.80	11.37	11.12	15.48
7	1.62	2.78	2.55	3.30	2.38	1.58	1.46	1.81	1.30	1.56	1.52	1.87	2.03	3.53	3.33	3.40	41.96

** STABILITY INDEX DISTRIBUTION IN PERCENT OF TOTAL OBS. **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.02	0.01	0.03	0.01	0.02	0.26
2	0.26	0.44	0.19	0.24	0.10	0.22	0.15	0.23	0.15	0.21	0.15	0.22	0.16	0.29	0.16	0.21	0.47
3	0.68	0.96	0.44	0.51	0.28	0.36	0.42	0.70	0.55	0.64	0.35	0.73	0.53	0.84	0.38	0.48	0.82
4(D)	2.44	2.60	0.99	1.28	0.86	1.50	1.67	3.25	3.03	3.38	2.04	3.39	2.80	3.05	1.77	1.73	0.44
4(N)	1.30	1.29	0.50	0.68	0.66	1.42	1.40	2.25	1.70	2.15	1.34	2.21	1.70	2.44	1.53	1.53	0.74
5	0.54	0.60	0.31	0.40	0.26	0.79	0.68	1.15	0.80	1.08	0.52	1.06	0.68	1.07	0.48	0.50	0.00
6	0.42	0.62	0.25	0.36	0.26	0.54	0.44	0.68	0.36	0.56	0.32	0.66	0.52	1.07	0.58	0.58	0.99
7	0.09	0.19	0.07	0.12	0.06	0.08	0.07	0.15	0.09	0.13	0.07	0.16	0.13	0.32	0.17	0.18	2.68

** AVERAGE WIND SPEED FOR EACH STABILITY INDEX AND DIRECTION (IN KNOTS) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1	4.2	4.3	4.4	4.3	5.0	3.7	4.0	3.3	5.0	4.0	4.3	4.0	4.5	4.2	4.4	3.6
2	6.1	5.8	5.9	5.7	5.4	5.0	5.5	5.3	5.3	5.3	5.3	5.1	5.3	4.7	5.2	5.1
3	8.0	7.6	7.5	7.1	7.8	6.8	7.6	7.9	8.8	8.9	8.6	8.1	8.5	7.4	6.9	6.6
4(D)	10.3	9.1	8.6	8.5	8.8	10.0	11.4	11.7	13.8	13.2	13.7	13.8	13.6	11.1	10.2	9.3
4(N)	9.4	9.1	8.2	7.8	9.4	10.2	11.3	12.0	13.1	12.8	13.2	12.7	12.3	10.5	10.4	9.2

**** ANNUAL AVERAGE **** * 5 YR DATA * CHICAGO, ILL. (O HARE FLD) 9/53-8/58

5	6.6	6.3	6.1	6.1	6.8	7.0	7.3	7.4	7.8	7.8	8.0	7.7	7.8	7.5	7.3	6.5
6	4.5	4.5	4.7	4.6	4.8	4.8	4.9	4.9	4.9	4.8	4.9	4.9	4.8	4.8	4.7	4.6
7	2.9	2.8	2.7	2.7	2.8	2.9	2.9	2.9	2.7	2.8	2.8	2.9	2.8	2.8	2.8	2.9

** HOURLY STABILITY INDEX DISTRIBUTION ** TOTAL NO OF OBS = 43813

HOUR INDEX	* IN PERCENT OF TOTAL OBS *							* IN PERCENT OF HOURLY OBS *						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
0	0.00	0.00	0.00	2.20	0.00	0.73	0.44	0.00	0.00	0.00	52.82	19.18	17.42	10.58
1	0.00	0.00	0.00	2.20	0.83	0.67	0.46	0.00	0.00	0.00	52.91	19.90	16.06	11.13
2	0.00	0.00	0.00	2.25	0.83	0.60	0.46	0.00	0.00	0.00	54.85	19.99	14.51	11.45
3	0.00	0.00	0.00	2.20	0.87	0.63	0.46	0.00	0.00	0.00	52.79	20.97	15.12	11.12
4	0.00	0.00	0.00	2.22	0.82	0.68	0.45	0.00	0.00	0.00	53.23	19.61	16.32	10.04
5	0.00	0.00	0.26	2.73	0.52	0.41	0.25	0.00	0.00	6.35	65.39	12.43	9.86	5.97
6	0.00	0.00	0.52	2.92	0.31	0.22	0.11	0.00	2.03	12.49	70.15	7.56	5.28	2.57
7	0.00	0.12	0.73	3.84	0.16	0.89	0.03	0.22	2.85	17.59	72.88	3.73	2.14	0.82
8	0.01	0.22	0.83	3.11	0.00	0.00	0.00	0.00	5.26	19.84	74.68	0.00	0.00	0.00
9	0.00	0.35	0.81	3.01	0.00	0.00	0.00	0.00	8.49	19.34	72.16	0.00	0.00	0.00
10	0.00	0.32	0.87	2.97	0.00	0.00	0.00	0.71	7.73	20.88	71.48	0.00	0.00	0.00
11	0.03	0.42	1.86	2.65	0.00	0.00	0.00	0.00	10.88	25.52	63.69	0.00	0.00	0.00
12	0.04	0.40	1.86	2.67	0.00	0.00	0.00	0.16	9.53	25.52	64.87	0.00	0.00	0.00
13	0.01	0.36	0.97	2.83	0.00	0.00	0.00	0.00	8.68	23.29	67.95	0.00	0.00	0.00
14	0.00	0.13	0.81	3.23	0.00	0.00	0.00	0.00	3.18	19.44	77.38	0.00	0.00	0.00
15	0.00	0.10	0.66	3.48	0.00	0.00	0.00	0.00	2.52	15.88	81.68	0.00	0.00	0.00
16	0.00	0.06	0.54	3.56	0.00	0.00	0.00	0.00	1.48	12.99	85.53	0.00	0.00	0.00
17	0.00	0.01	0.47	3.33	0.21	0.11	0.03	0.00	0.33	11.17	79.90	5.09	2.68	0.02
18	0.00	0.00	0.07	3.36	0.40	0.26	00.00	0.00	0.00	1.78	80.50	9.53	6.35	1.92
19	0.00	0.00	0.10	2.74	0.69	0.47	0.16	0.00	0.00	2.38	65.77	16.65	11.39	3.89
20	0.00	0.00	0.00	2.18	0.89	0.79	0.30	0.00	0.00	0.00	52.27	21.48	19.81	7.23
21	0.00	0.00	0.00	2.16	0.89	0.76	0.36	0.00	0.00	0.00	51.92	21.25	18.18	8.65
22	0.00	0.00	0.00	2.17	0.88	0.67	0.45	0.00	0.00	0.00	52.88	21.14	15.99	10.79
23	0.00	0.00	0.00	2.20	0.81	0.67	0.48	0.00	0.00	0.00	52.68	19.55	16.16	11.61

** DAY-NIGHT STABILITY INDEX DISTRIBUTION (IN PERCENT OF TOTAL OBS.) **

INDEX	1	2	3	4	5	6	7
DAY	0.08	2.59	9.76	37.84	0.00	0.00	0.00
NIGHT	0.00	0.00	0.00	27.49	9.92	7.77	4.56

** AVERAGE WIND SPEED FOR EACH STABILITY INDEX (IN KNOTS) **

INDEX	1	2	3	4(D)	4(N)	5	6	7
SPEED	3.7	5.7	8.0	11.7	11.2	7.2	4.3	1.6

** WIND ROSE FOR EACH STABILITY INDEX (IN PERCENT OF EACH INDEX TOTAL) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	2.78	11.11	5.56	16.67	22.22	0.00	0.00	0.00	2.78	0.00	5.56	11.11	2.78	0.00	2.78	2.78	13.89

**** ANNUAL AVERAGE **** * 5 YR DATA * MILWAUKEE, WIS. 12/58-11/63 5/16 66 YSK

2	6.18	9.62	9.62	10.33	10.59	7.41	3.00	3.44	5.83	4.85	6.53	7.24	6.35	3.18	0.97	1.24	2.82
3	8.39	5.94	4.14	5.75	9.17	8.86	4.79	4.26	7.18	6.94	9.52	7.44	7.81	3.55	2.17	1.45	2.64
4(D)	9.73	4.36	2.77	2.15	4.02	7.31	5.41	5.81	9.58	7.87	8.38	7.38	9.52	6.68	4.37	4.73	0.21
4(N)	8.59	4.37	2.97	2.47	2.95	3.29	5.15	6.63	9.63	7.68	7.81	6.56	10.34	0.61	6.79	5.88	1.05
5	5.48	2.02	0.92	0.74	1.60	2.55	6.95	10.56	14.52	11.30	9.71	9.78	12.15	0.01	2.95	2.69	0.00
6	3.50	1.73	1.02	1.38	1.05	3.23	10.55	10.64	11.31	7.14	8.55	11.81	11.02	4.64	2.32	3.14	5.05
7	2.05	1.55	1.29	1.58	1.75	5.11	8.16	8.76	7.41	6.16	7.21	6.51	4.56	2.45	2.10	2.45	31.00

** TOTAL NO OF OBS = 43813 **

** GROSS WIND ROSE (IN PERCENT OF TOTAL OBS) **

NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
7.93	4.09	2.77	2.58	4.14	5.46	5.91	6.50	9.78	7.85	8.34	7.70	9.65	6.39	4.33	3.99	2.58

** STABILITY INDEX DISTRIBUTION FOR EACH WIND DIRECTION (IN PERCENT OF DIRECTION TOTAL) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.03	0.22	0.16	0.53	0.44	0.00	0.00	0.00	0.02	0.00	0.05	0.12	0.02	0.00	0.05	0.86	0.44
2	2.01	6.08	8.97	10.34	6.62	3.51	1.66	1.37	1.54	1.68	2.02	2.43	1.70	1.29	0.58	0.80	2.83
3	10.33	14.17	14.57	21.73	21.63	15.84	7.92	6.39	7.16	8.64	11.13	9.43	7.90	5.43	4.90	3.55	10.01
4(D)	46.40	40.27	37.78	31.45	42.27	50.61	34.65	29.16	37.07	37.95	37.64	36.25	37.35	39.56	38.22	44.90	3.10
4(N)	29.78	29.34	29.47	26.33	19.59	16.55	23.95	28.07	27.06	26.90	25.71	23.41	29.52	37.02	43.12	35.05	11.16
5	6.85	4.91	3.29	2.83	4.83	4.64	11.66	16.13	14.72	14.28	11.54	12.60	12.49	9.32	6.75	6.70	0.00
6	3.42	3.29	3.70	4.15	3.48	4.68	13.87	12.72	8.98	7.07	7.96	11.91	8.87	5.64	4.16	6.13	17.63
7	1.18	1.73	2.06	2.65	1.93	4.26	6.30	6.15	3.45	3.56	3.94	3.85	2.15	1.75	2.21	2.01	54.83

** STABILITY INDEX DISTRIBUTION IN PERCENT OF TOTAL OBS. **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.00	0.01	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
2	0.16	0.25	0.25	0.27	0.27	0.19	0.18	0.09	0.15	0.13	0.17	0.19	0.16	0.08	0.03	0.03	0.07
3	0.82	0.58	0.40	0.56	0.89	0.87	0.47	0.42	0.70	0.68	0.93	0.73	0.76	0.35	0.21	0.14	0.26
4(D)	3.68	1.65	1.05	0.81	1.75	2.76	2.05	1.89	3.63	2.98	3.14	2.79	3.60	2.53	1.65	1.79	0.08
4(N)	2.36	1.20	0.82	0.68	0.81	0.90	1.42	1.82	2.65	2.11	2.15	1.80	2.85	2.37	1.87	1.48	0.29
5	0.54	0.20	0.09	0.87	0.17	0.25	0.69	1.85	1.44	1.12	0.96	0.97	1.21	0.68	0.29	0.27	0.00
6	0.27	0.13	0.10	0.11	0.14	0.25	0.82	0.83	0.88	0.55	0.66	0.92	0.86	0.36	0.18	0.24	0.45
7	0.09	0.07	0.06	0.07	0.08	0.23	0.37	0.48	0.34	0.28	0.33	0.30	0.21	0.11	0.10	0.11	1.41

** AVERAGE WIND SPEED FOR EACH STABILITY INDEX AND DIRECTION (IN KNOTS) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1	5.0	5.0	3.5	4.0	4.4	0.0	0.0	0.0	3.0	0.0	5.0	4.3	3.0	0.0	5.0	4.0
2	6.2	6.2	6.8	6.6	6.7	6.0	4.9	4.7	5.5	5.6	6.0	5.6	5.6	4.3	4.3	4.0
3	9.6	8.4	7.7	7.4	8.5	8.7	6.4	6.8	8.7	8.6	8.5	7.8	8.2	7.0	7.1	7.5
4(D)	12.5	10.6	10.9	10.1	10.0	10.4	10.1	10.7	12.3	12.6	12.3	11.5	12.3	12.3	13.0	13.0

**** ANNUAL AVERAGE ****   * 5 YR DATA *   MILWAUKEE, WIS.   12/58-11/63   5/16 66 YSK

4(N)	12.4	12.2	11.2	10.3	10.6	10.2	9.1	9.9	10.7	11.2	12.0	10.0	11.0	12.1	12.2	12.4
5	7.3	6.3	6.4	5.6	6.0	5.5	6.3	6.8	7.3	7.7	7.5	7.3	7.5	7.8	7.3	7.2
6	4.3	4.4	4.8	3.2	3.6	3.5	4.3	4.5	4.8	4.7	4.6	4.7	4.9	4.6	4.6	4.3
7	2.3	2.4	2.4	2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.3	2.4	2.3	2.4	2.2

**** ANNUAL AVERAGE **** . * 5 YEAR DATA * MILWAUKEE, WIS. 12/58 - 11/63 5/16/66 YSK

** ONE SECTOR CALCULATION **

** FREQUENCY OF PERSISTENCE (IN PERCENT) ** TOTAL OBS = 43801

HOURS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	1.33	1.37	0.98	1.05	1.35	1.53	1.82	2.06	2.08	2.32	2.39	2.43	2.04	1.62	1.34	1.26	0.78
2	1.07	0.86	0.65	0.63	0.81	1.07	1.25	1.41	1.71	1.59	1.64	1.58	1.56	1.24	0.76	0.86	0.50
3	0.84	0.58	0.06	0.32	0.58	0.75	0.84	0.87	1.05	1.26	1.09	1.05	1.13	0.93	0.52	0.51	0.27
4	0.64	0.37	0.18	0.19	0.34	0.46	0.58	0.63	0.93	0.74	0.77	0.69	0.92	0.68	0.39	0.39	0.22
5	0.72	0.31	0.15	0.14	0.21	0.48	0.35	0.46	0.74	0.33	0.63	0.46	0.67	0.51	0.31	0.19	0.13
6	0.44	0.19	0.16	0.04	0.29	0.38	0.30	0.29	0.58	0.52	0.41	0.33	0.58	0.34	0.23	0.18	0.25
7	0.40	0.14	0.05	0.08	0.08	0.21	0.11	0.22	0.29	0.40	0.24	0.27	0.59	0.30	0.24	0.13	0.10
8	0.37	0.09	0.07	0.05	0.11	0.13	0.10	0.16	0.46	0.11	0.33	0.22	0.31	0.20	0.15	0.05	0.07
9	0.29	0.08	0.04	0.02	0.02	0.12	0.10	0.10	0.29	0.23	0.25	0.08	0.39	0.08	0.12	0.12	0.08
10	0.23	0.02	0.05	0.00	0.00	0.07	0.07	0.07	0.30	0.11	0.09	0.09	0.16	0.02	0.00	0.09	0.11
11	0.20	0.03	0.05	0.03	0.05	0.10	0.08	0.05	0.20	0.05	0.05	0.05	0.23	0.18	0.05	0.10	0.05
12	0.19	0.03	0.03	0.00	0.03	0.05	0.03	0.00	0.14	0.00	0.08	0.08	0.25	0.14	0.11	0.03	0.00
13	0.09	0.03	0.00	0.00	0.00	0.03	0.06	0.03	0.21	0.06	0.06	0.06	0.15	0.00	0.00	0.03	0.00
14	0.10	0.00	0.00	0.00	0.03	0.00	0.06	0.03	0.06	0.00	0.06	0.06	0.13	0.00	0.03	0.00	0.03
15	0.10	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.14	0.00	0.00	0.03	0.10	0.00	0.03	0.03	0.00
16	0.07	0.00	0.00	0.00	0.00	0.04	0.00	0.07	0.11	0.04	0.00	0.11	0.07	0.04	0.04	0.00	0.00
17	0.16	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04	0.04	0.08	0.00	0.04	0.04	0.00	0.00	0.00
18	0.04	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.00	0.08	0.00	0.00	0.00	0.00
19	0.09	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.09	0.00	0.04	0.09	0.09	0.00	0.00	0.00	0.00
20	0.09	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.05	0.00	0.05	0.00	0.00	0.00	0.00
21	0.10	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.00	0.05	0.00	0.00	0.00	0.00
24	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
25	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	7.93	4.09	2.77	2.58	4.14	5.46	5.91	6.49	9.78	7.85	8.34	7.70	9.64	6.39	4.33	3.99	2.59

** OBS PRECEDED OR FOLLOWED BY CALM (IN PERCENT) **

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	TOTAL
PRECE	4.26	4.09	3.02	2.49	3.73	5.86	11.90	12.97	9.59	8.17	10.12	7.82	5.33	4.44	2.66	3.55	563
FOLLO	6.05	3.56	3.91	4.27	5.43	7.47	9.96	8.90	12.28	7.30	9.79	6.94	5.52	3.02	2.31	3.38	562

**** ANNUAL AVERAGE **** * 5 YEAR DATA * CHICAGO, ILL. (O HARE FLD) 9/53 - 8/58

** ONE SECTOR CALCULATION **

** FREQUENCY OF PERSISTENCE (IN PERCENT) ** TOTAL OBS = 43801

HOURS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	1.39	1.60	1.13	1.17	0.92	1.17	1.28	1.76	1.70	1.80	1.46	1.74	1.53	1.70	1.34	1.45	1.62
2	1.05	1.13	0.56	0.87	0.61	1.00	0.86	1.45	1.18	1.37	1.05	1.21	1.03	1.38	0.86	1.03	1.10
3	0.70	0.87	0.46	0.46	0.28	0.64	0.74	1.12	0.99	0.97	0.63	0.91	0.89	0.09	0.68	0.67	0.87
4	0.58	0.65	0.21	0.38	0.20	0.44	0.48	0.73	0.78	0.90	0.46	0.76	0.68	0.85	0.40	0.50	0.47
5	0.30	0.65	0.14	0.30	0.16	0.37	0.21	0.78	0.56	0.65	0.31	0.72	0.48	0.67	0.31	0.26	0.45
6	0.37	0.33	0.10	0.12	0.10	0.26	0.30	0.47	0.40	0.59	0.26	0.63	0.32	0.66	0.34	0.34	0.36
7	0.24	0.29	0.03	0.11	0.13	0.27	0.27	0.35	0.32	0.32	0.14	0.46	0.35	0.43	0.24	0.19	0.29
8	0.26	0.29	0.02	0.05	0.02	0.29	0.15	0.33	0.24	0.37	0.18	0.46	0.29	0.40	0.16	0.18	0.29
9	0.10	0.18	0.04	0.06	0.02	0.12	0.10	0.31	0.14	0.23	0.08	0.23	0.14	0.25	0.16	0.06	0.14
10	0.05	0.18	0.05	0.05	0.00	0.07	0.11	0.25	0.09	0.18	0.07	0.34	0.21	0.37	0.11	0.02	0.11
11	0.15	0.15	0.05	0.00	0.00	0.10	0.15	0.23	0.03	0.10	0.05	0.10	0.20	0.33	0.05	0.10	0.25
12	0.08	0.08	0.00	0.00	0.00	0.03	0.03	0.16	0.03	0.11	0.08	0.08	0.08	0.14	0.05	0.08	0.11
13	0.09	0.06	0.00	0.03	0.03	0.00	0.03	0.12	0.09	0.09	0.00	0.33	0.03	0.27	0.03	0.06	0.03
14	0.06	0.00	0.00	0.00	0.03	0.00	0.03	0.06	0.10	0.06	0.00	0.06	0.10	0.16	0.00	0.00	0.06
15	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10	0.00	0.03	0.03	0.14	0.03	0.07	0.03
16	0.07	0.04	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.11	0.00	0.15	0.07	0.11	0.07	0.00	0.11
17	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.00	0.04	0.04	0.00	0.00	0.00	0.08	0.12	0.00
18	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.16	0.04	0.08	0.00	0.00	0.08
19	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.09	0.00	0.00	0.00	0.00	0.04	0.04	0.00	0.04	0.00
20	0.05	0.09	0.00	0.00	0.00	0.00	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.05	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
38	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00
TOTAL	5.77	6.73	2.78	3.60	2.50	4.91	4.84	8.42	6.68	8.18	4.81	8.44	6.53	9.10	5.08	5.24	6.39

** OBS PRECEDED OR FOLLOWED BY CALM (IN PERCENT) **

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	TOTAL
PRECE	5.46	6.57	3.09	6.01	4.75	7.44	4.91	10.60	5.14	7.04	3.48	7.28	4.67	10.13	6.09	7.36	1264
FOLLO	6.01	10.12	3.95	6.80	3.40	6.01	4.11	7.75	3.79	5.93	2.69	8.85	4.98	10.83	6.17	8.62	1265

APPENDIX 2B: SIX MONTH STABILITY DATA FOR ZION POWER STATION

NOTE: This document was retyped for clarity in the 1992 UFSAR Update.

**** ANNUAL AVERAGE **** * 7 MO DATA * ZION COMM. ED. CO. 35 FT. LEVEL (01/26/70-06/18/70)

** HOURLY STABILITY INDEX DISTRIBUTION **TOTAL NO OF OBS = 2032

HOUR INDEX	* IN PERCENT OF TOTAL OBS *							* IN PERCENT OF HOURLY OBS *						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	0.00	.05	.49	1.72	1.38	.39	.20	0.00	1.16	11.63	40.70	32.56	9.30	4.65
2	0.00	0.00	.39	2.02	1.28	.34	.15	0.00	0.00	9.41	48.24	30.59	8.24	3.53
3	0.00	0.00	.54	1.72	1.23	.59	.15	0.00	0.00	12.79	40.70	29.07	13.95	3.49
4	0.00	0.00	.59	1.77	1.38	.39	0.00	0.00	0.00	14.29	42.86	33.33	9.52	0.00
5	.05	0.00	.54	1.72	1.43	.25	.10	1.20	0.00	13.25	42.17	34.94	6.02	2.41
6	0.00	0.00	.69	1.92	1.03	.39	0.00	0.00	0.00	17.07	47.56	25.61	9.76	0.00
7	0.00	.10	.69	1.97	1.03	.20	.10	0.00	2.41	16.87	48.19	25.30	4.82	2.41
8	0.00	.05	.84	1.92	1.03	.20	.05	0.00	1.20	20.48	46.99	25.30	4.82	1.20
9	0.00	.10	1.18	1.67	.89	.30	0.00	0.00	2.30	20.57	40.48	21.43	7.14	0.00
10	0.00	.15	1.28	1.67	.64	.30	.05	0.00	3.61	31.33	40.96	15.66	7.23	1.20
11	.10	.10	1.13	1.57	.89	.15	0.00	2.50	2.50	28.75	40.00	22.50	3.75	0.00
12	.05	.30	1.03	1.82	.64	.10	0.00	1.25	7.50	26.25	46.25	16.25	2.50	0.00
13	.10	.30	1.43	1.67	.54	0.00	0.00	2.44	7.32	35.37	41.46	13.41	0.00	0.00
14	0.00	.15	1.53	2.02	.39	.15	0.00	0.00	3.49	36.05	47.67	9.30	3.49	0.00
15	.05	.25	1.38	1.87	.39	.10	.05	1.20	6.02	33.73	45.78	9.64	2.41	1.20
16	0.00	.30	1.43	1.87	.59	.05	.05	0.00	6.90	33.32	43.68	13.79	1.15	1.15
17	0.00	.34	.94	2.02	.84	.10	.05	0.00	8.05	21.84	47.13	19.54	2.30	1.15
18	.10	.10	1.38	1.48	.94	.15	.10	2.33	2.33	32.56	34.88	22.09	3.49	2.33
19	0.00	0.00	.74	2.51	.84	.20	0.00	0.00	0.00	17.24	50.82	19.54	4.60	0.00
20	0.00	0.00	.49	1.92	1.48	.39	.05	0.00	0.00	11.36	44.32	34.09	9.09	1.14
21	0.00	0.00	.44	2.02	1.08	.49	.25	0.00	0.00	10.34	47.13	25.29	11.49	5.75
22	0.00	.05	.39	2.07	1.13	.34	.25	0.00	1.16	9.30	48.84	26.74	8.14	5.81
23	.05	.05	.44	1.72	1.38	.54	.10	1.15	1.15	10.34	48.23	32.18	12.64	2.30
24	0.00	0.00	.39	2.21	1.03	.34	.30	0.00	0.00	9.20	51.72	24.14	8.05	6.90

** STABILITY INDEX DISTRIBUTION (IN PERCENT OF TOTAL OBS.) **

INDEX	1	2	3	4	5	6	7
	.49	2.36	20.37	44.88	23.47	6.45	1.97

** AVERAGE WIND SPEED FOR EACH STABILITY INDEX (IN MPH) **

INDEX	1	2	3	4	5	6	7
SPEED	6.9	7.1	8.9	8.3	6.9	4.6	3.1

**** ANNUAL AVERAGE **** * 7 MO DATA * ZION COMM. ED. CO. 35 FT. LEVEL (01/26/70-06/18/70)

** WIND ROSE FOR EACH STABILITY INDEX (IN PERCENT OF EACH INDEX TOTAL) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.00	0.00	0.00	0.00	0.00	20.00	10.00	30.00	20.00	0.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00
2	2.08	0.00	0.00	2.08	2.08	16.67	25.00	20.83	6.25	2.08	2.08	2.08	2.08	0.00	0.00	2.08	14.58
3	0.00	0.00	.24	.48	1.69	3.14	12.56	18.84	5.31	10.14	11.11	18.12	10.87	7.00	.48	0.00	0.00
4	3.40	6.47	2.52	2.96	3.18	2.63	2.52	7.46	8.77	14.36	12.28	8.66	8.00	6.47	6.14	4.17	0.00
5	12.79	4.61	5.03	6.29	2.31	1.26	.42	2.73	6.92	8.39	3.56	2.10	1.47	2.52	4.61	20.55	14.47
6	5.34	1.53	2.29	2.29	0.00	.76	0.00	4.58	13.74	16.03	4.58	5.34	4.58	6.87	6.11	25.95	0.00
7	7.50	0.00	0.00	2.50	0.00	0.00	0.00	2.50	12.50	20.00	7.50	5.00	5.00	10.00	0.00	27.50	0.00

** TOTAL NO OF OBS = 2032 **

** GROSS WIND ROSE (IN PERCENT OF TOTAL OBS) **

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
	5.07	4.08	2.51	3.15	2.36	2.66	4.43	8.81	8.02	11.96	9.10	8.56	6.59	5.66	4.33	8.96	3.74
SPEED	10.5	9.9	6.9	7.1	8.5	7.2	5.8	6.8	7.9	8.2	7.5	8.4	7.1	6.0	6.5	11.9	0.0

** STABILITY INDEX DISTRIBUTION FOR EACH WIND DIRECTION (IN PERCENT OF DIRECTION TOTAL) **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.00	0.00	0.00	0.00	0.00	3.70	1.11	1.68	1.23	0.00	0.00	0.00	0.00	1.74	0.00	0.00	0.00
2	.97	0.00	0.00	1.56	2.08	14.81	13.33	5.59	1.84	.41	.54	.57	.75	0.00	0.00	.55	9.21
3	0.00	0.00	1.96	3.13	14.58	24.07	57.78	43.58	13.50	17.28	24.86	43.10	33.58	25.22	2.27	0.00	0.00
4	30.10	71.08	45.10	42.19	60.42	44.44	25.56	37.99	49.08	53.91	60.54	45.40	54.48	51.30	63.64	20.88	0.00
5	59.22	26.51	47.06	46.88	22.92	11.11	2.22	7.26	20.25	16.46	9.19	5.75	5.22	10.43	25.00	53.85	90.79
6	6.80	2.41	5.88	4.69	0.00	1.85	0.00	3.35	11.04	8.64	3.24	4.02	4.48	7.83	9.09	18.68	0.00
7	2.91	0.00	0.00	1.56	0.00	0.00	0.00	.56	3.07	3.29	1.62	1.15	1.49	3.48	0.00	6.04	0.00

** STABILITY INDEX DISTRIBUTION IN PERCENT OF TOTAL OBS. **

INDEX	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.00	0.00	0.00	0.00	0.00	.10	.05	.15	.10	0.00	0.00	0.00	0.00	.10	0.00	0.00	0.00
2	.05	0.00	0.00	.05	.05	.39	.59	.49	.15	.05	.05	.05	.05	0.00	0.00	.05	.34
3	0.00	0.00	.05	.10	.34	.64	2.56	3.84	1.08	2.07	2.26	3.69	2.21	1.43	.10	0.00	0.00
4	1.53	2.90	1.13	1.33	1.43	1.18	1.13	3.35	3.94	6.45	5.51	3.89	3.59	2.90	2.76	1.87	0.00
5	3.00	1.08	1.18	1.48	.54	.30	.10	.64	1.62	1.97	.84	.49	.34	.59	1.08	4.82	3.40
6	.34	.10	.15	.15	0.00	.05	0.00	.30	.89	1.03	.30	.34	.30	.44	.39	1.67	0.00
7	.15	0.00	0.00	.05	0.00	0.00	0.00	.05	.25	.39	.15	.10	.10	.20	0.00	.54	0.00

**** ANNUAL AVERAGE ****   * 7 MO DATA *ZION COMM. ED. CO. 35 FT. LEVEL (01/26/70-06/18/70)

(AVERAGE INVERSE SPEED)

1	0.00	0.00	0.00	0.00	0.00	.22	.17	.12	.22	0.00	0.00	0.00	0.00	.23	0.00	0.00
2	.08	0.00	0.00	.50	.25	.13	.15	.12	.26	.03	.08	.25	.20	0.00	0.00	.17
3	0.00	0.00	.20	.25	.16	.15	.28	.23	.14	.13	.15	.15	.19	.18	.12	0.00
4	.09	.14	.19	.19	.19	.18	.36	.19	.21	.22	.21	.20	.24	.40	.31	.07
5	.13	.16	.18	.29	.30	.23	.27	.30	.26	.23	.26	.26	.33	.37	.55	.11
6	.33	.38	.32	.44	0.00	.33	0.00	.30	.25	.29	.52	.27	.39	.50	.52	.23
7	1.00	0.00	0.00	.50	0.00	0.00	0.00	.20	.32	.48	.67	.75	.75	.37	0.00	.26

APPENDIX 2C: SITE AIRBORNE EFFLUENT DIFFUSION AND RECORD OF METEOROLOGICAL MONITORING FOR THE PERIOD OF MAY 1, 1971 - APRIL 30, 1972

NOTE: Portions of this document were retyped for clarity in the 1992 UFSAR Update.

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I. Record of Data Recovery - May, 1971 - April, 1972

II. Figures

X/Q Isopleths - 0 - 5 Miles - May, 1971 - April, 1972
X/Q Isopleths - 0-20 Miles - May, 1971 - April, 1972
X/Q Isopleths - 0-5 Miles - Fourth Quarter, 1971
X/Q Isopleths - 0-20 Miles - Fourth Quarter, 1971
X/Q Isopleths - 0-5 Miles - Third Quarter, 1971
X/Q Isopleths - 0-20 Miles - Third Quarter, 1971
X/Q Isopleths - 0-5 Miles - Second Quarter, 1971
X/Q Isopleths - 0-20 Miles - Second Quarter, 1971
X/Q Isopleths - 0-5 Miles - First Quarter, 1972
X/Q Isopleths - 0-20 Miles - First Quarter, 1972
Wind Rose - May, 1971 - April, 1972
Wind Rose - Fourth Quarter, 1971
Wind Rose - Third Quarter, 1971
Wind Rose - Second Quarter, 1971
Wind Rose - First Quarter, 1972

III. Tables

Annual Summaries - May, 1971 - April, 1972

Wind Rose - All Observations
Wind Rose - Nonprecipitation
Wind Rose - Precipitation
Wind Rose - Very Stable
Wind Rose - Moderately Stable
Wind Rose - Neutral
Wind Rose - Unstable
Wind Direction Persistence - All Observations
Wind Direction Persistence - Very Stable
Wind Direction Persistence - Moderately Stable
Wind Direction Persistence - Neutral
Wind Direction Persistence - Unstable
Wind Speed Persistence - All Observations
Wind Speed Persistence - Very Stable
Wind Speed Persistence - Moderately Stable
Wind Speed Persistence - Neutral
Wind Speed Persistence - Unstable
Stability Persistence
Hourly Stability Frequencies
Sigma Sub Theta - All Observations
Sigma Sub Theta - Very Stable
Sigma Sub Theta - Moderately Stable
Sigma Sub Theta - Neutral
Sigma Sub Theta - Unstable

ZION STATION RECORD OF DATA RECOVERY

May, 1971 - April, 1972

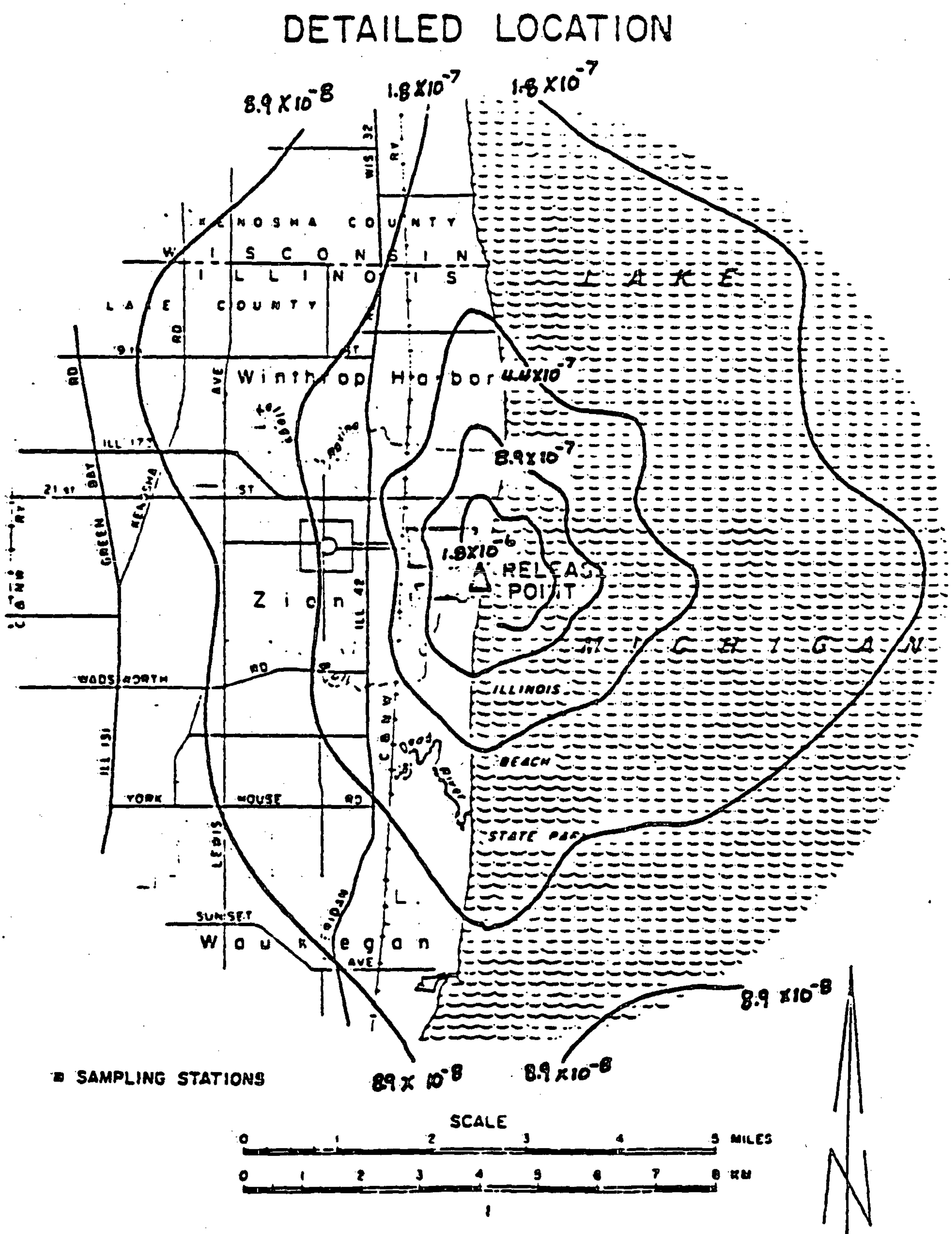
Parameter	Hours of Valid Record (% of Possible Hours)
Wind speed (35 ft level)	7861 (89)
Wind direction (35 ft level)	7229 (82)
Wind speed & direction (35 ft level)	7229 (82)
Differential temperature	8135 (93)
Precipitation	8157 (93)
Total	38,611 (88)

Computer programs developed and used to generate the data tables contained herein consist of the following:

1. Gross wind rose
2. Stability wind rose
3. Wind direction persistence
4. Wind speed persistence
5. Stability persistence
6. Stability by hour of day
7. Sigma sub theta frequencies
8. Daily weather data summaries
9. Relative concentration factors

FIGURE 1

X/Q Isopleths (sec/m³) Zion Station - Detailed Location
May 1971 - April 1972



August 1998

FIGURE 2

X/Q Isopleths (sec/m^3) Zion Station - General Location
May 1971 - April 1972

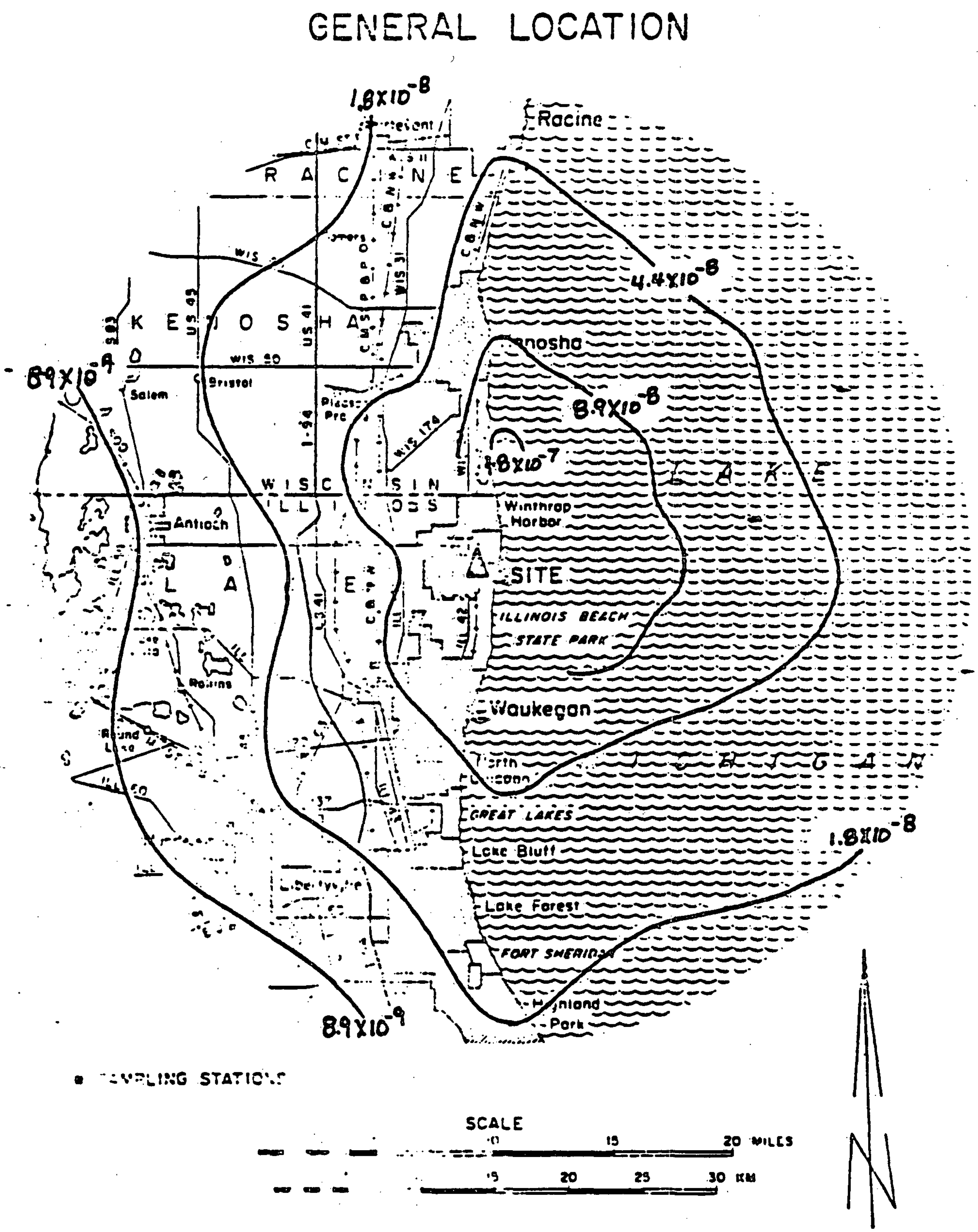
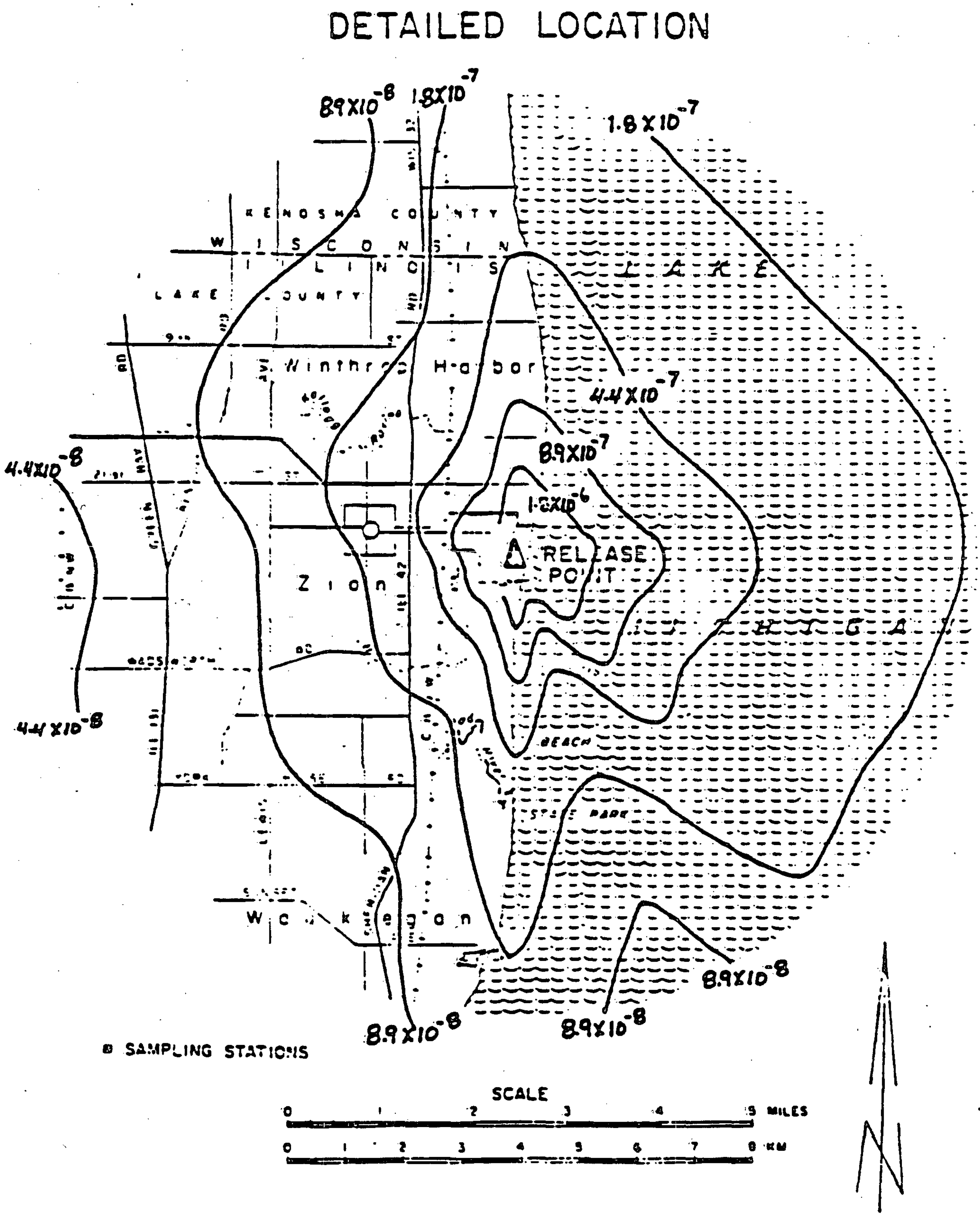


FIGURE 3

X/Q Isopleths (sec/m^3) Zion Station - Detailed Location
October - December 1971



August 1998

FIGURE 4

X/Q Isopleths (sec/m³) Zion Station - General Location
October - December 1971

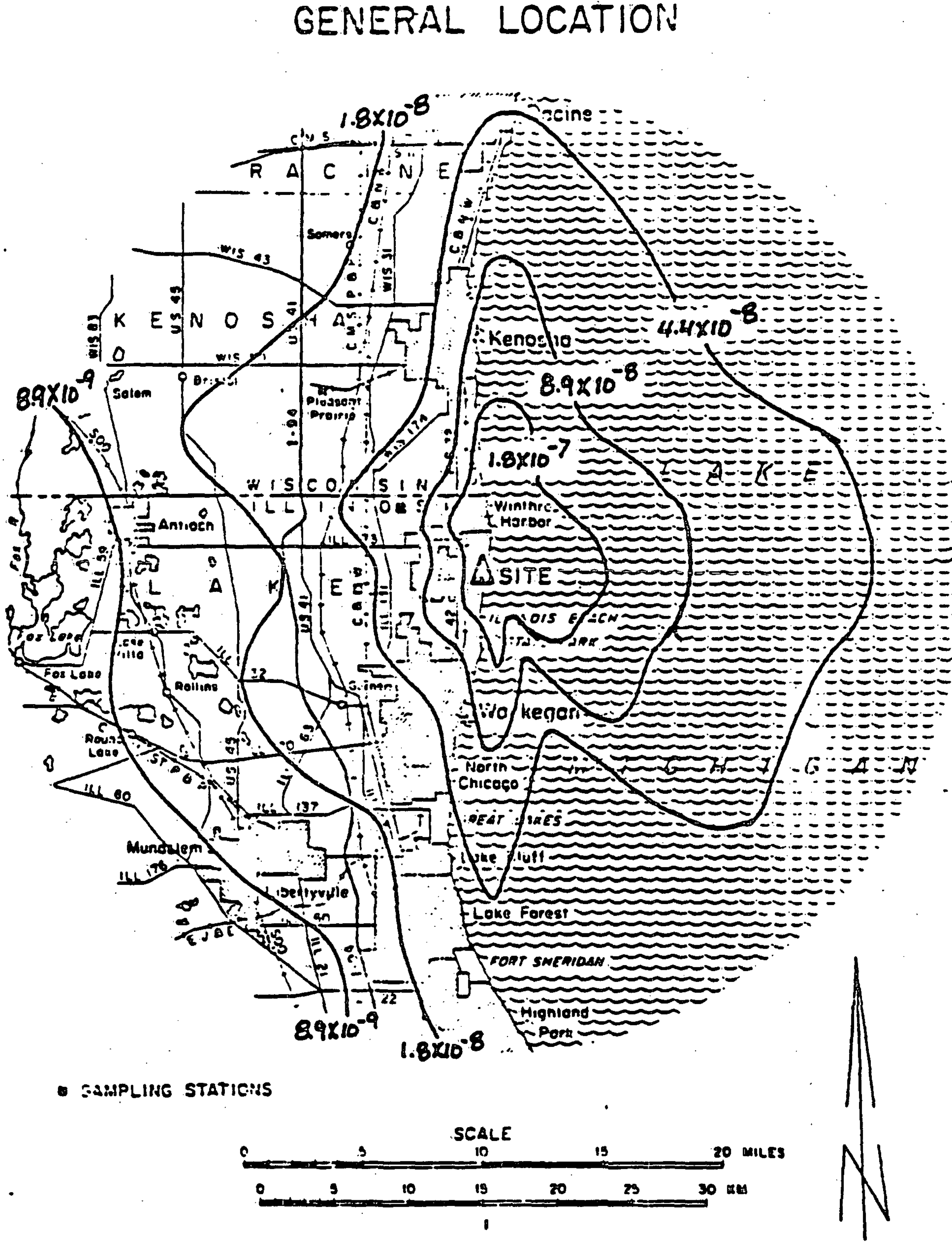
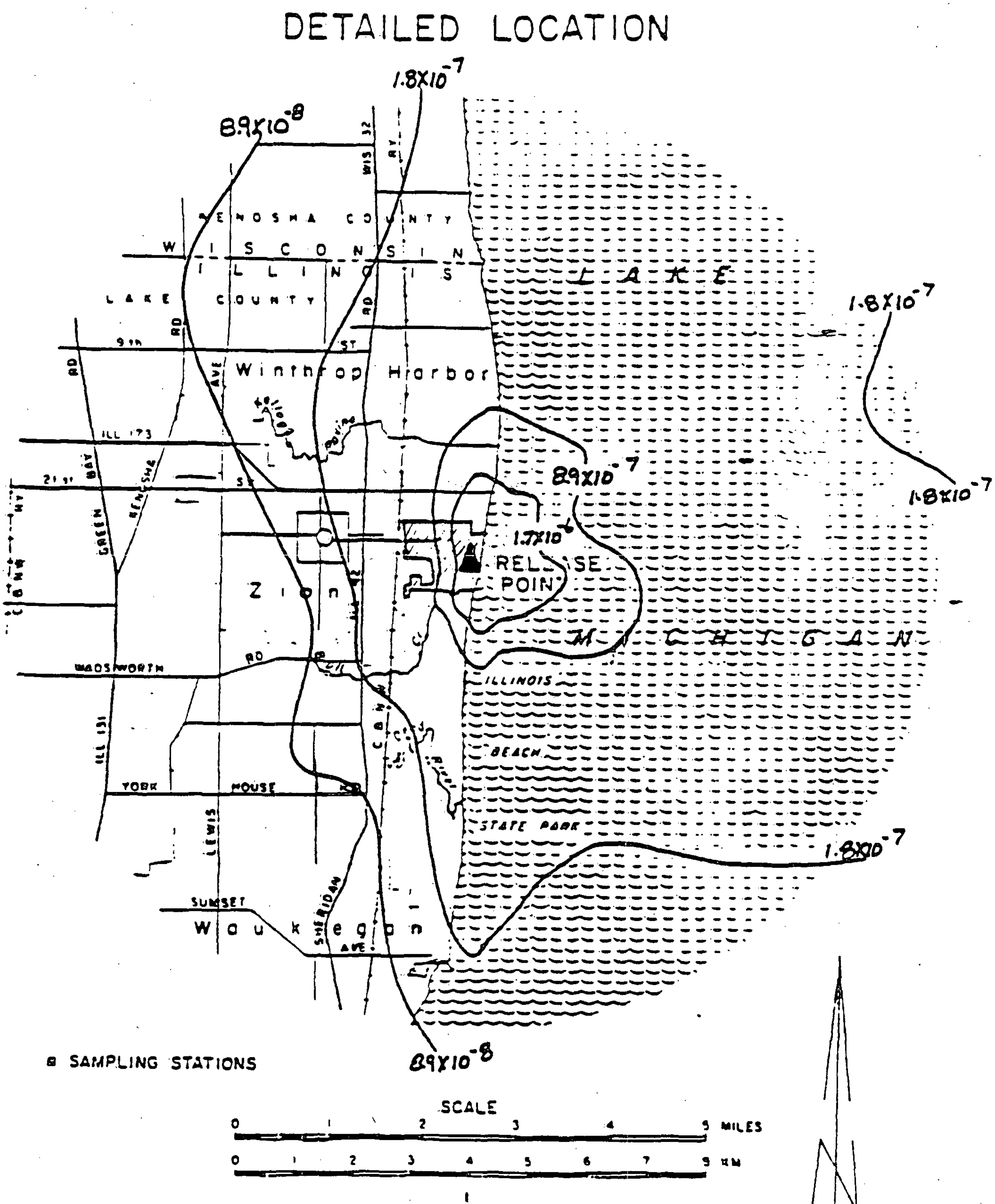


FIGURE 5

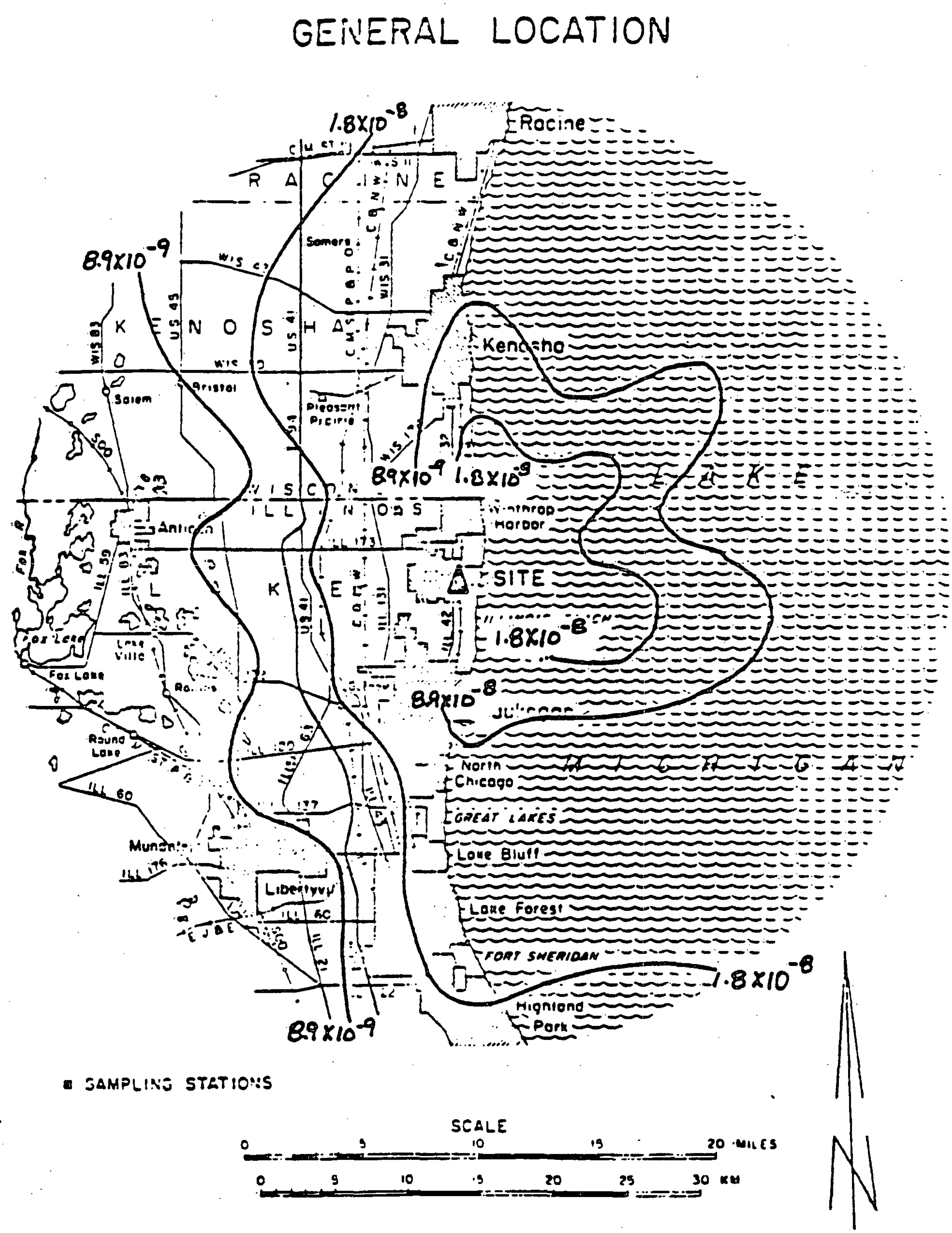
X/Q Isopleths (sec/m^3) Zion Station - Detailed Location
July - September 1971



August 1998

FIGURE 6

X/Q Isopleths (sec/m^3) Zion Station - General Location
July - September 1971

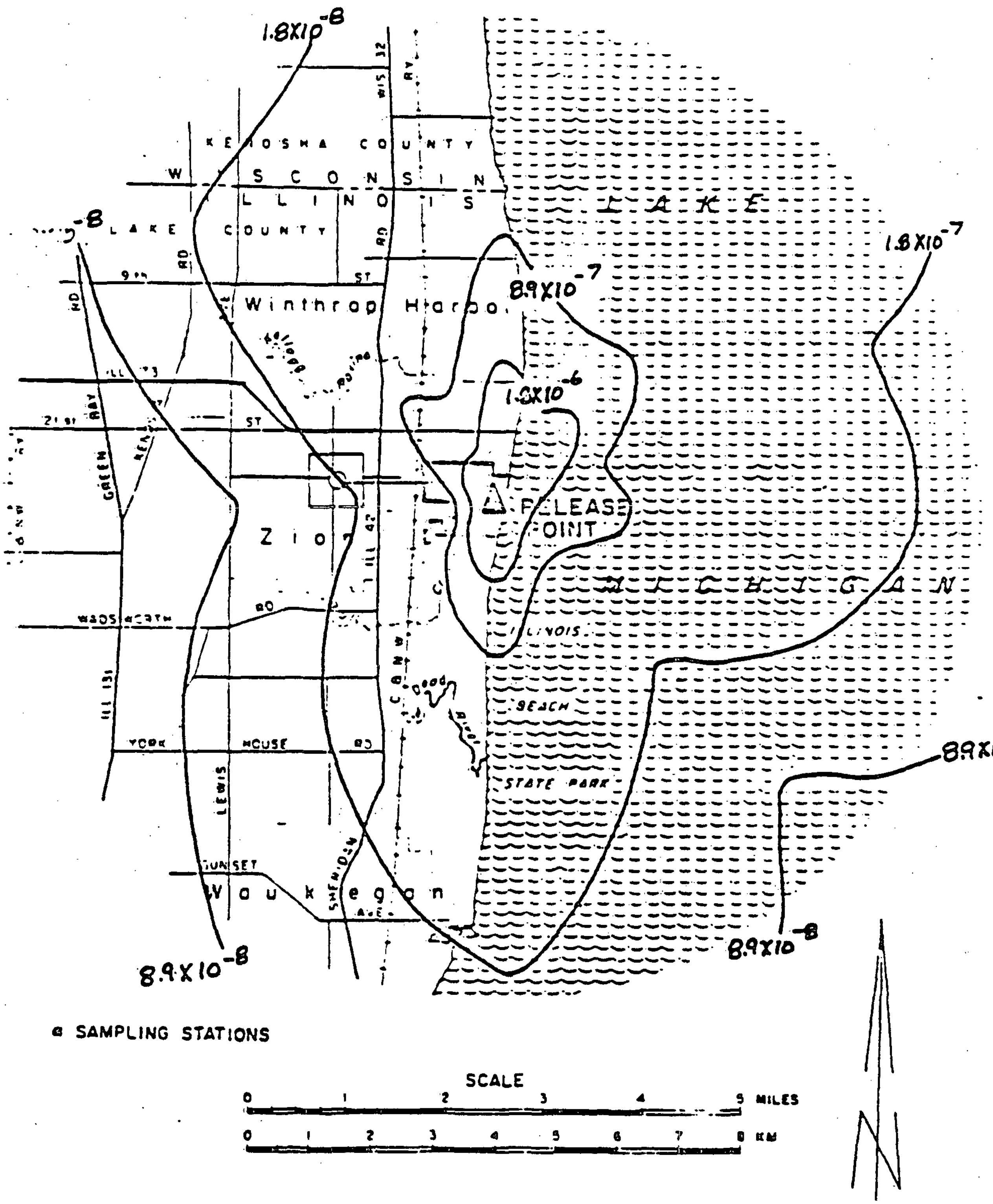


August 1998

FIGURE 7

X/Q Isopleths (sec/m³) Zion Station - Detailed Location
May - June 1971

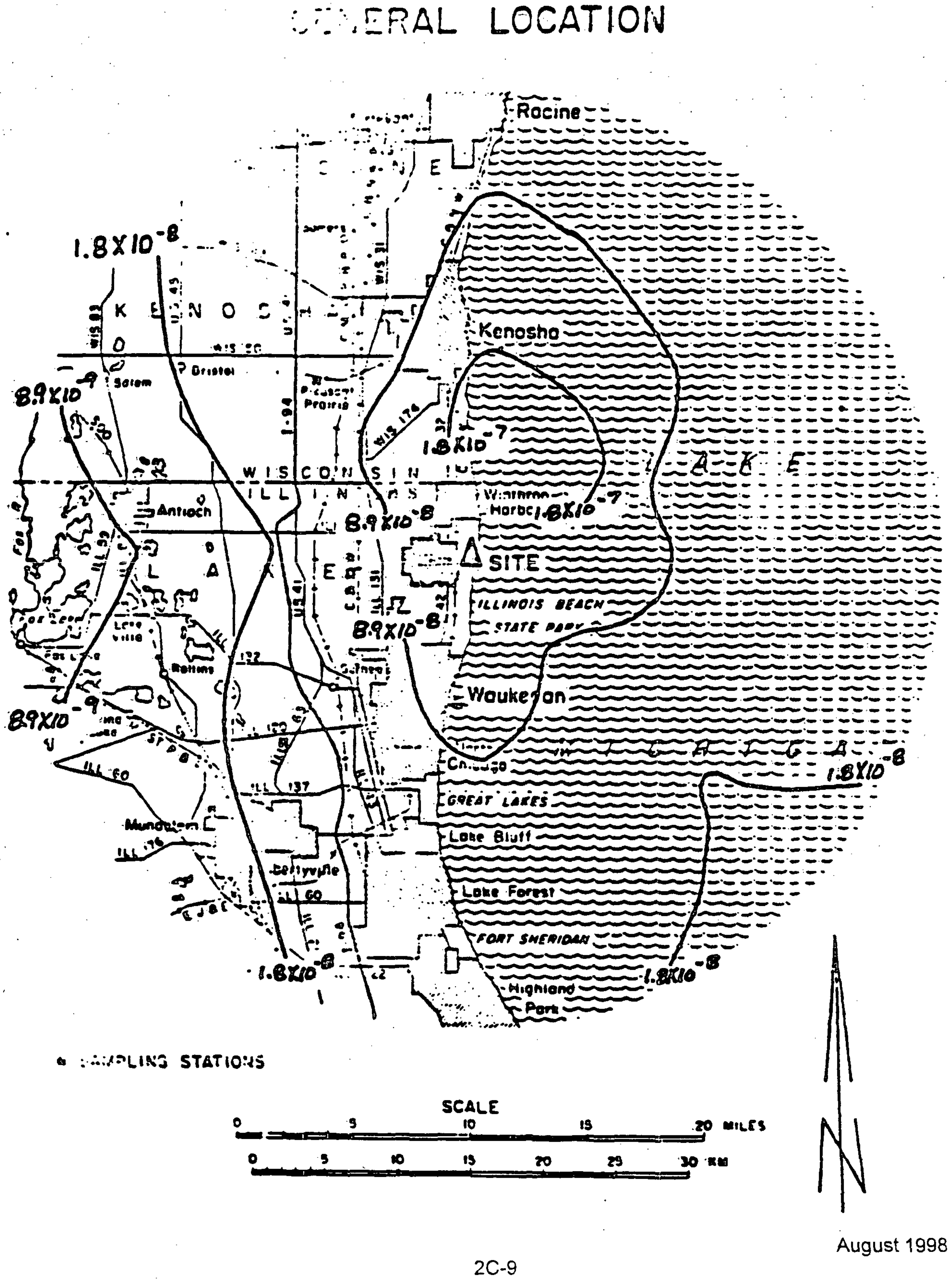
DETAILED LOCATION



August 1998

FIGURE 8

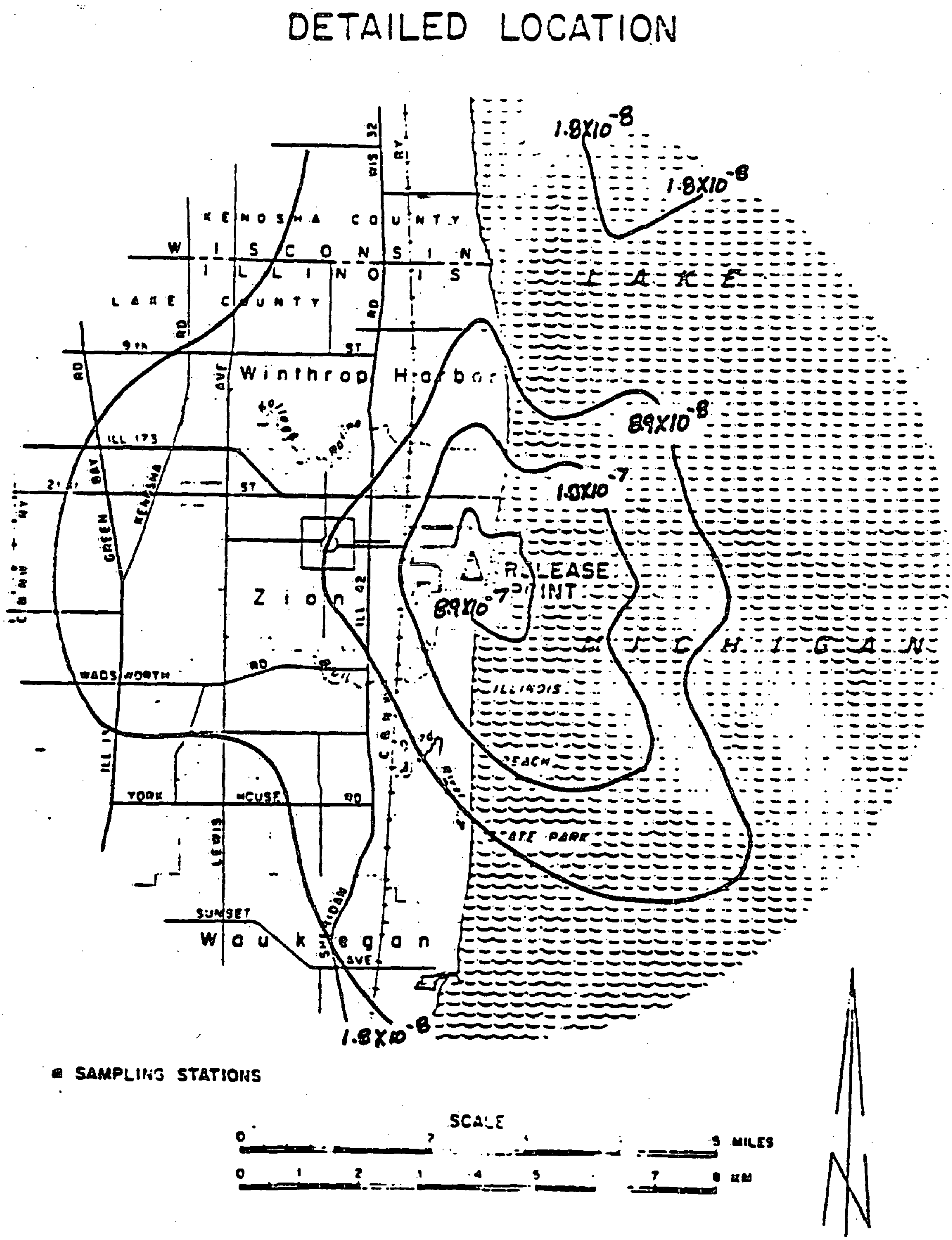
X/Q Isopleths (sec/m^3) Zion Station - General Location
May - June 1971



August 1998

FIGURE 9

X/Q Isopleths (sec/m³) Zion Station - Detailed Location
January - March 1972



August 1998

FIGURE 10

X/Q Isopleths (sec/m^3) Zion Station - General Location
January - March 1972

GENERAL LOCATION

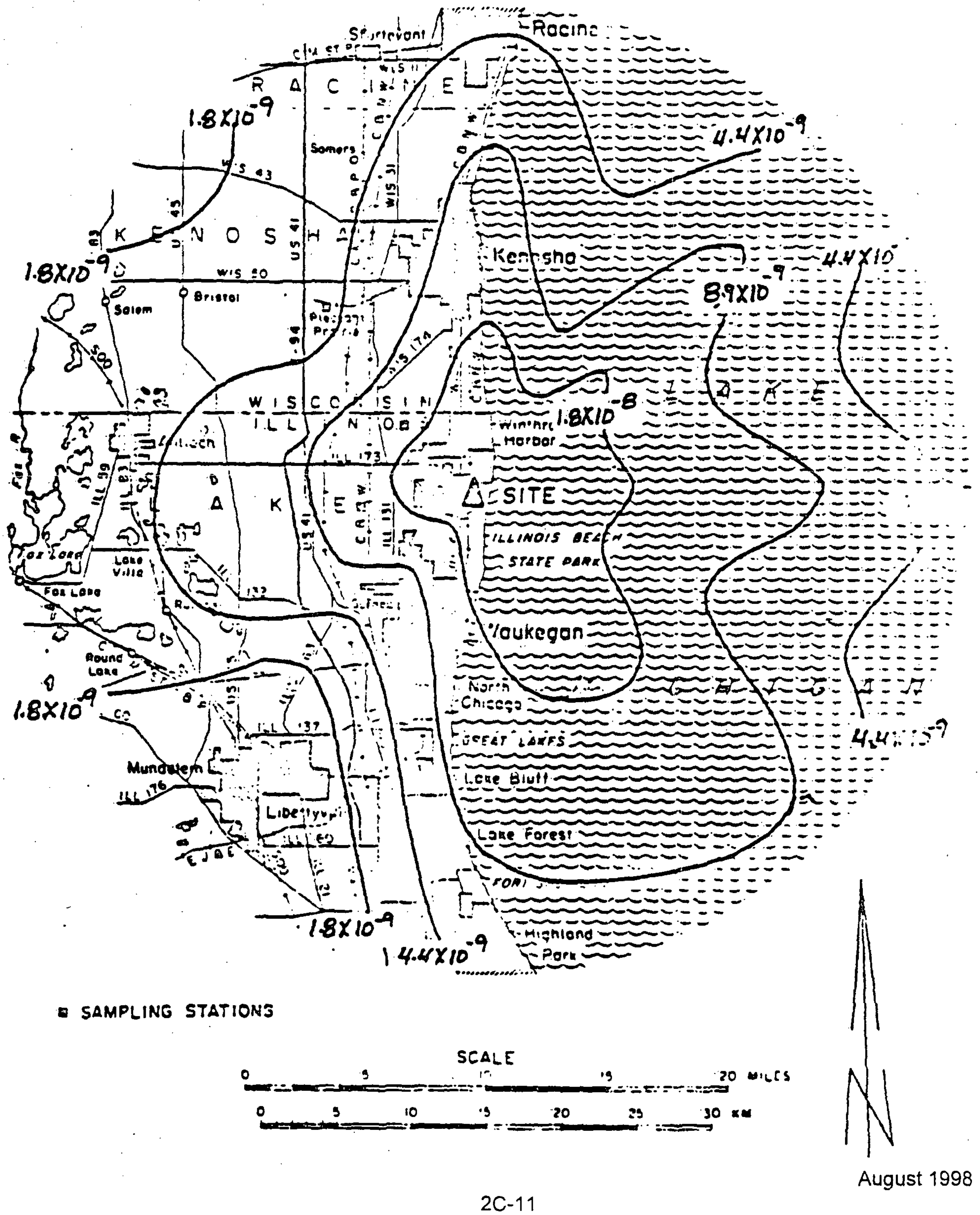


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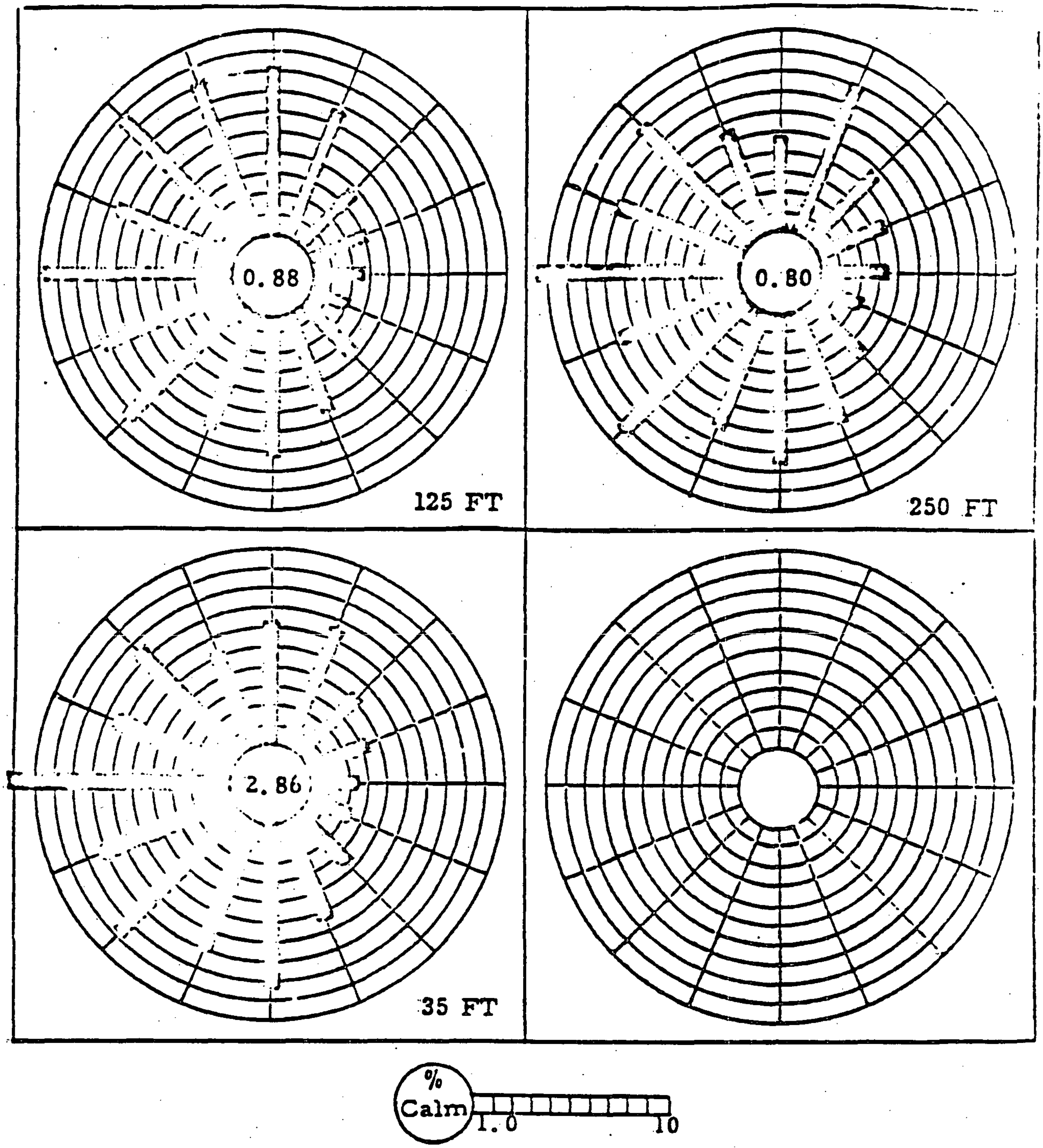
FIGURE
Zion Nuclear Power Station Wind Rose
May 1971 - April 1972
All Observations



ZION NUCLEAR POWER STATION
WIND ROSE MAY 1971-APRIL 1972
ALL OBSERVATIONS

TOTAL HOURS	35 FT	7442
	125 FT	7751
	250 FT	7497

FIGURE
Zion Nuclear Power Station Wind Rose
October - November - December 1971
All Observations Composite 22

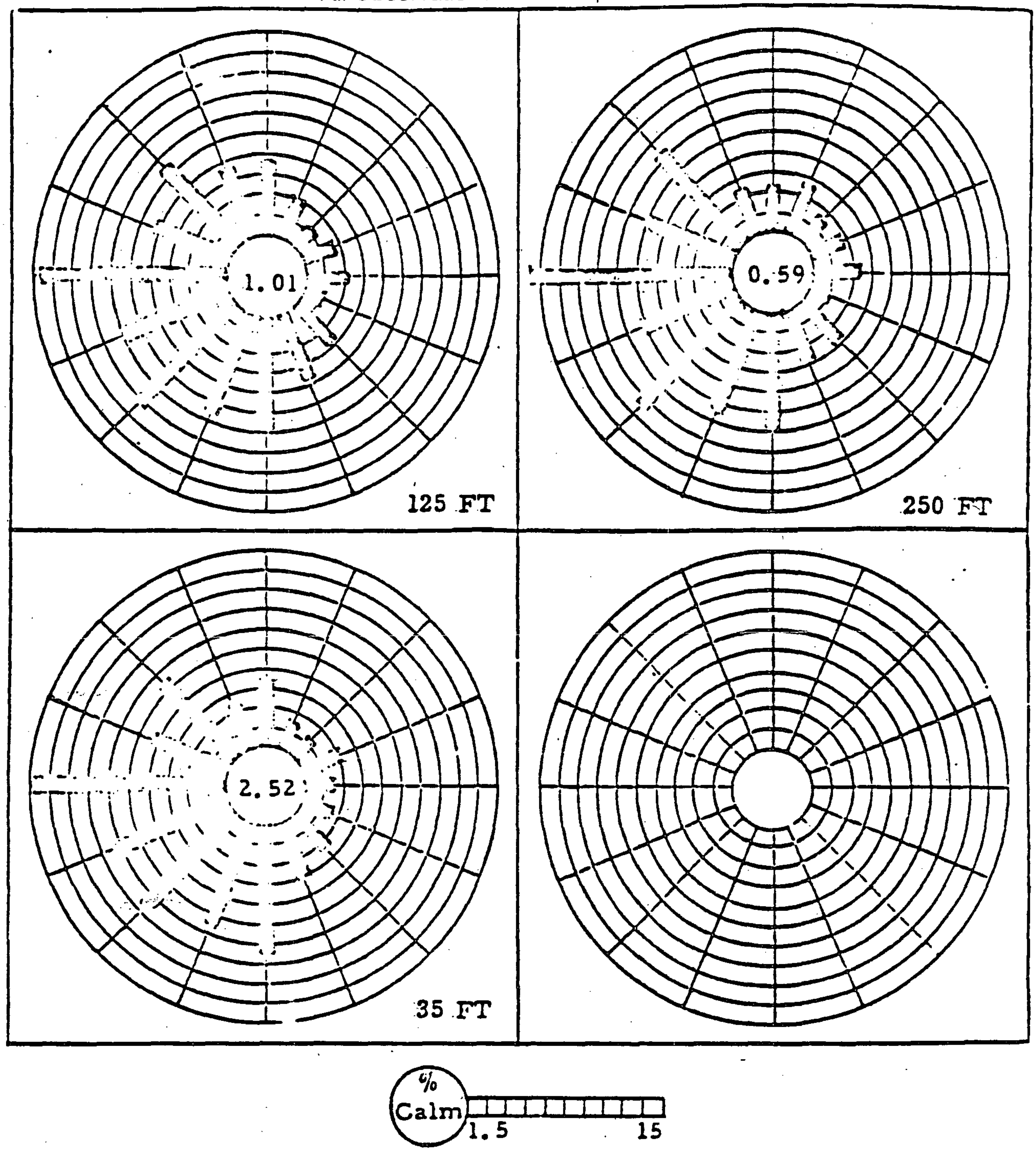


FIGURE 4 ZION NUCLEAR POWER STATION
WIND ROSE OCTOBER-NOVEMBER-DECEMBER 1971
ALL OBSERVATIONS COMPOSITE

TOTAL HOURS	35 FT	2064
	125 FT	2088
	250 FT	1857

August 1998

FIGURE
Zion Nuclear Power Station Wind Rose
Jul - Aug - Sept 1971
All Observations

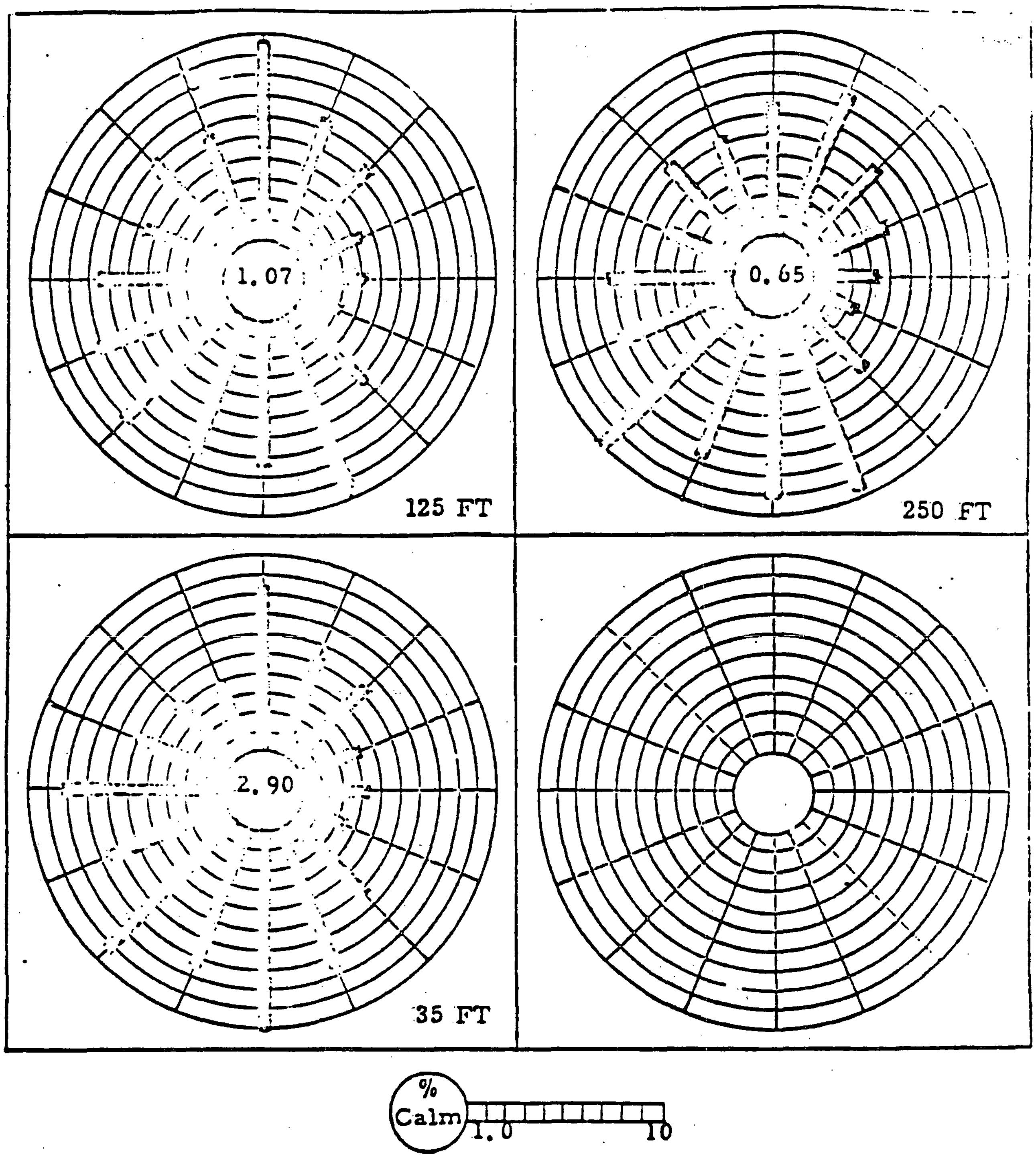


FIGURE 4 ZION NUCLEAR POWER STATION
WIND ROSE JUL-AUG-SEPT 1971
ALL OBSERVATIONS

TOTAL HOURS	35 FT	1584
	125 FT	1588
	250 FT	1686

FIGURE
Zion Generating Station Wind Rose
April - May - June 1971
All Observations

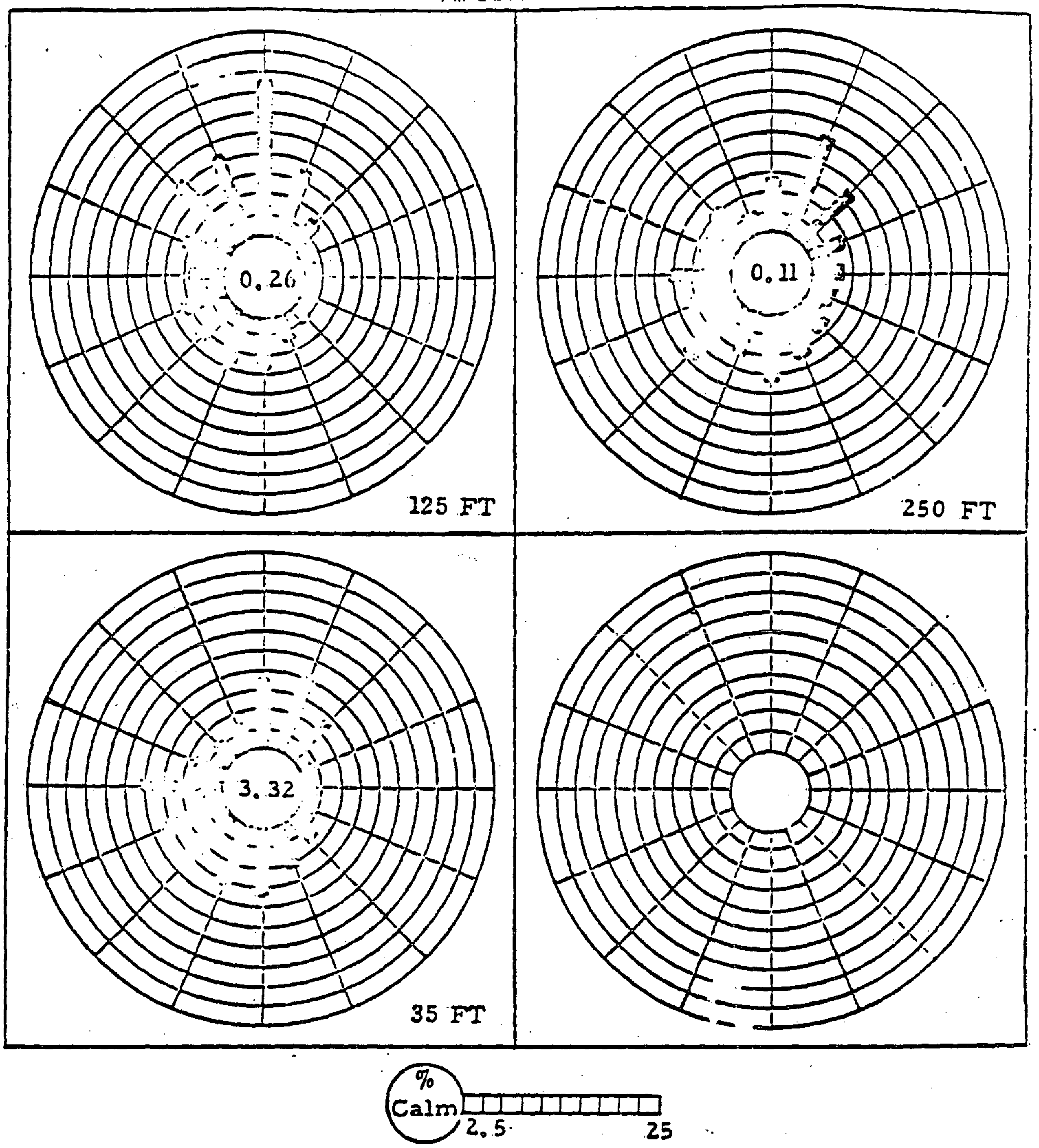


FIGURE 4

ZION GENERATING STATION
WIND ROSE
APRIL-MAY-JUNE 1971
ALL OBSERVATIONS

TOTAL HOURS	35 FT	1173
	125 FT	1926
	250 FT	1810

August 1998

FIGURE
Zion Nuclear Power Station Wind Rose
January - February - March 1972
All Observations

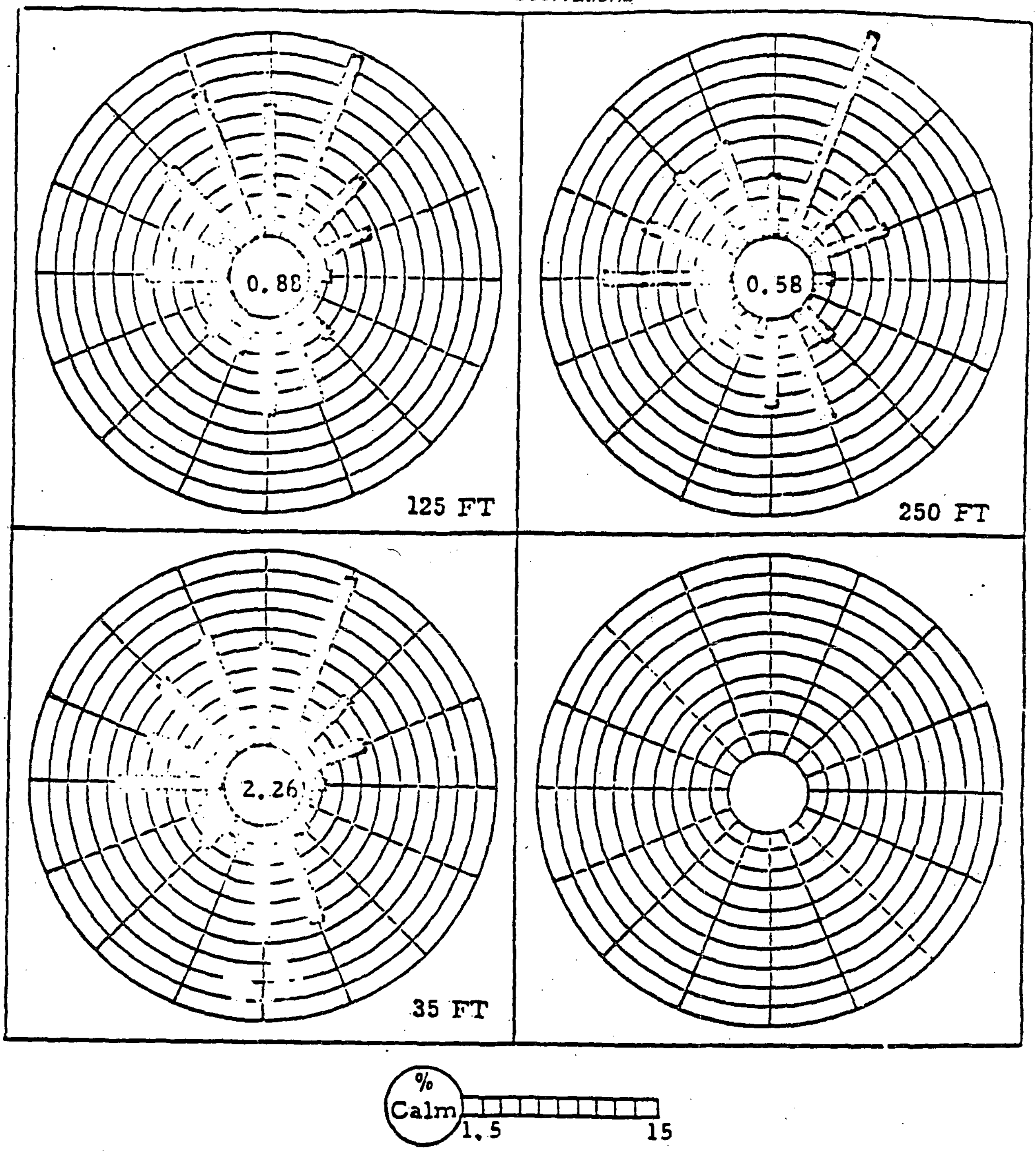


FIGURE ZION NUCLEAR POWER STATION
WIND ROSE
JANUARY-FEBRUARY-MARCH 1972
ALL OBSERVATIONS

TOTAL HOURS		
	35 FT	2033
	125 FT	2083
	250 FT	2090

TABLE I

CECO ZION NUCLEAR POWER STATION

WIND ROSE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7442 OF 7442 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.34	1.75	2.51	1.36	0.28	0.05	0.00	0.00	0.00	6.29
NNE	0.30	1.40	2.85	1.63	0.40	0.04	0.00	0.00	0.00	6.61
NE	0.21	1.59	1.75	0.51	0.23	0.00	0.00	0.00	0.00	4.29
ENE	0.11	1.20	1.09	0.59	0.12	0.20	0.00	0.00	0.00	3.31
E	0.16	0.[illegible]1	0.70	0.5[illegible]	0.15	0.04	0.00	0.00	0.00	2.55
ESE	0.24	1.12	0.59	0.38	0.07	0.00	0.00	0.00	0.00	2.39
SE	0.35	2.04	1.18	0.15	0.00	0.00	0.00	0.00	0.00	3.72
SSE	0.20	2.14	2.08	0.90	0.13	0.00	0.00	0.00	0.00	5.46
S	0.43	4.56	2.94	0.44	0.07	0.00	0.00	0.00	0.00	8.44
SSW	0.36	2.92	1.71	1.49	0.59	0.04	0.00	0.00	0.00	7.01
SW	0.44	2.78	3.00	1.84	0.69	0.08	0.00	0.00	0.00	8.83
WSW	0.46	2.28	2.39	1.79	0.31	0.04	0.00	0.00	0.00	7.27
W	0.67	3.16	4.23	2.71	0.52	0.09	0.01	0.00	0.00	11.41
WNW	0.73	2.74	2.11	0.99	0.05	0.00	0.00	0.00	0.00	6.62
NW	0.69	3.45	2.42	1.09	0.00	0.00	0.00	0.00	0.00	7.65
NNW	0.42	2.08	1.84	0.91	0.04	0.00	0.00	0.00	0.00	5.29
TOTL	6.10	36.01	33.39	17.37	3.65	0.59	0.01	0.00	0.00	100.00

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 2.86

TABLE I

CECO ?ON NUC'EAR POWER STATION

WIND ROSE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7751 OF 7751 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.08	0.65	2.32	2.98	1.52	0.28	0.05	0.00	0.00	8.09
NNE	0.15	0.65	2.13	2.21	1.16	0.34	0.15	C.01	0.00	6.80
NE	0.06	0.72	1.56	0.80	0.44	0.23	0.06	C.00	0.00	3.88
ENE	0.12	0.55	0.88	0.71	0.49	0.09	0.22	C.00	0.00	3.06
E	0.09	0.61	0.81	0.70	0.40	0.15	0.00	C.00	0.00	2.76
ESE	0.12	0.53	0.58	0.44	0.26	0.08	0.01	C.00	0.00	2.01
SE	0.05	0.79	1.39	1.06	0.44	0.06	0.00	C.00	0.00	3.79
SSE	0.04	0.54	2.39	1.54	0.34	0.12	0.00	C.00	0.00	5.56
S	0.06	0.67	2.44	2.95	0.74	0.30	0.06	C.00	0.00	7.22
SSW	0.03	0.54	2.14	2.40	0.77	0.49	0.15	C.00	0.00	6.53
SW	0.04	0.53	2.36	3.06	1.32	0.77	0.23	C.00	0.00	8.31
WSW	0.12	0.57	2.06	3.01	1.24	0.37	0.09	C.00	0.00	7.46
W	0.08	0.65	2.64	3.75	1.84	0.63	0.12	C.10	0.00	9.82
WNW	0.09	1.01	2.75	1.94	0.75	0.23	0.00	C.00	0.00	6.76
NW	0.13	1.23	3.79	2.83	0.89	0.12	0.00	C.00	0.00	8.98
NNW	0.09	0.[illegible]9	3.26	2.23	1.23	0.26	0.03	C.00	0.00	8.09
TOTL	1.34	11.71	33.52	32.9[illegible]	13.82	4.53	1.19	C.12	0.00	100.00

TABLE ENTRY IS FRECUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.80

TABLE I

CECO ZION NUCLEAR POWER STATION

WIND ROSE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7497 OF 7497 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.09	0.36	1.07	1.76	1.37	0.24	0.05	0.00	0.00	4.95
NNE	0.05	0 60	1.83	3.43	1.51	0.33	0.23	0.03	0.00	8.00
NE	0.12	0.87	1.97	1.11	0.39	0.36	0.01	0.00	0.00	4.83
ENE	0.13	0.[illegible]0	1.24	0.88	0.35	0.23	0.17	0.00	0.00	3.80
E	0.09	0.80	1.07	0.88	0.45	0.15	0.01	0.00	0.00	3.45
ESE	0.08	0.63	0.64	0.61	0.24	0.13	0.00	0.00	0.00	2.33
SE	0.11	0.69	1.43	1.08	0.60	0.07	0.00	0.00	0.00	3.97
SSE	0.07	0.73	2.39	1.89	0.83	0.23	0.00	0.00	0.00	6.14
S	0.11	0.73	1.93	2.81	1.48	0.53	0.09	0.00	0.00	7.70
SSW	0 12	0 36	1.23	2.47	1.21	0.73	0.17	0.00	0.00	6.30
SW	0.08	0.91	1.79	3.52	2.04	0.72	0.27	0.00	0.00	9.32
WSW	0.20	0 43	1.85	2.57	1.39	0.37	0.04	0.01	0.00	6.87
W	0.15	0.60	2.13	4.43	2.44	0.88	0.05	0.08	0.00	10.76
WNW	0.15	0 88	2.43	2.43	0.92	0.19	0.01	0.00	0.00	7.00
NW	0.19	1.05	3.48	2.73	0.65	0.04	0.00	0.00	0.00	8.15
NNW	0.07	0.52	2.09	2.16	0.65	0.12	0.00	0.00	0.00	5.62
TOTL	1.30	10.[illegible]6	28.57	34.77	16.53	5.32	1.12	0.12	0.00	100.00

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.80

TABLE 11

CECO ZION NUCLEAR POWER STATION

WIND ROSE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NON-PRECIPITATION

SAMPLE TOTAL IS 6725 OF 6983 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.29	1.70	2.49	1.30	0.20	0.04	0.00	0.00	0.00	6.03
NNE	0.27	1.39	2.99	1.53	0.32	0.03	0.00	0.00	0.00	6.57
NE	0.21	1.62	1.73	0.39	0.16	0.00	0.00	0.00	0.00	4.11
ENE	0.11	1.17	1.02	0.46	0.04	0.19	0.00	0.00	0.00	2.99
E	0.17	0.84	0.56	0.43	0.10	0.00	0.00	0.00	0.00	2.11
ESE	0.24	0.97	0.40	0.30	0.00	0.00	0.00	0.00	0.00	1.92
SE	0.33	1.83	1.07	0.13	0.00	0.00	0.00	0.00	0.00	3.37
SSE	0.20	2.06	1.95	0.66	0.14	0.00	0.00	0.00	0.00	5.01
S	0.42	4.65	2.88	0.40	0.07	0.00	0.00	0.00	0.00	8.42
SSW	0.37	2.75	1.70	1.37	0.59	0.03	0.00	0.00	0.00	6.82
SW	0.40	2.63	2.99	1.80	0.69	0.07	0.00	0.00	0.00	8.59
WSW	0.44	2.16	2.36	1.82	0.33	0.04	0.00	0.00	0.00	7.16
W	0.57	3.06	4.24	2.79	0.52	0.10	0.01	0.00	0.00	11.30
WNW	0.64	2.79	2.18	1.06	0.06	0.00	0.00	0.00	0.00	6.73
NW	0.64	3.22	2.45	1.10	0.00	0.00	0.00	0.00	0.00	7.42
NNW	0.40	1.90	1.75	0.87	0.04	0.00	0.00	0.00	0.00	4.97
TOTL	5.73	34.78	32.77	16.47	3.25	0.50	0.01	0.00	0.00	96.31

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 2.79

TABLE II

CECO ZION NUCLEAR POWER STATION

WIND ROSE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NON-PRECIPITATION

SAMPLE TOTAL IS 6957 OF 7211 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.06	0.73	2.20	2.94	1.47	0.25	0.03	C.00	0.00	7.72
NNE	0.17	0.67	2.22	2.33	1.12	0.31	0.12	C.01	0.00	6.95
NE	0.06	0.73	1.59	0.82	0.24	0.19	0.03	C.C0	0.00	3.66
ENE	0.12	0.58	0.37	0.67	0.39	0.06	0.21	C.00	0.00	2.90
E	C.08	0.60	0.73	0.62	0.26	0.10	0.00	C.00	0.00	2.40
ESE	0.12	0.50	0.57	0.31	0.17	0.01	0.00	C.00	0.00	1.68
SE	0.06	C.79	1.19	C.86	0.40	0.00	0.00	C.00	0.00	3.30
SSE	0.04	0.83	2.39	1.68	0.26	0.07	0.00	0.00	0.00	5.27
S	0.07	C.64	2.51	2.93	0.71	0.28	0.07	C.C0	0.00	7.20
SSW	0.03	0.54	2.05	2.43	0.72	0.50	0.12	C.00	0.00	6.39
SW	0.04	C.49	2.32	2.86	1.22	0.76	0.25	C.C0	0.00	7.93
WSW	0 11	0.54	1.94	2.93	1.19	0.35	0.10	0.00	0.00	7.16
W	C.08	C.57	2.65	3.80	1.90	0.65	0.11	C.11	0.00	9.87
WNW	0.10	0.94	2.77	2.00	0.76	0.25	0.00	0.00	0.00	6.82
NW	0.11	1.07	3.70	2.86	0.90	0.12	0.0C	C.C0	0.00	8.76
NNW	0.10	0.73	3.00	2.20	1.32	0.28	0.03	0.00	0.00	7.65
TOTL	1.35	11.00	32.71	32.21	13.04	4.17	1.C7	C.12	0.00	96.48

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.80

TABLE II

CECO ZION NUCLEAR POWER STATION

WIND ROSE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NON-PRECIPITATION

SAMPLE TOTAL IS 6739 OF 7003 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.06	0.29	1.06	1.64	1.36	0.24	0.03	C.00	0.00	4.67
NNE	0.06	0.60	1.83	3.57	1.49	0.31	0.20	0.00	0.00	8.05
NE	0.13	0.[illegible]7	2.01	1.07	0.37	0.24	0.00	C.00	0.00	4.70
ENE	0 11	0.83	1.27	0.80	0.23	0.13	0.16	C.00	0.00	3.53
E	0.10	0.[illegible]1	1.01	0.80	0.30	0.C7	0.00	C.C0	0.00	3.10
ESE	0.06	0.59	0.64	0.40	0.14	0.07	0.00	C.C0	0.00	1.90
SE	0.11	0.64	1.31	0.96	0.53	0.C4	0.00	C.C0	0.00	3.60
SSE	0.06	0.73	2.33	1.70	0.77	0.17	0.00	C.C0	0.00	5.75
S	0.11	0.71	1.86	2.86	1.43	0.51	0.10	C.C0	0.00	7.58
SSW	0.11	0.37	1.16	2.44	1.10	0.74	0.14	C.C0	0.00	6.07
SW	0.07	0.77	1.71	3.34	1.96	0.70	0.29	C.C0	0.00	8.84
WSW	0.21	0.34	1.77	2.41	1.39	0.39	0.04	C.01	0.00	6.57
W	0.14	0.54	2.11	4.40	2.54	0.90	0.06	C.09	0.00	10.78
WNW	0.13	0.89	2.41	2.53	0.94	0.20	0.01	C.00	0.00	7.11
NW	0.17	1.00	3.37	2.67	0.66	0.04	0.00	C.00	0.00	7.91
NNW	0.07	0.41	1.90	2.13	0.70	0.13	0.00	C.C0	0.00	5.34
TOTL	1.71	10.40	27.76	33.71	15.89	4.90	1.03	C.10	0.00	96.23

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
* COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.73

TABLE III

CECO ZION NUCLEAR POWER STATION

WIND ROSE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: PRECIPITATION

SAMPLE TOTAL IS 253 OF 6983 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.00	0.06	0.11	0.04	0.04	0.01	0.00	0.00	0.00	0.27
NNE	0.01	0.07	0.01	0.04	0.11	0.01	0.00	0.00	0.00	0.27
NE	0.01	0.00	0.10	0.03	0.09	0.00	0.00	0.00	0.00	0.23
ENE	0.00	0.07	0.09	0.04	0.09	0.03	0.00	0.00	0.00	0.32
E	0.00	0.00	0.10	0.04	0.04	0.04	0.00	0.00	0.00	0.23
ESE	0.00	0.06	0.16	0.04	0.01	0.00	0.00	0.00	0.00	0.27
SE	0.03	0.03	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.13
SSE	0.01	0.09	0.07	0.10	0.00	0.00	0.00	0.00	0.00	0.27
S	0.01	0.07	0.19	0.07	0.00	0.00	0.00	0.00	0.00	0.34
SSW	0.00	0.04	0.06	0.10	0.04	0.01	0.00	0.00	0.00	0.26
SW	0.01	0.10	0.01	0.06	0.01	0.00	0.00	0.00	0.00	0.20
WSW	0.00	0.04	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.17
W	0.00	0. 6	0.16	0.06	0.04	0.00	0.00	0.00	0.00	0.32
WNW	0.03	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.10
NW	0.01	0.10	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.20
NNW	0.01	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.07
TOTL	0.16	0.83	1.35	0.72	0.49	0.11	0.00	0.00	0.00	3.69

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.04

TABLE III

CECO ZION NUCLEAR POWER STATION

WIND ROSE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: PRECIPITATION

SAMPLE TOTAL IS 254 OF 7211 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.00	0.01	0.07	0.08	0.08	0.03	0.03	0.00	0.00	0.31
NNE	0.00	0.03	0.03	0.03	0.03	0.06	0.04	0.00	0.00	0.21
NE	0.01	0.01	0.03	0.01	0.08	0.06	0.04	0.00	0.00	0.25
ENE	0.00	0.01	0.01	0.10	0.03	0.04	0.03	0.00	0.00	0.22
E	0.00	0.01	0.06	0.03	0.04	0.06	0.00	0.00	0.00	0.19
ESE	0.00	0.01	0.00	0.08	0.07	0.01	0.01	0.00	0.00	0.19
SE	0.00	0.01	0.07	0.07	0.03	0.01	0.00	0.00	0.00	0.19
SSE	0.00	0.03	0.06	0.06	0.01	0.03	0.00	0.00	0.00	0.18
S	0.00	0.06	0.06	0.14	0.07	0.01	0.00	0.00	0.00	0.33
SSW	0.00	0.01	0.06	0.10	0.04	0.03	0.04	0.00	0.00	0.28
SW	0.00	0.04	0.07	0.06	0.06	0.00	0.00	0.00	0.00	0.22
WSW	0.01	0.03	0.04	0.01	0.07	0.04	0.00	0.00	0.00	0.21
W	0.00	0.03	0.06	0.07	0.07	0.03	0.01	0.00	0.00	0.26
WNW	0.00	0.04	0.07	0.03	0.03	0.00	0.00	0.00	0.00	0.17
NW	0.01	0.03	0.06	0.03	0.03	0.00	0.00	0.00	0.00	0.15
NNW	0.00	0.03	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.15
TOTL	0.04	0.40	0.75	0.9[illegible]	0.73	0.40	0.21	0.00	0.00	3.52

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.00

TABLE III

CECO ZION NUCLEAR POWER STATION

WIND ROSE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: PRECIPITATION

SAMPLE TOTAL IS 264 OF 7003 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.00	0.00	0.01	0.10	0.09	0.00	0.03	0.00	0.00	0.23
NNE	0.00	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.00	0.26
NE	0.00	0.00	0.01	0.03	0.01	0.14	0.01	0.00	0.00	0.21
ENE	0.00	0.00	0.01	0.09	0.01	0.11	0.03	0.00	0.00	0.26
E	0.00	0.01	0.07	0.06	0.07	0.07	0.01	0.00	0.00	0.30
ESE	0.00	0.03	0.00	0.10	0.04	0.03	0.00	0.00	0.00	[illegible]
SE	0.00	0.03	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.14
SSE	0.01	0.04	0.04	0.13	0.03	0.03	0.00	0.00	0.00	0.29
S	0.00	0.03	0.09	0.06	0.14	0.03	0.00	0.00	0.00	0.34
SSW	0.01	0.01	0.03	0.07	0.11	0.04	0.04	0.00	0.00	0.33
SW	0.00	0.09	0.03	0.09	0.04	0.01	0.00	0.00	0.00	0.26
WSW	0.00	0.04	0.01	0.06	0.07	0.01	0.00	0.00	0.00	0.20
W	0.00	0.00	0.04	0.14	0.04	0.04	0.00	0.00	0.00	0.27
WNW	0.00	0.01	0.11	0.00	0.03	0.00	0.00	0.00	0.00	0.16
NW	0.00	0.03	0.06	0.04	0.03	0.00	0.00	0.00	0.00	0.16
NNW	0.00	0.01	0.07	0.04	0.00	0.00	0.00	0.00	0.00	0.13
TOTAL	0.03	0.37	0.63	1.10	0.83	0.57	0.17	0.03	0.00	3.77

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.04

TABLE IV

CECO ZION NUCLEAR POWER STATION

WIND ROSE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 851 OF 6950 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.12	0.37	0.04	0.03	0.01	0.00	0.00	0.00	0.00	0.58
NNE	0.09	0.07	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.26
NE	0.09	0.07	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.22
ENE	0.04	0.10	0.12	0.03	0.00	0.00	0.00	0.00	0.00	0.29
E	0.06	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.16
ESE	0.09	0.19	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.32
SE	0.06	0.26	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.42
SSE	0.04	0.29	0.23	0.07	0.01	0.00	0.00	0.00	0.00	0.65
S	0.17	1.40	0.55	0.06	0.00	0.00	0.00	0.00	0.00	2.17
SSW	0.14	1.02	0.16	0.01	0.00	0.00	0.00	0.00	0.00	1.34
SW	0.19	1.02	0.07	0.01	0.00	0.00	0.00	0.00	0.00	1.29
WSW	0.20	0.55	0.09	0.01	0.00	0.00	0.00	0.00	0.00	0.85
W	0.24	0.66	0.13	0.00	0.00	0.00	0.00	0.00	0.00	1.04
WNW	0.26	0.47	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.78
NW	0.14	0.35	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.52
NNW	0.09	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36
TOTL	2.01	7.17	1.71	0.30	0.03	0.00	0.00	0.00	0.00	12.24

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 1.02

TABLE IV

CECO ZION NUCLEAR POWER STATION

WIND ROSE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 914 OF 7174 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.01	0.22	0.32	0.22	0.03	0.00	0.00	0.00	0.00	0.81
NNE	0.04	0.11	0.31	0.07	0.01	0.00	0.00	0.00	0.00	0.54
NE	0.03	0.13	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.24
ENE	0.06	0.13	0.06	0.04	0.06	0.00	0.00	0.00	0.00	0.33
E	0.03	0.08	0.04	0.04	0.06	0.01	0.00	0.00	0.00	0.26
ESE	0.04	0.13	0.06	0.06	0.03	0.00	0.00	0.00	0.00	0.31
SE	0.01	0.19	0.21	0.11	0.00	0.00	0.00	0.00	0.00	0.52
SSE	0.03	0.14	0.35	0.24	0.07	0.03	0.00	0.00	0.00	0.85
S	0.03	0.10	0.68	0.63	0.04	0.01	0.00	0.00	0.00	1.49
SSW	0.00	0.22	0.75	0.81	0.06	0.03	0.00	0.00	0.00	1.87
SW	0.00	0.18	0.68	0.56	0.03	0.04	0.00	0.00	0.00	1.49
WSW	0.03	0.15	0.46	0.29	0.04	0.00	0.00	0.00	0.00	0.98
W	0.00	0.13	0.67	0.17	0.00	0.00	0.00	0.00	0.00	0.96
WNW	0.01	0.11	0.43	0.11	0.04	0.00	0.00	0.00	0.00	0.71
NW	0.00	0.17	0.47	0.03	0.00	0.00	0.00	0.00	0.00	0.67
NNW	0.03	0.07	0.32	0.17	0.01	0.00	0.00	0.00	0.00	0.60
TOTL	0.35	2.24	5.87	3.57	0.47	0.13	0.00	0.00	0.00	12.74

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.11

TABLE IV

CECO ZION NUCLEAR POWER STATION

WIND ROSE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 846 OF 6971 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.01	0.06	0.23	0.23	0.03	0.00	0.00	0.00	0.00	0.56
NNE	0.00	0.06	0.19	0.26	0.03	0.00	0.00	0.00	0.00	0.53
NE	0.03	0.26	0.22	0.07	0.00	0.00	0.00	0.00	0.00	0.57
ENE	0.03	0.06	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.27
E	0.00	0.26	0.13	0.10	0.09	0.03	0.00	0.00	0.00	0.60
ESE	0.01	0.07	0.09	0.07	0.04	0.01	0.00	0.00	0.00	0.30
SE	0.00	0.17	0.23	0.10	0.10	0.01	0.00	0.00	0.00	0.62
SSE	0.01	0.09	0.29	0.23	0.16	0.04	0.00	0.00	0.00	0.82
S	0.00	0.13	0.55	0.73	0.36	0.06	0.00	0.00	0.00	1.82
SSW	0.06	0.09	0.39	0.65	0.20	0.07	0.00	0.00	0.00	1.45
SW	0.01	0.26	0.44	0.72	0.16	0.00	0.00	0.00	0.00	1.59
WSW	0.03	0.09	0.19	0.22	0.13	0.00	0.00	0.00	0.00	0.65
W	0.07	0.07	0.33	0.40	0.17	0.00	0.00	0.00	0.00	1.05
WNW	0.01	0.09	0.22	0.13	0.04	0.00	0.00	0.00	0.00	0.49
NW	0.01	0.11	0.23	0.10	0.00	0.00	0.00	0.00	0.00	0.46
NNW	0.00	0.06	0.10	0.09	0.00	0.00	0.00	0.00	0.00	0.24
TOTL	0.30	1.91	3.92	4.16	1.51	0.23	0.00	0.00	0.00	12.14

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.11

TABLE V

CECO ZION NUCLEAR POWER STATION

WIND ROSE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1237 OF 6950 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.13	0.79	0.68	0.23	0.00	0.00	0.00	0.00	0.00	1.83
NNE	0.03	0.42	0.33	0.04	0.00	0.00	0.00	0.00	0.00	0.82
NE	0.07	0.35	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.60
ENE	0.03	0.23	0.20	0.01	0.00	0.00	0.00	0.00	0.00	0.47
E	0.03	0.07	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.19
ESE	0.06	0.22	0.12	0.01	0.01	0.00	0.00	0.00	0.00	0.42
SE	0.14	0.52	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.94
SSE	0.03	0.45	0.53	0.09	0.00	0.00	0.00	0.00	0.00	1.09
S	0.13	1.27	0.63	0.04	0.00	0.00	0.00	0.00	0.00	2.07
SSW	0.04	0.75	0.55	0.16	0.04	0.01	0.00	0.00	0.00	1.55
SW	0.12	0 66	0.78	0.13	0.00	0.00	0.00	0.00	0.00	1.68
WSW	0.14	0.53	0.37	0.06	0.00	0.00	0.00	0.00	0.00	1.11
W	0.07	0. 2	0.65	0.16	0.00	0.00	0.00	0.00	0.00	1.70
WNW	0.09	0.55	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.76
NW	0.32	0.69	0.09	0.00	0.00	0.00	0.00	0.00	0.00	1.09
NNW	0.14	0.62	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.81
TOTL	1.57	8 92	5.64	0.94	0.06	0.01	0.00	0.00	0.00	17.80

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.66

TABLE V

CECO ZION NUCLEAR POWER STATION

WIND ROSE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1260 OF 7174 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.01	0.22	0.70	1.03	0.20	0.01	0.00	0.00	0.00	2.17
NNE	0.01	0.17	0.39	0.32	0.04	0.01	0.00	0.00	0.00	0.95
NE	0.01	0.17	0.24	0.09	0.03	0.00	0.00	0.00	0.00	0.53
ENE	0.01	0.08	0.10	0.14	0.08	0.00	0.00	0.00	0.00	0.42
E	0.01	0.14	0.21	0.17	0.00	0.01	0.00	0.00	0.00	0.54
ESE	0.01	0.08	0.07	0.01	0.03	0.01	0.01	0.00	0.00	0.24
SE	0.03	0.14	0.21	0.24	0.06	0.00	0.00	0.00	0.00	0.67
SSE	0.01	0.26	0.68	0.59	0.04	0.01	0.00	0.00	0.00	1.60
S	0.01	0.17	0.54	0.75	0.13	0.03	0.00	0.00	0.00	1.63
SSW	0.00	0.11	0.47	0.60	0.11	0.01	0.03	0.00	0.00	1.34
SW	0.00	0.11	0.43	0.68	0.15	0.03	0.00	0.00	0.00	1.41
WSW	0.03	0.11	0.40	0.49	0.17	0.00	0.00	0.00	0.00	1.20
W	0.01	0.14	0.50	0.66	0.24	0.03	0.00	0.00	0.00	1.58
WNW	0.03	0.11	0.47	0.24	0.01	0.00	0.00	0.00	0.00	0.86
NW	0.03	0.08	0.67	0.36	0.01	0.00	0.00	0.00	0.00	1.16
NNW	0.06	0.10	0.63	0.28	0.00	0.01	0.00	0.00	0.00	1.16
TOTL	0.29	2.29	6.72	6.64	1.30	0.18	0.04	0.00	0.00	17.56

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.11

TABLE V

CECO ZION NUCLEAR POWER STATION

WIND ROSE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1219 OF 6971 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.01	0.13	0.32	0.47	0.32	0.00	0.00	0.00	0.00	1.25
NNE	0.01	0.17	0.42	0.66	0.22	0.01	0.00	0.00	0.00	1.49
NE	0.04	0.13	0.26	0.29	0.01	0.00	0.00	0.00	0.00	0.73
ENE	0.01	0.14	0.24	0.23	0.03	0.01	0.00	0.00	0.00	0.67
E	0.04	0.09	0.17	0.27	0.01	0.01	0.00	0.00	0.00	0.60
ESE	0.03	0.13	0.13	0.10	0.04	0.04	0.00	0.00	0.00	0.47
SE	0.00	0.13	0.16	0.22	0.19	0.03	0.00	0.00	0.00	0.72
SSE	0.01	0.19	0.55	0.66	0.17	0.07	0.00	0.00	0.00	1.65
S	0.04	0.20	0.40	0.75	0.33	0.06	0.01	0.00	0.00	1.79
SSW	0.03	0.09	0.33	0.69	0.22	0.07	0.04	0.00	0.00	1.46
SW	0.03	0.14	0.24	0.65	0.34	0.03	0.00	0.00	0.00	1.43
WSW	0.00	0.11	0.27	0.27	0.14	0.07	0.00	0.00	0.00	0.88
W	0.00	0.07	0.24	0.65	0.33	0.04	0.00	0.00	0.00	1.33
WNW	0.01	0.13	0.26	0.52	0.04	0.00	0.00	0.00	0.00	0.96
NW	0.00	0.04	0.39	0.60	0.00	0.00	0.00	0.00	0.00	1.03
NNW	0.03	0.03	0.34	0.30	0.07	0.01	0.00	0.00	0.00	0.79
TOTL	0.32	1.92	4.72	7.32	2.47	0.47	0.06	0.00	0.00	17.49

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.22

TABLE VI

CECO ZION NUCLEAR POWER STATION

WIND ROSE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1397 OF 6950 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.04	0.33	0.58	0.16	0.03	0.00	0.00	0.00	0.00	1.14
NNE	0.04	0.27	0.43	0.19	0.09	0.00	0.00	0.00	0.00	1.02
NE	0.01	0.36	0.17	0.07	0.00	0.00	0.00	0.00	0.00	0.62
ENE	0.00	0.23	0.14	0.07	0.00	0.00	0.00	0.00	0.00	0.45
E	0.04	0.13	0.14	0.22	0.13	0.01	0.00	0.00	0.00	0.68
ESE	0.04	0.19	0.17	0.20	0.01	0.00	0.00	0.00	0.00	0.62
SE	0.04	0.36	0.39	0.07	0.00	0.00	0.00	0.00	0.00	0.86
SSE	0.06	0.46	0.47	0.12	0.00	0.00	0.00	0.00	0.00	1.11
S	0.07	0.73	0.73	0.10	0.00	0.00	0.00	0.00	0.00	1.64
SSW	0.09	0.63	0.53	0.55	0.12	0.03	0.00	0.00	0.00	1.99
SW	0.07	0.46	0.95	0.62	0.07	0.01	0.00	0.00	0.00	2.19
WSW	0.00	0.43	0.42	0.35	0.07	0.00	0.00	0.00	0.00	1.27
W	0.14	0.52	1.08	0.82	0.12	0.00	0.00	0.00	0.00	2.68
WNW	0.19	0.53	0.30	0.16	0.00	0.00	0.00	0.00	0.00	1.18
NW	0.09	0.69	0.35	0.27	0.00	0.00	0.00	0.00	0.00	1.40
NNW	0.10	0.30	0.30	0.10	0.00	0.00	0.00	0.00	0.00	0.81
TOTL	1.04	6.68	7.17	4.06	0.63	0.06	0.00	0.00	0.00	20.10

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.47

TABLE VI

CECO [illegible]ION NUCLEAR POWER STATION

WIND ROSE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1467 OF 7174 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.00	0.20	0.43	0.45	0.25	0.03	0.00	0.00	0.00	1.35
NNE	0.06	0.11	0.31	0.35	0.20	0.01	0.03	0.00	0.00	1.06
NE	0.00	0.14	0.21	0.20	0.06	0.00	0.00	0.00	0.00	0.60
ENE	0.01	0.13	0.17	0.13	0.04	0.00	0.00	0.00	0.00	0.47
E	0.01	0.08	0.15	0.11	0.18	0.13	0.00	0.00	0.00	0.67
ESE	0.03	0.08	0.21	0.07	0.11	0.00	0.00	0.00	0.00	0.50
SE	0.00	0.22	0.17	0.25	0.22	0.01	0.00	0.00	0.00	0.88
SSE	0.00	0.17	0.47	0.39	0.03	0.01	0.00	0.00	0.00	1.07
S	0.01	0.15	0.39	0.75	0.17	0.10	0.01	0.00	0.00	1.59
SSW	0.00	0.11	0.57	0.60	0.26	0.14	0.03	0.00	0.00	1.71
SW	0.01	0.14	0.59	0.84	0.56	0.10	0.00	0.00	0.00	2.23
WSW	0.01	0.08	0.35	0.42	0.25	0.13	0.04	0.00	0.00	1.28
W	0.00	0.15	0.54	1.06	0.64	0.15	0.04	0.00	0.00	2.59
WNW	0.03	0.21	0.56	0.28	0.17	0.06	0.00	0.00	0.00	1.30
NW	0.06	0.25	0.77	0.32	0.15	0.03	0.00	0.00	0.00	1.58
NNW	0.00	0.08	0.53	0.43	0.31	0.01	0.00	0.00	0.00	1.37
TOTL	0.24	2.31	6.41	6.64	3.60	0.91	0.15	0.00	0.00	20.45

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.20

TABLE VI

CECO ZION NUCLEAR POWER STATION

WIND ROSE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1434 OF 6971 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.00	0.07	0.16	0.23	0.19	0.04	0.00	0.00	0.00	0.69
NNE	0.03	0.07	0.32	0.65	0.26	0.01	0.09	0.00	0.00	1.42
NE	0.00	0.20	0.23	0.20	0.06	0.00	0.00	0.00	0.00	0.69
ENE	0.03	0.24	0.22	0.14	0.03	0.00	0.00	0.00	0.00	0.66
E	0.01	0.17	0.26	0.17	0.14	0.07	0.00	0.00	0.00	0.83
ESE	0.00	0.13	0.19	0.13	0.04	0.03	0.00	0.00	0.00	0.52
SE	0.03	0.14	0.34	0.36	0.09	0.00	0.00	0.00	0.00	0.96
SSE	0.01	0.10	0.49	0.33	0.16	0.04	0.00	0.00	0.00	1.13
S	0.03	0.20	0.43	0.75	0.36	0.10	0.01	0.00	0.00	1.88
SSW	0.01	0.17	0.33	0.53	0.37	0.11	0.09	0.00	0.00	1.62
SW	0.00	0.24	0.44	1.00	0.76	0.10	0.04	0.00	0.00	2.60
WSW	0.04	0.03	0.40	0.53	0.27	0.09	0.01	0.00	0.00	1.38
W	0.03	0.11	0.42	1.15	0.63	0.23	0.00	0.00	0.00	2.57
WNW	0.03	0.22	0.46	0.39	0.23	0.04	0.00	0.00	0.00	1.36
NW	0.01	0.24	0.69	0.53	0.10	0.00	0.00	0.00	0.00	1.58
NNW	0.01	0.04	0.22	0.29	0.04	0.01	0.00	0.00	0.00	0.62
TOTL	0.29	2.40	5.58	7.37	3.73	0.89	0.24	0.00	0.00	20.57

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.07

TABLE VII

CECO ZION NUCLEAR POWER STATION

WIND ROSE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3465 OF 6950 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.06	0.36	1.34	0.95	0.20	0.03	0.00	0.00	0.00	2.94
NNE	0.14	0.59	2.04	1.41	0.32	0.04	0.00	0.00	0.00	4.55
NE	0.06	0.81	1.32	0.46	0.24	0.00	0.00	0.00	0.00	2.89
ENE	0.04	0.65	0.63	0.50	0.13	0.22	0.00	0.00	0.00	2.17
E	0.04	0.66	0.35	0.39	0.03	0.03	0.00	0.00	0.00	1.50
ESE	0.06	0.42	0.20	0.17	0.04	0.00	0.00	0.00	0.00	0.89
SE	0.10	0.68	0.36	0.06	0.00	0.00	0.00	0.00	0.00	1.19
SSE	0.07	0.85	0.69	0.52	0.13	0.00	0.00	0.00	0.00	2.26
S	0.07	0.85	0.96	0.27	0.07	0.00	0.00	0.00	0.00	2.23
SSW	0.07	0.30	0.50	0.82	0.45	0.00	0.00	0.00	0.00	2.14
SW	0.06	0.55	1.15	1.18	0.66	0.07	0.00	0.00	0.00	3.67
WSW	0.09	0.60	1.44	1.38	0.26	0.04	0.00	0.00	0.00	3.81
W	0.13	1.14	2.43	1.86	0.45	0.10	0.01	0.00	0.00	6.12
WNW	0.20	1.31	1.76	0.86	0.06	0.00	0.00	0.00	0.00	4.19
NW	0.14	1.93	2.10	0.88	0.00	0.00	0.00	0.00	0.00	5.05
NNW	0.09	1.01	1.61	0.86	0.04	0.00	0.00	0.00	0.00	3.61
TOTL	1.42	12.69	13.89	12.5[illegible]	3.0[illegible]	0.53	0.01	0.00	0.00	49.86

TABLE ENTRY IS FRECUENCY OF VALID OBSERVATIONS WIND OCCUPIED
SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED
A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.65

TABLE VII

CECO ZION NUCLEAR POWER STATION

WIND ROSE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3533 OF 7174 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH)									
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.06	0.22	0.98	1.42	1.03	0.20	0.04	0.00	0.00	3.94
NNE	0.06	0.24	1.09	1.55	0.96	0.32	0.11	0.01	0.00	4.34
NE	0.01	0.29	1.07	0.50	0.36	0.25	0.07	0.00	0.00	2.56
ENE	0.03	0.25	0.54	0.39	0.35	0.08	0.24	0.00	0.00	1.88
E	0.03	0.29	0.40	0.36	0.18	0.01	0.00	0.00	0.00	1.28
ESE	0.03	0.21	0.24	0.21	0.10	0.07	0.00	0.00	0.00	0.85
SE	0.01	0.29	0.66	0.32	0.15	0.00	0.00	0.00	0.00	1.44
SSE	0.00	0.29	0.78	0.47	0.15	0.04	0.00	0.00	0.00	1.74
S	0.01	0.26	0.71	0.78	0.42	0.14	0.06	0.00	0.00	2.38
SSW	0.03	0.13	0.31	0.38	0.38	0.31	0.10	0.00	0.00	1.62
SW	0.03	0.10	0.56	0.96	0.66	0.66	0.25	0.00	0.00	3.21
WSW	0.06	0.22	0.79	1.63	0.84	0.28	0.06	0.00	0.00	3.88
W	0.07	0.26	0.98	1.71	1.03	0.46	0.08	0.11	0.00	4.71
WNW	0.03	0.63	1.38	1.35	0.54	0.20	0.00	0.00	0.00	4.13
NW	0.06	0.77	1.85	2.09	0.77	0.10	0.00	0.00	0.00	5.63
NNW	0.01	0.71	1.90	1.44	0.96	0.24	0.03	0.00	0.00	5.28
TOTL	0.52	5.17	14.23	15.57	8.88	3.35	1.03	0.13	0.00	49.25

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.38

TABLE VII

CECO ZION NUCLEAR POWER STATION

WIND ROSE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3472 OF 6971 VALID OBSERVATIONS

WIND DIRECTION	WIND SPEED (MPH) 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	GT 46	TOTAL
N	0.04	0.10	0.37	0.79	0.76	0.13	0.04	0.00	0.00	2.24
NNE	0.01	0.33	0.92	2.04	1.08	0.32	0.14	0.00	0.00	4.83
NE	0.06	0.30	1.22	0.55	0.33	0.37	0.01	0.00	0.00	2.84
ENE	0.06	0.36	0.65	0.44	0.29	0.20	0.19	0.00	0.00	2.18
E	0.04	0.24	0.46	0.33	0.19	0.04	0.01	0.00	0.00	1.32
ESE	0.03	0.27	0.26	0.24	0.11	0.04	0.00	0.00	0.00	0.96
SE	0.09	0.26	0.59	0.33	0.22	0.00	0.00	0.00	0.00	1.48
SSE	0.03	0.39	0.95	0.56	0.32	0.04	0.00	0.00	0.00	2.28
S	0.04	0.20	0.55	0.55	0.52	0.22	0.06	0.00	0.00	2.12
SSW	0.03	0.03	0.22	0.47	0.43	0.47	0.06	0.00	0.00	1.71
SW	0.03	0.23	0.72	1.25	0.89	0.65	0.24	0.00	0.00	4.00
WSW	0.14	0.19	0.99	1.48	0.76	0.24	0.03	0.01	0.00	3.84
W	0.04	0.39	1.22	2.24	1.26	0.63	0.06	0.09	0.00	5.92
WNW	0.09	0.49	1.56	1.51	0.65	0.16	0.01	0.00	0.00	4.46
NW	0.17	0.72	2.15	1.55	0.60	0.04	0.00	0.00	0.00	5.24
NNW	0.03	0.40	1.33	1.58	0.59	0.10	0.00	0.00	0.00	4.03
TOTL	0.93	4.89	14.14	15.89	8.98	3.66	0.36	0.10	0.00	49.81

TABLE ENTRY IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED AND DIRECTION CLASS SIMULTANEOUSLY
A ROW TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED A COMPASS DIRECTION CLASS REGARDLESS OF WIND SPEED
A COLUMN TOTAL IS FREQUENCY OF VALID OBSERVATIONS WIND OCCUPIED SPEED CLASS REGARDLESS OF DIRECTION

PERCENT CALM 0.34

TABLE VIII

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 35 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7229 OF 7229 VALID OBSERVATIONS

PERSISTENCE (HOURS)	DIRECTION N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	89	87	83	59	56	73	95	96	129	143	116	143	121	111	100	94	66
2	36	40	37	28	20	22	31	45	63	48	50	41	61	48	43	37	30
3	16	29	20	14	8	11	15	18	35	25	25	25	31	24	32	11	13
4	15	5	7	5	2	0	9	9	8	15	19	8	24	16	14	12	6
5	5	6	2	3	2	4	5	8	13	6	17	9	14	6	9	8	1
6	6	3	4	3	2	0	0	6	5	3	6	9	7	4	7	2	2
7	2	6	3	0	1	0	2	2	7	2	6	3	6	3	5	5	1
8	5	2	0	0	0	1	0	2	2	3	3	4	3	5	3	0	0
9	1	2	1	1	0	0	0	0	1	0	4	2	5	1	1	2	0
10	1	0	1	1	1	0	0	1	3	4	1	0	2	1	1	1	0
11	1	2	0	0	1	0	0	0	0	2	0	1	2	0	2	0	0
12	0	1	0	0	1	0	0	0	2	0	0	0	2	0	0	0	0
13	0	2	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0
14	0	0	0	0	0	0	0	1	0	0	2	2	1	0	0	0	0
15	1	0	0	0	0	0	0	0	0	0	0	0	3	0	1	2	0
16	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0
17	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
21 - 25	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	22	22	10	17	12	8	7	14	13	11	16	14	20	16	16	15	7
50.0 %	2	2	1	1	1	1	1	1	2	1	2	1	2	1	2	1	1
80.0 %	4	3	3	3	2	2	2	3	3	3	4	3	4	3	4	3	2
90.0 %	6	6	4	4	4	3	4	5	5	4	5	5	6	4	5	5	3
99.0 %	17	13	9	10	12	5	7	10	12	10	14	11	16	9	13	15	6
99.9 %	22	22	10	17	12	8	7	14	13	11	16	14	20	16	16	15	7

BLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION
D WIND DIRECTION

TABLE VIII

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 125 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7805 OF 7805 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	96	90	76	64	77	76	101	99	100	121	111	132	114	128	118	96	34
2	49	37	40	24	14	22	28	38	43	34	44	48	66	57	55	48	8
3	25	32	18	13	9	9	12	30	27	32	21	26	35	19	29	21	3
4	16	10	7	7	7	0	6	15	14	16	14	18	15	12	15	13	1
5	12	11	1	3	1	0	7	5	11	4	8	6	12	7	11	18	1
6	6	4	3	1	3	0	4	4	7	8	8	7	6	8	10	6	0
7	4	6	3	1	1	2	1	4	2	3	7	3	3	4	8	5	0
8	2	2	2	0	1	0	2	1	3	1	7	7	6	4	4	0	0
9	3	1	1	0	0	0	0	3	3	2	4	0	3	1	4	1	0
10	0	1	0	0	1	0	0	0	1	2	3	3	4	0	3	1	0
11	2	1	0	0	1	0	0	0	4	1	2	1	1	0	2	1	0
12	2	3	0	0	0	0	0	0	0	2	2	0	2	1	0	0	0
13	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0
14	2	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0
15	0	0	0	0	0	0	0	0	3	0	1	0	2	1	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
17	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	0
18	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
21 - 25	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0
26 - 30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE HOURS	24	26	9	17	11	7	8	9	15	12	15	13	22	15	17	23	5
50.0 %	2	2	1	1	1	1	1	2	2	1	2	1	2	1	2	2	1
80.0 %	4	4	3	3	3	2	2	3	4	3	4	3	4	3	4	4	2
90.0 %	6	5	4	4	4	3	4	4	6	5	7	5	6	5	6	5	3
95.0 %	17	12	8	14	10	7	8	9	15	11	12	10	16	9	11	20	5
99.9 %	24	26	9	17	11	7	8	9	15	12	15	13	22	15	17	23	5

ABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE VIII

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 250 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7537 OF 7537 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	[illegible]	[illegible]	[illegible]	70	66	71	78	[illegible]	100	[illegible]	96	135	104	102	101	76	23
2	42	34	33	32	20	19	32	40	47	[illegible]	48	49	51	53	27	36	9
3	11	22	31	14	15	9	15	31	27	[illegible]	22	20	23	21	27	19	3
4	12	15	4	7	6	4	9	13	17	13	19	15	21	8	17	11	1
5	9	9	3	6	3	3	6	9	3	7	7	15	9	7	11	15	0
6	4	6	2	2	2	0	1	6	5	6	8	3	9	7	8	4	1
7	2	6	5	2	1	0	3	1	5	0	6	1	8	5	6	2	0
8	2	4	4	1	2	1	0	4	6	3	6	1	7	4	3	1	0
9	0	4	1	0	0	0	0	2	1	0	3	3	3	6	1	1	0
10	0	1	0	0	1	0	1	1	2	1	2	1	3	0	4	0	0
11	1	3	0	0	1	0	1	0	1	4	0	1	5	1	2	1	0
12	0	3	0	0	0	0	0	1	1	2	1	1	5	0	3	0	0
13	0	1	0	0	1	0	0	0	2	0	3	0	1	0	1	0	0
14	0	1	0	0	0	0	0	0	1	0	1	0	0	0	2	0	0
15	1	1	0	0	0	0	0	0	1	1	1	0	0	1	0	1	0
16	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
17	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
19	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
20	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	15	19	9	17	13	8	11	12	15	15	20	12	19	15	14	21	6
50.0 %	1	2	1	1	1	1	1	2	2	1	2	1	2	2	2	2	1
80.0 %	3	5	3	3	3	2	3	3	4	3	4	3	5	3	4	4	2
90.0 %	5	7	4	4	4	3	4	5	6	5	7	5	8	6	7	5	3
95.0 %	11	15	8	8	11	5	10	10	13	12	17	10	18	9	13	21	6
99.9 %	15	19	9	17	13	8	11	12	15	15	20	12	19	15	14	21	6

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

August 1998

TABLE

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 35 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 780 OF 6755 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	21	12	11	11	11	15	21	19	46	47	30	28	27	20	15	16	26
2	5	3	2	3	0	2	4	10	21	14	9	2	10	9	4	3	12
3	3	0	0	1	0	1	0	2	7	2	3	0	4	4	2	1	2
4	0	0	0	0	0	0	0	0	3	3	3	1	0	1	0	0	2
5	0	0	0	0	0	0	0	0	2	0	3	1	1	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0
7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1
8	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	3	2	2	3	1	3	2	3	13	4	6	6	8	4	7	3	7
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
80.0 %	2	1	1	2	1	1	1	2	2	2	3	1	2	2	2	1	2
90.0 %	3	2	2	2	1	2	2	2	3	2	4	5	3	3	3	2	3
95.0 %	3	2	2	3	1	3	2	3	13	4	6	6	8	4	7	3	7
99.9 %	3	2	2	3	1	3	2	3	13	4	6	6	8	4	7	3	7

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE X

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 125 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS [illegible]21 OF 7231 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	25	15	9	13	13	20	26	28	43	45	43	36	23	20	21	22	8
2	5	9	4	4	3	1	4	12	17	20	9	6	8	6	6	4	0
3	5	0	0	1	1	0	1	2	4	7	7	4	4	3	3	2	0
4	2	1	0	0	0	0	0	0	1	4	4	1	2	1	0	0	0
5	0	0	0	0	0	0	0	1	3	1	2	0	2	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0
7	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	4	4	2	3	3	2	3	5	7	7	5	6	5	6	6	7	1
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
80.0 %	2	2	2	2	2	1	1	2	2	2	2	2	3	2	2	2	1
90.0 %	3	2	2	2	2	1	2	2	3	3	3	3	4	3	3	3	1
99.0 %	4	4	2	3	3	2	3	5	7	7	5	6	5	6	6	7	1
99.9 %	4	4	2	3	3	2	3	5	7	7	5	6	5	6	6	7	1

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE X

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 250 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 539 OF 7019 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	13	19	19	14	13	13	21	25	33	36	30	27	24	14	18	10	3
2	2	6	5	1	8	4	8	11	21	16	14	5	10	8	3	2	1
3	2	2	2	1	3	0	2	2	2	7	4	1	6	0	1	1	1
4	0	0	0	0	1	0	0	1	5	1	5	0	1	1	0	0	0
5	1	0	1	0	0	0	0	0	0	0	2	1	0	0	1	0	0
6	1	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
8	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	6	3	5	3	4	2	3	4	13	8	6	5	7	4	5	3	3
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
80.0 %	2	2	2	1	2	2	2	2	2	2	3	2	2	2	2	2	2
90.0 %	3	2	3	2	3	2	2	2	4	3	4	2	3	2	2	2	3
99.0 %	6	3	5	3	4	2	3	4	13	8	6	5	7	4	5	3	3
99.9 %	6	3	5	3	4	2	3	4	13	8	6	5	7	4	5	3	3

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE XII

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 35 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1099 OF 6755 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	30	21	28	7	6	13	38	36	64	50	35	29	31	23	31	21	23
2	13	9	3	3	1	4	7	8	15	5	11	9	11	6	3	6	8
3	5	1	1	2	1	1	2	4	6	6	2	2	4	2	6	4	1
4	2	2	1	1	0	0	0	0	1	0	2	3	4	2	1	0	1
5	1	1	0	0	0	0	0	0	1	2	3	0	2	0	2	0	0
6	0	0	0	0	0	0	0	1	0	1	3	1	0	0	1	1	0
7	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
8	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	11	5	4	10	3	3	3	6	7	8	6	6	12	4	6	6	4
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
60.0 %	3	2	1	3	2	2	1	2	2	2	2	2	3	2	3	2	2
90.0 %	5	3	2	4	3	2	2	3	3	3	5	3	4	3	3	3	2
99.0 %	11	5	4	10	3	3	3	6	7	8	6	6	12	4	6	6	4
99.9 %	11	5	4	10	3	3	3	6	7	8	6	6	12	4	6	6	4

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION
D WIND DIRECTION

TABLE XII

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 125 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1197 OF 7231 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
	DIRECTION																
1	44	33	23	15	18	13	26	42	62	50	36	34	38	28	30	28	5
2	10	9	6	2	1	3	2	11	10	4	8	11	16	7	7	5	0
3	10	4	1	0	1	0	4	7	9	4	2	2	5	2	3	3	1
4	1	1	0	0	1	0	1	2	1	1	4	2	1	0	2	3	0
5	2	0	0	1	0	0	0	0	0	2	2	0	2	1	2	2	0
6	2	0	0	1	0	0	0	2	0	1	1	1	0	1	0	0	0
7	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	11	4	3	6	11	2	4	6	4	7	6	6	11	6	9	7	3
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
[illegible]0.0 %	3	2	2	2	1	1	2	2	2	2	2	2	2	2	2	3	1
90.0 %	5	3	2	5	3	2	3	3	3	3	4	2	3	3	4	4	3
99.0 %	11	4	3	6	11	2	4	6	4	7	6	6	11	6	9	7	3
99.9 %	11	4	3	6	11	2	4	6	4	7	6	6	11	6	9	7	3

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION
D WIND DIRECTION

TABLE XII

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 250 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1123 OF 7019 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	27	38	21	22	14	19	26	43	63	54	40	31	30	22	21	31	6
2	10	12	7	1	4	2	4	12	13	4	11	4	12	6	4	4	2
3	3	5	2	3	0	1	2	5	3	4	5	1	2	5	3	3	0
4	3	3	2	1	0	1	2	1	1	2	0	1	3	1	1	0	0
5	1	1	0	0	1	0	0	1	0	2	1	0	1	1	3	1	1
6	0	0	0	0	0	0	0	0	1	1	1	2	0	0	1	0	0
7	0	1	0	1	0	0	0	1	0	0	0	0	1	0	1	0	0
8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	10	7	4	7	13	4	4	8	6	6	6	6	7	5	7	5	5
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
60.0 %	2	2	2	2	2	1	2	2	2	1	2	2	2	2	3	2	2
90.0 %	4	3	3	3	2	2	3	3	2	3	3	3	4	3	5	3	5
99.0 %	10	7	4	7	13	4	4	8	6	6	6	6	7	5	7	5	5
99.9 %	10	7	4	7	13	4	4	8	6	6	6	6	7	5	7	5	5

ABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION
ND WIND DIRECTION

TABLE XIV

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 35 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1288 OF 6755 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	37	41	18	13	17	19	33	41	55	56	44	38	57	31	28	23	18
2	4	5	9	3	5	3	6	9	12	11	14	14	13	13	8	11	4
3	2	1	1	2	4	3	2	1	7	4	7	1	6	2	3	1	2
4	3	0	0	0	1	1	0	1	1	4	3	1	3	1	1	0	0
5	1	0	0	0	0	1	1	1	0	3	4	1	0	1	1	0	0
6	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0
7	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
9	0	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	5	9	3	3	4	5	7	5	9	7	12	5	15	5	16	8	3
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
80.0 %	2	1	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2
90.0 %	3	2	2	3	3	3	2	2	3	4	4	2	3	2	4	2	2
99.0 %	5	9	3	3	4	5	7	5	9	7	12	5	15	5	16	8	3
99.9 %	5	9	3	3	4	5	7	5	9	7	12	5	15	5	16	8	3

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE XIV

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 125 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1395 OF 7231 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	42	40	23	14	16	23	27	45	49	50	40	44	50	43	30	32	4
2	15	5	6	4	3	3	6	8	9	9	11	12	15	8	12	17	3
3	3	3	2	2	4	1	2	2	2	4	8	5	7	6	7	3	1
4	3	1	0	0	3	1	0	2	2	6	7	1	3	0	3	1	0
5	0	0	0	0	0	0	0	0	1	1	0	0	3	0	1	1	0
6	0	0	0	0	0	0	2	0	0	0	1	0	2	0	0	0	0
7	0	0	0	0	0	0	0	0	1	2	4	0	0	0	0	0	0
8	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0
9	0	1	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0
10	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	4	9	3	3	4	4	8	4	10	7	9	4	14	8	9	8	3
50.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
70.0 %	2	1	2	2	3	1	2	2	2	2	3	2	3	2	3	2	2
90.0 %	2	2	2	2	4	2	3	2	3	4	4	2	4	3	4	3	3
99.0 %	4	9	3	3	4	4	8	4	10	7	9	4	14	8	9	8	3
99.9 %	4	9	3	3	4	4	8	4	10	7	9	4	14	8	9	8	3

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE XIV

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 250 FT LEVEL (22.5 DEG SECTORS)

MAY.1971-APR.1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1367 OF 7019 VALID OBSERVATIONS

RSISTENCE HOURS)	DIRECTION N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	29	40	25	19	26	20	23	44	55	45	37	46	50	32	26	21	2
2	2	9	7	6	6	6	7	13	14	11	14	13	11	11	10	8	1
3	1	3	2	2	2	0	3	0	3	4	8	3	5	6	3	3	0
4	2	2	0	0	2	1	1	0	3	5	6	2	4	1	6	0	0
5	0	1	0	1	0	0	0	1	0	0	5	0	4	0	1	0	0
6	0	0	0	0	0	0	2	0	0	0	1	0	1	1	1	0	0
7	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	1	0
9	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
- 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AXIMUM RSISTENCE HOURS)	4	9	3	5	4	4	6	5	10	7	12	4	12	8	13	8	2
.0 %	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
.0 %	1	2	2	2	2	2	2	2	2	2	4	2	3	2	4	2	2
. %	2	3	2	3	3	2	3	2	3	3	5	2	5	3	4	3	2
.0 %	4	9	3	5	4	4	6	5	10	7	12	4	12	8	13	8	2
.9 %	4	9	3	5	4	4	6	5	10	7	12	4	12	8	13	8	2

BLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION
D WIND DIRECTION

TABLE XVI

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 35 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3588 OF 6755 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	57	56	37	38	33	24	38	53	54	41	61	87	79	65	63	58	14
2	23	24	26	13	13	11	8	16	18	16	24	25	41	27	32	25	6
3	10	15	14	6	4	3	7	8	5	10	13	13	20	10	19	7	2
4	8	6	6	4	2	0	3	4	3	3	10	5	11	9	7	9	2
5	4	6	1	3	2	1	0	2	3	2	6	6	10	6	6	6	0
6	3	3	1	3	1	0	0	1	0	0	2	1	4	4	4	1	1
7	1	6	3	0	1	1	0	1	2	0	2	1	1	1	2	3	0
8	1	1	0	0	1	0	0	1	0	1	1	3	2	3	1	0	0
9	0	2	1	1	0	0	0	0	0	0	2	2	3	1	1	1	0
10	0	0	1	0	0	0	0	0	2	1	0	0	0	1	1	1	0
11	0	1	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
13	0	2	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	8	13	10	17	8	7	4	13	10	11	9	9	20	16	15	15	6
50.0 %	1	2	2	1	1	1	1	1	1	1	1	1	2	1	2	1	1
80.0 %	3	4	3	3	2	2	2	3	2	3	3	3	3	4	3	3	2
90.0 %	4	6	4	5	4	3	3	4	4	4	5	4	5	5	5	5	4
99.0 %	7	13	10	17	8	7	4	13	10	11	9	9	14	10	13	10	6
99.9 %	8	13	10	17	8	7	4	13	10	11	9	9	20	16	15	15	6

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE XVI

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 125 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3718 OF 7231 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	63	53	40	31	38	27	40	40	41	37	50	63	71	65	69	56	11
2	34	23	18	12	6	9	10	13	10	11	24	27	39	48	35	27	5
3	13	19	15	8	3	4	5	7	6	8	7	15	17	11	18	15	1
4	8	8	4	5	2	0	3	5	4	4	6	10	12	1	9	10	1
5	8	6	2	1	2	0	3	2	4	0	3	7	3	6	7	11	0
6	2	3	1	0	1	0	1	1	1	1	3	4	3	5	8	5	0
7	2	2	2	1	2	1	0	0	2	0	2	1	2	2	2	1	0
8	0	0	2	0	0	0	0	0	1	0	4	1	2	2	3	0	0
9	1	2	1	0	0	0	0	2	2	0	2	0	1	1	2	0	0
10	1	1	0	0	0	0	0	0	0	0	1	2	1	0	3	1	0
11	0	3	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
12	1	2	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0
13	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
14	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
15	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	12	12	9	17	7	7	6	9	13	12	10	10	15	12	13	23	4
50.0 %	2	2	2	1	1	1	1	1	1	1	2	2	2	2	2	2	1
80.0 %	3	4	3	3	2	2	2	3	4	3	4	3	3	3	4	4	2
90.0 %	5	6	4	4	4	3	4	4	6	4	6	5	4	5	6	5	3
99.0 %	10	12	9	17	7	7	6	9	13	12	9	10	12	9	10	21	4
99.9 %	12	12	9	17	7	7	6	9	13	12	10	10	15	12	13	23	4

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

TABLE XVI

CECO ZION NUCLEAR POWER STATION

WIND DIRECTION PERSISTENCE 250 FT LEVEL (22.5 DEG SECTORS)

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3690 OF 7019 VALID OBSERVATIONS

PERSISTENCE (HOURS)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	CALM
1	59	49	39	30	40	33	35	45	31	29	57	71	57	68	71	53	10
2	24	21	17	19	6	10	9	10	12	13	20	28	38	34	20	26	4
3	5	19	20	7	4	2	5	14	8	3	13	11	14	7	17	13	1
4	6	6	2	6	4	1	7	6	4	4	6	8	14	5	13	9	1
5	3	8	1	2	1	0	2	2	0	2	6	9	4	7	6	7	0
6	3	4	2	2	0	0	0	0	0	1	2	2	6	4	7	3	0
7	0	2	2	1	1	1	1	0	2	0	4	0	2	2	3	0	0
8	0	3	4	0	1	0	0	1	2	0	3	2	2	4	2	1	0
9	0	0	0	0	0	0	0	2	0	0	3	1	2	5	0	0	0
10	0	1	0	0	0	0	0	1	1	0	1	1	1	0	3	0	0
11	0	1	0	0	0	0	0	0	0	2	0	0	2	0	1	0	0
12	0	2	0	0	0	0	0	0	0	1	0	0	3	0	1	0	0
13	0	1	0	0	0	0	0	0	2	0	1	0	1	0	0	0	0
14	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
26 - 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	6	14	8	17	8	7	7	10	13	12	13	10	19	9	12	21	4
50.0 %	1	2	2	2	1	1	1	1	1	1	2	1	2	1	2	2	1
60.0 %	2	4	3	3	2	2	3	3	3	3	4	3	4	3	4	4	2
90.0 %	4	6	5	4	4	2	4	4	7	5	7	5	6	6	6	5	3
99.0 %	6	13	8	17	8	7	7	10	13	12	10	9	13	9	11	21	4
99.9 %	6	14	8	17	8	7	7	10	13	12	13	10	19	9	12	21	4

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND WIND DIRECTION

August 1998

TABLE XVIII

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7648 OF 7648 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	66	242	336	303	132	42	13	1	0	0
2	30	5	173	163	77	18	1	0	0	0
3	13	39	93	103	47	17	1	0	0	0
4	6	20	71	67	37	8	3	0	0	0
5	1	10	48	37	18	2	1	0	0	0
6	2	8	42	30	16	1	0	0	0	0
7	1	0	21	28	13	3	0	0	0	0
8	0	1	15	18	6	0	0	0	0	0
9	0	2	9	14	4	2	1	0	0	0
10	0	0	13	10	1	0	0	0	0	0
11	0	1	12	7	2	0	0	0	0	0
12	0	1	5	3	6	1	0	0	0	0
13	0	0	4	7	1	1	0	0	0	0
14	0	0	4	4	4	1	0	0	0	0
15	0	0	3	3	2	0	0	0	0	0
16	0	0	4	0	1	0	0	0	0	0
17	0	0	1	2	2	1	0	0	0	0
18	0	0	1	0	0	0	0	0	0	0
19	0	0	0	1	1	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	3	0	2	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	1	0	1	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	7	12	38	19	39	17	9	1	0	0
50.0 %	1	1	2	2	2	2	1	1	0	0
80.0 %	2	2	5	5	5	4	4	1	0	0
90.0 %	3	4	7	7	7	6	4	1	0	0
99.0 %	6	8	16	14	19	17	9	1	0	0
99.9 %	7	12	38	19	39	17	9	1	0	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XVIII

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7921 OF 7921 VALID OBSERVATIONS

PERSISTENCE (HOURS)	CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
				WIND SPEED (MPH)						
1	34	100	228	373	335	189	69	21	1	0
2	8	37	119	172	166	94	33	6	0	0
3	3	9	56	100	113	56	23	2	0	0
4	1	4	29	65	65	25	9	2	0	0
5	1	1	16	48	44	17	11	2	0	0
6	0	2	7	28	42	17	3	2	0	0
7	0	0	6	24	27	3	1	1	0	0
8	0	0	3	17	13	5	3	0	1	0
9	0	1	1	11	16	3	0	0	0	0
10	0	0	1	9	14	0	0	1	0	0
11	0	0	0	9	4	5	0	0	0	0
12	0	0	0	1	5	1	1	0	0	0
13	0	0	0	7	2	0	0	0	0	0
14	0	0	0	4	1	2	0	0	0	0
15	0	0	0	2	3	0	0	0	0	0
16	0	0	0	5	1	2	0	1	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	1	2	0	0	0	0	0
19	0	0	1	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	2	0	0	0	0	0	0
26 - 30	0	0	0	0	0	1	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	5	9	19	21	18	26	12	16	8	0
50.0 %	1	1	2	2	2	2	2	1	1	0
80.0 %	2	2	3	4	5	3	3	4	8	0
90.0 %	3	3	4	7	7	5	5	6	8	0
99.0 %	5	6	8	15	13	14	8	16	8	0
99.9 %	5	9	19	21	18	26	12	16	8	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XVIII

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 7596 OF 7596 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	23	71	189	283	301	195	71	21	0	1
2	9	34	90	181	156	110	37	4	1	C
3	3	10	52	106	105	60	22	1	0	0
4	1	6	19	43	70	37	12	2	0	0
5	0	4	13	42	55	21	11	1	0	0
6	1	1	12	25	35	9	5	0	0	0
7	0	0	3	14	24	16	2	2	1	0
8	0	0	2	14	17	2	0	2	0	0
9	0	0	2	10	21	6	2	1	0	0
10	0	0	2	11	6	3	1	0	0	0
11	0	0	2	5	6	4	0	0	0	0
12	0	0	0	2	4	2	0	0	0	0
13	0	0	0	2	6	2	C	0	0	0
14	0	0	0	2	3	1	1	0	0	0
15	0	0	0	3	5	0	0	0	0	0
16	0	0	0	1	0	0	0	0	0	0
17	0	0	0	2	1	0	0	0	0	0
18	0	0	0	0	2	0	0	0	0	0
19	0	0	0	0	1	0	0	0	0	0
20	0	0	0	0	1	0	C	0	0	0
21 - 25	0	0	0	0	0	1	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	C	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	C
41 - 48	0	0	0	0	C	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	6	6	11	17	20	21	14	9	7	1
50.0 %	1	1	2	2	2	2	2	1	2	1
80.0 %	2	2	3	4	5	4	4	4	7	1
90.0 %	3	3	4	6	7	5	5	7	7	1
99.0 %	6	5	10	14	15	12	10	9	7	1
99.9 %	6	6	11	17	20	21	14	9	7	1

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION
ND SPEED CLASS

TABLE XIX

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 976 OF 7342 VALID OBSERVATIONS

PERSISTENCE	WIND SPEED (MPH)									
(HOURS)	CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	26	96	123	60	9	2	0	0	0	0
2	12	27	48	19	3	0	0	0	0	0
3	2	12	31	5	2	0	0	0	0	0
4	2	6	10	1	0	0	0	0	0	0
5	0	3	9	0	0	0	0	0	0	0
6	0	2	3	1	0	0	0	0	0	0
7	1	0	5	0	0	0	0	0	0	0
8	0	0	1	0	0	0	0	0	0	0
9	0	0	2	0	0	0	0	0	0	0
10	0	0	1	0	0	0	0	0	0	0
11	0	0	1	0	0	0	0	0	0	0
12	0	0	1	0	0	0	0	0	0	0
13	0	0	1	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	7	6	13	6	3	1	0	0	0	0
50.0 %	1	1	1	1	1	1	0	0	0	0
80.0 %	2	2	3	2	2	1	0	0	0	0
90.0 %	3	3	5	2	3	1	0	0	0	0
99.0 %	7	6	11	6	3	1	0	0	0	0
99.9 %	7	6	13	6	3	1	0	0	0	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XIX

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 975 OF 7395 VALID OBSERVATIONS

ISTENCE					WIND SPEED (MPH)					
OURS)	CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	8	25	77	119	88	16	2	0	0	0
2	0	14	21	37	30	9	2	0	0	0
3	0	2	8	24	14	0	1	0	0	0
4	0	0	5	9	10	0	0	0	0	0
5	0	1	2	10	4	0	0	0	0	0
6	0	0	0	4	1	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	1	0	0	0	0	0	0
9	0	0	1	3	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
- 25	0	0	0	0	0	0	0	0	0	0
- 30	0	0	0	0	0	0	0	0	0	0
- 35	0	0	0	0	0	0	0	0	0	0
- 40	0	0	0	0	0	0	0	0	0	0
- 48	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0
IMUM SISTENCE OURS)	1	5	9	12	6	2	3	0	0	0
.0 %	1	1	1	1	1	1	2	0	0	0
.0 %	1	2	2	3	2	2	2	0	0	0
.0 %	1	2	3	4	4	2	3	0	0	0
0 %	1	5	5	9	5	2	3	0	0	0
9 %	1	5	9	12	6	2	3	0	0	0

E ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION SPEED CLASS

TABLE XIX

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 894 OF 7124 VALID OBSERVATIONS

PERSISTENCE (HOURS)	CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
				WIND SPEED (MPH)						
1	3	19	47	89	79	33	6	0	0	0
2	1	7	12	31	41	11	2	0	0	0
3	1	3	10	16	24	7	2	0	0	0
4	0	0	5	5	8	3	0	0	0	0
5	0	0	1	6	2	1	0	0	0	0
6	0	0	2	1	1	1	0	0	0	0
7	0	0	0	0	1	1	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	1	1	0	0	0	0	0
10	0	0	0	1	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	1	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	3	3	6	10	13	7	3	0	0	0
50.0 %	1	1	1	1	1	1	1	0	0	0
80.0 %	2	2	3	2	3	3	2	0	0	0
90.0 %	3	3	4	3	3	4	3	0	0	0
99.0 %	3	3	6	9	9	7	3	0	0	0
99.9 %	3	3	6	10	13	7	3	0	0	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XX

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1231 OF 7342 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	23	89	225	118	32	1	1	0	0	0
2	8	16	55	41	5	1	0	0	0	0
3	I	8	32	12	0	0	0	0	0	0
4	1	1	15	6	0	0	0	0	0	0
5	0	1	5	4	1	0	0	0	0	0
6	0	1	4	6	0	0	0	0	0	0
7	0	0	1	3	0	0	0	0	0	0
8	0	0	0	2	0	0	0	0	0	0
9	0	0	2	0	1	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	1	0	1	0	0	0	0	0	0
12	0	0	1	0	0	0	0	0	0	0
13	0	0	1	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	4	11	13	11	9	2	1	0	0	0
50.0 %	1	1	1	1	1	1	1	0	0	0
80.0 %	2	2	2	2	1	2	1	0	0	0
90.0 %	2	3	3	4	2	2	1	0	0	0
99.0 %	4	6	9	8	9	2	1	0	0	0
99.9 %	4	11	13	11	9	2	1	0	0	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XX

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1215 OF 7395 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	5	30	89	184	150	34	7	2	0	0
2	0	6	30	59	38	8	2	0	0	0
3	1	3	6	17	27	3	0	0	0	0
4	0	1	0	5	9	0	0	0	0	0
5	0	0	0	5	7	1	0	0	0	0
6	0	0	0	2	3	2	0	0	0	0
7	0	0	0	1	4	0	0	0	0	0
8	0	0	0	1	2	0	0	0	0	0
9	0	0	0	0	1	1	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	1	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	3	4	3	13	9	9	2	1	0	0
50.0 %	1	1	1	1	1	1	1	1	0	0
80.0 %	1	2	2	2	3	2	2	1	0	0
90.0 %	3	2	2	3	4	3	2	1	0	0
99.0 %	3	4	3	7	8	9	2	1	0	0
99.9 %	3	4	3	13	9	9	2	1	0	0

ABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XX

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1152 OF 7124 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	6	19	67	154	143	49	17	4	0	0
2	2	4	21	39	50	25	6	0	0	0
3	0	0	4	6	26	9	0	0	0	0
4	0	0	0	5	6	3	0	0	0	0
5	1	1	0	4	11	2	0	0	0	0
6	0	0	1	1	4	0	0	0	0	0
7	0	0	0	0	1	0	0	0	0	0
8	0	0	0	1	2	0	0	0	0	0
9	0	0	0	0	1	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	1	0	0	0	0
12	0	0	0	0	1	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	1	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	5	5	6	8	14	11	2	1	0	0
50.0 %	1	1	1	1	1	1	1	1	0	0
80.0 %	2	2	2	2	3	2	2	1	0	0
90.0 %	5	2	2	2	4	3	2	1	0	0
99.0 %	5	5	6	5	9	11	2	1	0	0
99.9 %	5	5	6	8	14	11	2	1	0	0

ABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XXI

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1404 OF 7342 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	18	78	211	179	73	16	3	0	0	0
2	4	16	62	36	19	4	0	0	0	0
3	2	2	23	22	14	2	0	0	0	0
4	0	0	9	10	2	0	0	0	0	0
5	0	2	5	3	3	0	0	0	0	0
6	0	1	1	6	2	0	0	0	0	0
7	0	0	1	1	2	0	0	0	0	0
8	0	0	0	2	1	0	0	0	0	0
9	0	0	0	0	1	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	1	0	0	0	0	0	0
12	0	0	0	2	0	0	0	0	0	0
13	0	0	0	0	1	0	0	0	0	0
14	0	0	1	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	1	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	3	6	14	12	17	3	1	0	0	0
50.0 %	1	1	1	1	1	1	1	0	0	0
80.0 %	2	2	2	2	3	2	1	0	0	0
90.0 %	2	2	3	3	4	2	1	0	0	0
99.0 %	3	6	5	11	13	3	1	0	0	0
99.9 %	3	6	14	12	17	3	1	0	0	0

ABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XXI

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1434 OF 7395 VALID OBSERVATIONS

SISTENCE	WIND SPEED (MPH)									
HOURS)	CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	4	24	96	215	167	85	23	8	0	0
2	3	6	24	44	51	21	5	1	0	0
3	1	1	5	19	17	6	3	0	0	0
4	0	0	1	13	15	6	0	0	0	0
5	0	0	2	4	5	5	1	0	0	0
6	0	0	1	2	5	3	1	0	0	0
7	0	0	0	1	0	2	0	0	0	0
8	0	0	0	0	0	1	0	0	0	0
9	0	0	0	0	1	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	1	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
- 25	0	0	0	0	0	0	0	0	0	0
- 30	0	0	0	0	0	0	0	0	0	0
- 35	0	0	0	0	0	0	0	0	0	0
- 40	0	0	0	0	0	0	0	0	0	0
- 48	0	0	0	0	0	0	0	0	0	0
· 48	0	0	0	0	0	0	0	0	0	0
IMUM SISTENCE HOURS)	3	3	6	11	9	8	6	2	0	0
.0 %	1	1	1	1	1	1	1	1	0	0
.0 %	2	2	2	2	2	2	2	1	0	0
.0 %	3	2	2	3	3	4	3	2	0	0
.0 %	3	3	5	6	6	7	6	2	0	0
.9 %	3	3	6	11	9	8	6	2	0	0

BLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION ID SPEED CLASS

TABLE XXI

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1382 OF 7124 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	2	17	67	153	183	93	25	3	0	0
2	1	5	17	51	59	19	6	2	0	0
3	0	3	7	15	20	12	2	0	0	0
4	0	1	3	6	12	5	0	1	0	0
5	0	0	3	5	9	3	1	0	0	0
6	0	0	1	2	2	1	1	0	0	0
7	0	0	0	0	0	2	0	0	0	0
8	0	0	0	1	1	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	1	0	2	0	0	0	0	0
11	0	0	0	0	0	1	0	0	0	0
12	0	0	0	0	1	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	2	4	10	8	12	11	6	4	0	0
50.0 %	1	1	1	1	1	1	1	1	0	0
80.0 %	2	2	2	2	2	2	2	2	0	0
90.0 %	2	3	3	3	3	3	3	4	0	0
99.0 %	2	4	10	6	10	7	6	4	0	0
99.9 %	2	4	10	8	12	11	6	4	0	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XXII

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3731 OF 7342 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	14	76	191	184	117	29	8	1	0	0
2	6	22	99	112	44	14	1	0	0	0
3	2	12	33	63	37	16	2	0	0	0
4	2	2	24	37	26	7	2	0	0	0
5	0	1	16	20	16	2	1	0	0	0
6	1	1	8	16	17	2	0	0	0	0
7	0	0	7	19	9	2	0	0	0	0
8	0	0	3	8	7	0	0	0	0	0
9	0	0	5	5	3	2	1	0	0	0
10	0	0	2	6	0	0	0	0	0	0
11	0	0	1	4	1	0	0	0	0	0
12	0	0	1	3	2	1	0	0	0	0
13	0	0	2	1	0	1	0	0	0	0
14	0	0	1	2	3	0	0	0	0	0
15	0	0	0	1	1	0	0	0	0	0
16	0	0	2	0	0	0	0	0	0	0
17	0	0	0	0	2	1	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	1	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	1	0	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	6	6	16	15	25	17	9	1	0	0
50.0 %	1	1	2	2	2	2	1	1	0	0
80.0 %	2	2	3	4	5	4	4	1	0	0
90.0 %	4	3	5	7	7	6	5	1	0	0
99.0 %	6	5	13	12	17	17	9	1	0	0
99.9 %	6	6	16	15	25	17	9	1	0	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XXII

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3771 OF 7395 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	11	37	100	198	219	134	49	14	1	0
2	5	7	42	93	99	55	26	6	0	0
3	1	4	23	42	58	36	17	3	0	0
4	1	1	10	29	23	18	6	3	0	0
5	0	0	8	20	20	11	7	2	0	0
6	0	0	2	11	11	11	2	1	0	0
7	0	0	2	12	13	1	0	1	0	0
8	0	0	2	7	5	2	3	0	1	0
9	0	0	1	5	10	3	0	0	0	0
10	0	0	0	0	5	0	0	0	0	0
11	0	0	0	2	3	1	0	0	0	0
12	0	0	0	1	0	1	1	0	0	0
13	0	0	0	1	1	1	0	0	0	0
14	0	0	0	1	0	1	0	0	0	0
15	0	0	1	0	0	0	0	0	0	0
16	0	0	0	2	1	0	0	1	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	0	0	0	0	0
26 - 30	0	0	0	0	0	1	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	4	4	15	16	16	26	12	16	8	0
50.0 %	1	1	1	2	2	2	2	2	1	0
80.0 %	2	2	3	4	3	3	3	4	8	0
90.0 %	3	3	4	5	6	5	5	5	8	0
99.0 %	4	4	9	12	11	13	8	16	8	0
99.9 %	4	4	15	16	16	26	12	16	8	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION AND SPEED CLASS

TABLE XXII

CECO ZION NUCLEAR POWER STATION

WIND SPEED PERSISTENCE 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3696 OF 7124 VALID OBSERVATIONS

PERSISTENCE (HOURS)	WIND SPEED (MPH) CALM	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46
1	10	39	103	169	183	119	46	13	0	0
2	4	10	50	98	84	64	26	5	0	0
3	1	4	18	49	49	38	11	2	0	0
4	1	3	4	25	34	15	5	2	0	0
5	0	2	5	23	27	11	10	1	0	0
6	0	0	2	7	12	8	3	0	0	0
7	0	0	3	6	12	7	1	1	1	0
8	0	0	2	5	3	2	0	1	0	0
9	0	0	0	5	11	3	2	1	0	0
10	0	0	0	5	4	2	1	0	0	0
11	0	0	1	0	2	0	0	0	0	0
12	0	0	0	0	1	1	0	0	0	0
13	0	0	0	1	1	0	0	0	0	0
14	0	0	0	1	1	0	1	0	0	0
15	0	0	0	1	1	0	0	0	0	0
16	0	0	0	1	0	0	0	0	0	0
17	0	0	0	1	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21 - 25	0	0	0	0	0	1	0	0	0	0
26 - 30	0	0	0	0	0	0	0	0	0	0
31 - 35	0	0	0	0	0	0	0	0	0	0
36 - 40	0	0	0	0	0	0	0	0	0	0
41 - 48	0	0	0	0	0	0	0	0	0	0
> 48	0	0	0	0	0	0	0	0	0	0
MAXIMUM PERSISTENCE (HOURS)	4	5	11	17	15	21	14	9	7	0
50.0 %	1	1	1	2	2	2	2	1	7	0
80.0 %	2	2	2	4	4	3	4	4	7	0
90.0 %	3	3	3	5	6	5	5	7	7	0
99.0 %	4	5	8	13	11	10	10	9	7	0
99.9 %	4	5	11	17	15	21	14	9	7	0

TABLE ENTRIES ARE THE OCCURRENCES THE WIND PERSISTED FOR A SPECIFIC DURATION
ID SPEED CLASS

TABLE XXIII

CECO ZION NUCLEAR POWER STATION

STABILITY PERSISTENCE

MAY,1971-APR,1972

SAMPLE TOTAL IS 8134

PERSISTENCE (HOURS)	STABILITY CLASS VERY STABLE	MODERATELY STABLE	NEUTRAL	UNSTABLE
1	88	282	324	110
2	45	100	146	57
3	34	60	53	39
4	19	30	37	23
5	23	22	19	18
6	16	9	11	22
7	5	11	5	23
8	8	5	8	21
9	10	6	4	16
10	11	2	3	16
11	4	5	8	17
12	5	3	3	13
13	3	3	1	9
14	1	2	2	4
15	3	C	3	1
16	0	0	1	3
17	0	0	3	3
18	0	0	2	4
19	1	0	0	2
20	0	C	C	3
21 - 25	0	1	0	10
26 - 30	0	0	0	8
31 - 35	0	0	1	0
36 - 40	0	C	0	3
41 - 48	0	1	0	1
> 48	0	C	C	17
MAXIMUM PERSISTENCE (HOURS)	19	41	34	149
50.0 %	3	1	1	4
80.0 %	6	3	3	11
90.0 %	10	5	5	18
99.0 %	15	13	16	104
99.9 %	19	41	34	149

ABLE ENTRIES ARE THE OCCURRENCES THE STABILITY CLASS PERSISTED FOR A SPECIFIC URATION

TABLE XXIV

CECO ZION NUCLEAR POWER STATION

HOURLY STABILITY CLASS

MAY,1971-APR,1972

SAMPLE TOTAL IS 8134

HOUR (CST)	STABILITY CLASS			
	VERY STABLE	MODERATELY STABLE	NEUTRAL	UNSTABLE
0	23.2	22.1	24.7	30.0
1	22.0	22.9	24.3	30.8
2	22.0	22.9	24.3	30.8
3	23.2	20.9	24.1	31.8
4	22.7	21.8	22.4	33.0
5	21.2	23.0	21.8	33.9
6	15.5	22.6	22.3	39.6
7	10.9	15.8	20.5	52.8
8	4.4	8.8	19.7	67.1
9	4.1	7.7	13.0	75.1
10	2.1	8.1	11.9	77.9
11	3.6	5.1	11.6	79.8
12	3.6	9.3	11.9	75.2
13	6.0	6.9	9.6	77.5
14	7.6	8.2	12.1	72.2
15	6.3	10.1	13.4	70.1
16	8.4	10.1	21.8	59.7
17	10.5	15.5	18.4	55.6
18	11.7	18.5	20.5	49.3
19	13.8	18.2	27.6	40.5
20	15.0	24.6	25.5	34.9
21	19.0	24.5	24.5	32.1
22	20.6	27.6	21.8	29.9
23	22.2	24.9	21.9	31.0
UMN TOTALS	1087	1360	1596	4091

BLE ENTRY IS FREQUENCY (PERCENT OF ROW TOTAL) WITH WHICH A PARTICULAR ABILITY CLASS OCCURRED ON A PARTICULAR HOUR OF THE DAY

LUMN TOTAL IS DAILY DISTRIBUTION OF STABILITY CLASSES REGARDLESS OF TIME DAY

TABLE XXV

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 6559 OF 6559 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.91	0.87	0.02	0.00	0.00	0.00	0.00	0.00	0.00	1.80
2-3	1.40	4.25	0.06	0.05	0.00	0.00	0.00	0.00	0.00	5.76
4-7	1.11	7.93	4.09	1.13	0.23	0.14	0.00	0.00	0.00	14.62
8-12	0.91	15.15	18.95	8.80	1.65	0.27	0.00	0.00	0.00	45.74
13-17	0.21	5.99	11.14	8.69	2.20	0.24	0.02	0.00	0.00	28.50
18-22	0.08	0.78	1.74	0.72	0.02	0.00	0.00	0.00	0.00	3.32
> 22	0.00	0.12	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.26
										100.00

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

.ABLE XXV

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 6953 OF 6953 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.32	1.14	1.28	0.40	0.04	0.00	0.00	0.00	0.00	3.18
2-3	0.22	2.66	7.91	4.13	0.78	0.27	0.06	0.00	0.00	16.02
4-7	0.17	2.99	13.97	15.81	6.08	1.31	0.56	0.01	0.00	40.90
8-12	0.13	2.24	8.77	13.23	7.75	3.02	0.66	0.12	0.00	35.93
13-17	0.07	0.37	1.16	1.50	0.30	0.22	0.00	0.00	0.00	3.62
18-22	0.00	0.04	0.16	0.03	0.00	0.00	0.00	0.00	0.00	0.23
> 22	0.00	0.03	0.03	0.06	0.00	0.00	0.00	0.00	0.00	0.12
										100.00

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXV

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: ALL OBSERVATIONS

SAMPLE TOTAL IS 6839 OF 6839 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.15	0.56	1.70	1.89	0.44	0.19	0.03	0.00	0.00	4.94
2-3	0.26	1.86	6.24	8.26	3.00	0.77	0.22	0.01	0.00	20.63
4-7	0.32	3.49	11.45	16.64	8.63	2.32	0.63	0.00	0.00	43.49
8-12	0.38	2.68	8.20	9.05	5.35	2.24	0.32	0.10	0.00	28.32
13-17	0.06	0.57	0.79	0.60	0.16	0.04	0.00	0.00	0.00	2.22
18-22	0.04	0.06	0.07	0.06	0.01	0.00	0.00	0.00	0.00	0.25
> 22	0.00	0.06	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.15
										100.00

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXVI

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 662 OF 6140 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.49	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.11
2-3	0.49	1.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.39
4-7	0.41	1.76	0.28	0.05	0.00	0.00	0.00	0.00	0.00	2.49
8-12	0.18	1.76	0.80	0.20	0.03	0.00	0.00	0.00	0.00	2.96
13-17	0.05	0.86	0.55	0.07	0.00	0.00	0.00	0.00	0.00	1.53
18-22	0.02	0.08	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.24
> 22	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05
										10.78

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXVI

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 746 OF 6448 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED									ROW TOTAL
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	
0-1	0.08	0.34	0.60	0.19	0.02	0.00	0.00	0.00	0.00	1.23
2-3	0.09	0.47	2.84	1.05	0.08	0.02	0.00	0.00	0.00	4.54
4-7	0.05	0.40	1.23	1.35	0.17	0.02	0.00	0.00	0.00	3.21
8-12	0.02	0.19	0.65	0.92	0.19	0.05	0.00	0.00	0.00	2.00
13-17	0.02	0.08	0.16	0.14	0.03	0.05	0.00	0.00	0.00	0.47
18-22	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.08
> 22	0.00	0.02	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.05
										11.57

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXVI

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: VERY STABLE

SAMPLE TOTAL IS 717 OF 6367 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.02	0.14	0.69	0.94	0.20	0.06	0.00	0.00	0.00	2.06
2-3	0.05	0.60	1.73	2.07	0.77	0.05	0.00	0.00	0.00	5.26
4-7	0.03	0.36	0.80	0.83	0.36	0.08	0.00	0.00	0.00	2.47
8-12	0.02	0.24	0.30	0.31	0.19	0.05	0.00	0.00	0.00	1.10
13-17	0.00	0.11	0.11	0.03	0.02	0.00	0.00	0.00	0.00	0.27
18-22	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.05
> 22	0.00	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06
										11.26

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXVII

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 983 OF 6140 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.20	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41
2-3	0.28	1.29	0.05	0.00	0.00	0.00	0.00	0.00	0.00	1.61
4-7	0.29	2.33	0.88	0.02	0.00	0.00	0.00	0.00	0.00	3.52
8-12	0.28	3.08	3.03	0.47	0.00	0.00	0.00	0.00	0.00	6.86
13-17	0.03	1.27	1.42	0.36	0.05	0.02	0.00	0.00	0.00	3.14
18-22	0.02	0.11	0.29	0.02	0.00	0.00	0.00	0.00	0.00	0.44
> 22	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.03
										16.01

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXVII

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 1030 OF 6448 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED									ROW TOTAL
	1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	
1	0.09	0.26	0.36	0.12	0.00	0.00	0.00	0.00	0.00	0.84
3	0.03	0.54	2.00	1.52	0.11	0.00	0.00	0.00	0.00	4.20
7	0.03	0.45	2.25	3.21	0.76	0.05	0.00	0.00	0.00	6.75
12	0.03	0.39	1.29	1.55	0.40	0.08	0.03	0.00	0.00	3.77
17	0.00	0.09	0.09	0.17	0.00	0.00	0.00	0.00	0.00	0.36
22	0.00	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.05
22	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
										15.97

B E ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS
D SIGMA SUB THETA CLASS

TABLE XXVII

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: MODERATELY STABLE

SAMPLE TOTAL IS 992 OF 6367 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.03	0.22	0.41	0.49	0.08	0.03	0.00	0.00	0.00	1.26
2-3	0.09	0.47	1.52	2.84	0.83	0.13	0.00	0.00	0.00	5.89
4-7	0.06	0.44	1.63	2.98	1.26	0.22	0.05	0.00	0.00	6.64
8-12	0.02	0.20	0.42	0.71	0.14	0.02	0.02	0.00	0.00	1.52
13-17	0.00	0.05	0.03	0.06	0.02	0.02	0.00	0.00	0.00	0.17
18-22	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.03
> 22	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.06
										15.58

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXVIII

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1175 OF 6140 VALID OBSERVATIONS

WIND SPEED

4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL	· 46	ROW TOTAL
0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	).00	0.48
0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	).00	3.49
1.64	1.11	0.31	0.07	0.00	0.00	0.00	0.00	3.31	).00	8.41
3.06	3.71	1.61	0.13	0.02	0.00	0.00	0.00	8.68	).00	6.58
0.99	2.20	1.95	0.29	0.03	0.00	0.00	0.00	5.49	).00	0.57
0.11	0.28	0.15	0.00	0.00	0.00	0.00	0.00	0.54	).00	0.00
0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.03	).00	0.00
								19.14		19.53

IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS ASS
3 THETA CLASS

TABLE XXVIII

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: NEUTRAL

SAMPLE TOTAL IS 1241 OF 6367 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.05	0.06	0.17	0.13	0.03	0.02	0.00	0.00	0.00	0.46
2-3	0.05	0.53	1.48	1.44	0.49	0.09	0.02	0.00	0.00	4.10
4-7	0.06	0.93	2.29	4.44	2.04	0.38	0.11	0.00	0.00	10.26
8-12	0.02	0.28	1.10	1.46	0.99	0.28	0.05	0.00	0.00	4.18
13-17	0.02	0.03	0.19	0.11	0.03	0.00	0.00	0.00	0.00	0.42
18-22	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.08
> 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
										19.49

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXIX

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 35 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3320 OF 6140 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
2-3	0.28	0.29	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.64
4-7	0.24	2.38	1.81	0.80	0.16	0.15	0.00	0.00	0.00	5.54
8-12	0.33	7.21	11.78	6.79	1.53	0.24	0.00	0.00	0.00	27.88
13-17	0.13	2.49	6.79	6.61	1.97	0.21	0.02	0.00	0.00	18.22
18-22	0.03	0.36	0.80	0.42	0.02	0.00	0.00	0.00	0.00	1.63
> 22	0.00	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.13
										54.07

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXIX

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 125 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3413 OF 6448 VALID OBSERVATIONS

SIGMA SUB THETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
0-1	0.11	0.36	0.08	0.03	0.03	0.00	0.00	0.00	0.00	0.60
2-3	0.08	1.12	1.32	0.78	0.26	0.19	0.06	0.00	0.00	3.80
4-7	0.08	1.57	7.71	7.66	3.99	1.15	0.53	0.02	0.00	22.69
8-12	0.08	1.33	5.27	8.30	5.57	2.39	0.59	0.12	0.00	23.65
13-17	0.00	0.22	0.65	0.78	0.23	0.12	0.00	0.00	0.00	2.00
18-22	0.00	0.02	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.12
> 22	0.00	0.02	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.06
										52.93

TABLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS AND SIGMA SUB THETA CLASS

TABLE XXIX

CECO ZION NUCLEAR POWER STATION

SIGMA SUB THETA 250 FT LEVEL

MAY,1971-APR,1972

CONDITIONS: UNSTABLE

SAMPLE TOTAL IS 3417 OF 6367 VALID OBSERVATIONS

GMA UB ETA	WIND SPEED 1-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	> 46	ROW TOTAL
1	0.00	0.05	0.20	0.14	0.11	0.08	0.02	0.00	0.00	0.60
3	0.08	0.24	1.43	1.74	0.85	0.50	0.20	0.00	0.00	5.04
7	0.17	1.93	6.74	8.47	5.04	1.51	0.50	0.00	0.00	24.36
12	0.36	2.04	6.53	6.69	4.19	1.96	0.28	0.11	0.00	22.18
17	0.05	0.33	0.49	0.41	0.08	0.00	0.00	0.00	0.00	1.35
22	0.03	0.05	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.11
22	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.03
										53.67

\BLE ENTRY IS FREQUENCY THAT WIND OCCUPIED A PARTICULAR SPEED CLASS
ID SIGMA SUB THETA CLASS

The data presented in Appendix 2C is based on the following criteria:

1. The Δt interval used was between the 250 foot and 35 foot elevations.

2. The stability classifications are defined as:

Very stable	Δt < 1.8°F
Moderately stable	-0.6°F < Δt < 1.8°F
Neutral	-1.8°F < Δt < -0.6°F
Unstable	Δt < -1.8°F

The highest average X/Q at 400 meters for the one year site data occurred in the north direction. The value was 3.1×10^{-6} sec/m^3.

For the **Fuel Handling** accident analysis, a X/Q of **3.7×10^{-3}** sec/m^3 was used. This value is listed in **Table 5-3**.

Reference List - Chapter 2

Z1 - Ltr to E.G. Case from C. Reed 12/18/77 "The Environmental Impact Assessment of Occasional Temperature Excursions above 20°F Intake - Discharge Temperature Differential and a 55°F Discharge Temperature During Ice Melt at Zion Station."

Z1 - M22-1(2)-80-06

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3.1 CONFORMANCE WITH NRC GENERAL DESIGN CRITERIA

The general design criteria followed in the design of the Zion Station were developed as performance criteria which define or describe safety objectives and procedures. Along with these performance criteria, the Zion Station was designed to comply with the applicant's understanding of the intent of the Atomic Energy Commission's (AEC) proposed General Design Criteria, as published for comment by the AEC in July 1967. The Zion construction permit, which fixed many of the safety-related design criteria, was issued in December 1968. The Zion FSAR, which presented the detailed design of the plant, was filed in December 1970. Subsequent to this filing, the AEC's final General Design Criteria were published as Appendix A to 10CFR50 in July 1971. The AEC requested Commonwealth Edison Company to demonstrate that the Zion Station design complies with each of the final General Design Criteria published as Appendix A to 10CFR50 (July 1971). The response to this request was supplied as an informative comparison but is not included here.

The performance criteria used in the design of Zion Station that remain applicable in the defueled condition are specifically addressed in the DSAR where they are pertinent. There, the performance criteria are quoted and are followed by a brief summary of the design or procedures. The design or procedures are then more fully described in later sections of the chapter.

Compliance with Commonwealth Edison's understanding of the intent of the AEC's proposed General Design Criteria, as published in July 1967, that remain applicable in the defueled condition are summarized below and described in the following paragraphs. The references cited throughout this section have been updated to correspond to current DSAR chapters and sections.

CRITERIA	1967 NUMBER
I. OVERALL PLANT REQUIREMENTS	
Quality Standards	1
Performance Standards	2
Fire Protection	3
Record Requirements	5

	CRITERIA	1967 NUMBER
III.	NUCLEAR AND RADIATION CONTROL	
	Control Room	11
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I. Overall Plant Requirements

Criterion 1 - Quality Standards (Category A)

Those systems and components of reactor facilities which are essential to the prevention of accidents which could affect the public health and safety or to mitigation of their consequences shall be identified and then designed, fabricated, and erected to quality standards that reflect the importance of the safety function to be performed. Where generally recognized codes or standards on design, materials, fabrication, and inspection are used, they shall be identified. Where adherence to such codes or standards does not suffice to assure a quality product in keeping with the safety functions, they shall be supplemented or modified as necessary. Quality assurance programs, test procedures, and inspection acceptance levels to be used shall be identified. A showing of sufficiency and applicability of codes, standards, quality assurance programs, test procedures, and inspection acceptance levels used is required.

Answer

The systems and components of the facility have been classified according to their importance in the prevention and mitigation of accidents which could cause undue risk to the health and safety of the public. These classifications are described in Chapter 1.

Criterion 2 - Performance Standards

Those systems and components of reactor facilities which are essential to the prevention of accidents which could affect the public health and safety or to mitigation of their consequences shall be designed, fabricated, and erected to performance standards that will enable the facility to withstand, without loss of the capability to protect the public, the additional forces that might be imposed by natural phenomena such as earthquakes, tornadoes, flooding conditions, winds, ice, and other local site effects. The design bases so established shall reflect: (a) appropriate consideration of the most severe of these natural phenomena that have been recorded for the site and the surrounding area; and (b) an appropriate margin for withstanding forces greater than those recorded to reflect uncertainties about the historical data and their suitability as a basis for design.

Answer

The systems and components designated Seismic Class I are designed to withstand, without loss of capability to protect the public, the most severe environmental phenomena ever experienced at the site with appropriate margins included in the design for uncertainties in historical data. Potential environmental hazards are discussed and analyzed in Chapters 2 and 5 of the report and the influence of these hazards on various aspects of the plant design is discussed in the sections covering the specific systems and components concerned. An outline of the design philosophy for Seismic Class I systems and components and a listing of the applicable report sections describing the systems and components covered by this criterion are included in Chapter 3.

Criterion 3 - Fire Protection

The reactor facility shall be designed: (1) to minimize the probability of events such as fires and explosions; and (2) to minimize the potential effects of such events to safety. Noncombustible and fire resistant materials shall be used whenever practical throughout the facility, particularly in areas containing critical portions of the facility such as Containment, Control Room, and components of engineered safety features.

Answer

Through the use of noncombustible and fire resistant materials wherever practical in the facility and the limitation of combustible supplies (e.g. logs, records, manuals, etc.) in such areas as the Control Rooms to amounts required for current operation, the probability of such events as fire and explosion and the effects of such events should they occur are minimized. Fire protection criteria and specific means of meeting these criteria are described in the Fire Protection Report.

Criterion 5 - Records Requirements

Records of the design, fabrication, and construction of essential components of the plant shall be maintained by the reactor operator or under its control throughout the life of the reactor.

Answer

The applicant intends to maintain, either in its possession or under its control, a complete set of records of the design, fabrication, construction and testing of major Seismic Class I plant components throughout the life of plant. A quality assurance program has been employed and appropriate records have been and are being maintained directly by Commonwealth Edison or are under Commonwealth Edison's control.

III. Nuclear and Radiation Controls

Criterion 11 - Control Room

The facility shall be provided with a control room from which actions to maintain safe operational status of the plant can be controlled. Adequate radiation protection shall be provided to permit access, even under accident conditions, to equipment in the control room or other areas as necessary to shut down and maintain safe control of the facility without radiation exposures of personnel in excess of 10CFR20 limits. It shall be possible to shut the reactor down and maintain it in a safe condition if access to the control room is lost due to fire or other cause.

Answer

A common control room contains all controls and instrumentation that were necessary for operation of each unit's reactor, turbine generator, and auxiliary and emergency systems under normal or accident conditions.

The Control Room is designed and equipped to minimize the possibility of events which might preclude occupancy. In addition, provisions were made for bringing both units to and maintaining them in a hot shutdown condition for an extended period of time from locations outside the Control Room. Chapter 3 discusses the Control Room Ventilation System.

Criterion 12 - Instrumentation and Control Systems

Instrumentation and controls shall be provided as required to monitor and maintain variables within prescribed operating ranges.

Answer

Sufficient instrumentation and controls are provided for safe and efficient operation of the facility. Additional details on instrumentation and controls are included in sections relating to specific systems and components.

Criterion 17 - Monitoring Radioactivity Releases

Means shall be provided for monitoring the containment atmosphere, the facility effluent discharge paths, and the facility environs for radioactivity that could be released from normal operations, from anticipated transients, and from accident conditions.

Answer

The facility contains means for monitoring the containment atmosphere, effluent discharge paths, and the facility environs for radioactivity which could be released under any conditions. The details of the effluent discharge path and containment monitoring methods are contained in Chapter 4 while the environmental radiation monitoring system is described in Chapter 2.

Criterion 18 - Monitoring Fuel and Waste Storage

Monitoring and alarm instrumentation shall be provided for fuel and waste storage and handling areas for conditions that might contribute to loss of continuity in decay heat removal and to radiation exposures.

Answer

Sufficient monitoring and alarm instrumentation is provided in waste and fuel storage areas to detect conditions which might contribute to loss of cooling for decay heat removal or abnormal radiation releases. Details of the monitoring systems are included in Chapter 4.

VIII. Fuel and Waste Storage Systems

Criterion 66 - Prevention of Fuel Storage Criticality

Criticality in new and spent fuel storage shall be prevented by physical systems or processes. Such means as geometrically safe configurations shall be emphasized over procedural controls.

Answer

Criticality in new and spent fuel storage areas is prevented both by physical separation of new and spent fuel elements and the presence of borated water in the spent fuel storage pool. Criticality prevention is discussed in detail in Chapter 3.

Criterion 67 - Fuel and Waste Storage Decay Heat

Reliable decay heat removal systems shall be designed to prevent damage to the fuel in storage facilities that could result in radioactivity release to plant operating areas or the public environs.

Answer

The Spent Fuel Pool Cooling System provides decay heat removal for the spent fuel pool. In addition, the water in the pool is sufficient to absorb the decay heat produced from $1^2/_3$ spent cores. Details of the Spent Fuel Pool Cooling System and fuel handling facilities are described in Chapter 3.

Criterion 68 - Fuel and Waste Storage Radiation Shielding

Shielding for radiation protection shall be provided in the design of spent fuel and waste storage facilities as required to meet the requirements of 10CFR20.

Answer

Shielding is provided for fuel handling and waste storage areas to lower radiation doses to levels below limits specified in 10CFR20. Shielding for these areas and other plant shielding requirements and criteria are included in Chapter 4.

Criterion 69 - Protection Against Radioactivity Release From Spent Fuel and Waste Storage

Containment of fuel and waste storage shall be provided if accidents could lead to release of undue amounts of radioactivity to the public environs.

Answer

All fuel storage and waste storage facilities are designed to prevent the release of undue of radioactivity to the public. Fuel storage facilities are described in Chapter 3, waste storage facilities are described in Chapter 4 and analysis of potential accidents in these systems is included in Chapter 5.

IX. Effluents

Criterion 70 - Control of Releases of Radioactivity to the Environment

The facility design shall include those means necessary to maintain control over the plant radioactive effluents, whether gaseous, liquid, or solid. Appropriate holdup capacity shall be provided for retention of gaseous, liquid, or solid effluents, particularly where unfavorable environmental conditions can be expected to require operational limitations upon the release of radioactive effluents to the environment. In all cases, the design for radioactivity control shall be justified: (a) on the basis of 10CFR20 requirements for normal operations and for any transient situation that might reasonably be anticipated to occur; and (b) on the basis of 10CFR100 dosage level guidelines for potential reactor accidents of exceeding low probability of occurrence except that reduction of the recommended dosage levels may be required where high population densities or very large cities can be affected by the radioactive effluents.

Answer

Provision is included in the facility design for storage and processing of radioactive waste and the release of such waste under controls adequate to prevent exceeding the limits of 10CFR20. The facility also includes provision to prevent radioactivity releases during accidents from exceeding the limits of 10CFR100. A description of the Radioactive Waste Disposal System is included in Chapter 4. The effects of potential accidents are analyzed in Chapter 5.

3.2 CLASSIFICATION OF STRUCTURES, COMPONENTS, AND SYSTEMS

3.2.1 Seismic Classifications

The plant structures and process systems are classified according to their function and their degree of integrity required to protect the public from uncontrolled releases of radioactivity. Structural design criteria include three seismic classes as follows:

Seismic Class I is defined as those structures, mechanical components, the Reactor Protection System, the interface between Reactor Protection and Anticipated Transient Without Scram (ATWS) Mitigation (AMS) Systems, and the Engineered Safety Feature (ESF) Actuation System whose failure might have caused or increased the severity of a loss-of-coolant accident (LOCA). Also, those structures and components that were vital to safe shutdown and isolation are defined as Seismic Class I.

Seismic Class II is defined as those structures and mechanical components which are not Seismic Class I but functioned in direct support of reactor operation.

Seismic Class III is defined as those structures and components which are neither Seismic Class I nor II.

For Seismic Class I equipment, dynamic analyses, static analyses, or tests were used to determine that components and structures will operate or maintain their integrity, as required. For Seismic Class II equipment, static analysis methods were used. Seismic Class III equipment meets applicable codes.

Seismic design is discussed in Section 3.7.

3.2.2 Seismic Class I Structures

The Containment Building, Fuel Handling Building, and the Auxiliary Building are Seismic Class I structures. The spent fuel pool, in the Fuel Handling Building, and the Control Room, in the Auxiliary Building, are therefore Seismic Class I. As for the intake structure, that portion of the Crib House enclosing the service water pumps and the related essential piping, are all Seismic Class I.

In the permanently defueled condition, the Containment Building, Auxiliary Building, and Crib House are not vital to the safe shutdown and isolation of the plant since both reactors have been permanently defueled. Although the potential for a LOCA no longer exists, the seismic qualification of these structures continues to ensure that a structural failure will not result in an increase in the severity of any accident postulated to occur in the defueled condition. In addition, the Containment and Auxiliary Building also function to contain radioactive materials.

3.2.3 Seismic Class I Systems and Components

Following the cessation of reactor operations at Zion Station, various systems and components were assessed to determine their relative importance in the permanently defueled condition. This section of the DSAR has been modified to only address those systems and components originally designed as Seismic Class I and determined to be important to the defueled condition of the plant. Systems and components formerly classified as Seismic Class I and not included in the DSAR will not be used to support the storage, cooling, or integrity of spent fuel, and are not associated with the handling of radioactive materials or involved with radiological safety. As such, these systems and components have no safety significance.

Table 3-3 lists the Seismic Class I systems and components applicable in the defueled condition.

3.2.4 Structures, Systems and Components Important to the Defueled Condition (ITDC)

3.2.4.1 General

SSC classification involves a determination that an SSC is, or is, not safety related[1]. SSCs classified as safety-related are treated differently by regulation than other SSCs[2].

SSC's were originally classified according to the safety function they performed during power operation. Clearly, the first two parts of the safety-related definition in 10CFR50.2 (ensuring integrity of the reactor coolant pressure boundary, and the capability to achieve and maintain safe shutdown) are not applicable to a permanently defueled plant. The third part of the safety-related definition (prevent or mitigate consequences of accidents comparable to 10CFR50.34(a)(1) or 10CFR100.11 guidelines) is also not applicable. This is primarily due to the fact that the present day source terms are significantly reduced.

The accidents and events that remain applicable to Zion Station in its permanently defueled condition are:

- Fuel Handling Accident in the Fuel Building
- Spent Fuel Pool Events/Operational Occurrences
- Radioactive Waste Handling Accident
- Spent Fuel Cask Drop

A new analysis has been performed for the Fuel Handling Accident in the Fuel Building. This analysis indicates that off-site doses (without mitigation) are much lower than previously evaluated and, thus, well within the 10CFR50.34(a)(1) and 10CFR100.11 exposure guidelines. The dose to Control Room personnel remains within the limits specified in 10CFR50, Appendix A, GDC-19. These results are primarily due to the fact that the spent fuel assemblies in the Spent Fuel Pool have undergone in excess of a year of radioactive decay and there is an insignificant amount of radioactive iodine left in the fuel assemblies. This accident is discussed in Chapter 5.

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1. Safety related SSCs are those relied upon to remain functional during and following design basis events to ensure: a). the integrity of the reactor coolant pressure boundary; b). the capability to shut down the reactor and maintain it in a safe shutdown condition, and c). the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to guidelines of 10CFR100.

2. 10CFR50, Appendix B notes that "The pertinent requirements of this appendix apply to all activities affecting the safety-related functions of..." SSCs.

The Spent Fuel Pool Events are a loss of forced cooling and a loss of water level. Both cases result in a loss of forced cooling and a loss of inventory such that boiling in the pool eventually occurs. Based on the reduced heat load in the Spent Fuel Pool (due to the elapsed time since both reactors were shutdown), the evaluations of these events demonstrate that, in both cases, the loss of inventory is very slow. For both the loss of Spent Fuel Pool forced cooling and the loss of Spent Fuel Pool inventory, a significant period of time will elapse from the loss of forced cooling until boiling and boiloff of the pool occurs until the water level drops to approximately 3.9 feet above the stored fuel assemblies. At this water level, the resultant radiological dose at the edge of the Spent Fuel Pool is approximately 3.6 R/hr. In either of the above cases, adequate time is available to initiate corrective measures for restoration of malfunctioning components, or to initiate an alternative method of cooling using onsite or offsite water supplies, without significant radiological consequences to plant workers in the Fuel Handling Building or to members of the general public. These events are discussed in Chapter 5.

An evaluation of an accident associated with a container of radioactive resins generated during decontamination activities has been performed. This evaluation indicated that, based upon a curie content of waste significantly higher than would be allowed in a shipping container, an accident that results in the airborne release of dewatered resin will not result in a dose at the EAB in excess of the USEPA Protective Action Guidelines or 10CFR100 limits. This accident is described in Chapter 5 (Radioactive Waste Handling Accident).

The Spent Fuel Cask Drop analysis is used only for structural considerations to demonstrate that impact of a swinging spent fuel cask that is dropped from the maximum allowed height will not result in damage to the Spent Fuel Pool such that uncontrolled water loss occurs. The permanently defueled condition of the plant does not change this analysis or its conclusions. This event is discussed in section 3.9.5

Based on the above, it is concluded that no SSC's are required to be classified as safety-related at Zion in its permanently defueled condition. This results in two areas of interest:

1. Zion's "nuclear grade" processes are based largely upon quality assurance (10CFR50, Appendix B) requirements. Reclassifying all SSCs as non-safety related could lead to the elimination of most management controls in situations where maintaining management controls is desired.

2. Zion recognizes that certain functions remain important to safety in the defueled condition.

It is necessary to reclassify SSCs in order to proceed with decommissioning. Strictly following regulatory requirements in reclassification will result in elimination of most of the current management controls, which is contrary to management's intent.

These concerns are addressed by introducing an artificial classification scheme that goes beyond regulatory requirements:

- SSCs which support a fuel safety or radiation protection safety function are designated as Important to the Defueled Condition (ITDC).
- Enhanced management controls are maintained on SSCs classified as ITDC.
- The current license basis for ITDC SSCs is reviewed and revised if appropriate using the applicable change mechanism (e.g., 10CFR50.54, 50.90, 50.59, etc.). This includes their safety-related or non-safety related designations.
- SSCs which are not ITDC are eliminated from the license basis.

The following criteria are used to determine which SSCs are designated as ITDC:

Criteria 1. Is the SSC associated with storage, control, or maintenance of nuclear fuel in a safe condition; or handling of radioactive waste? This includes direct as well as indirect effects[3].

Criteria 2. Is the SSC associated with Radiological Safety?[4]

Criteria 3. Is the SSC associated with an outstanding commitment to the regulators which remains applicable to storage, control, or maintenance of nuclear fuel in a safe condition; or handling of radioactive waste?

Criteria 4. Does the SSC satisfy a requirement based in regulations? This includes any SSC which is independently required by Technical Specifications[5].

A positive response to any criteria indicates that an SSC is ITDC. A negative response to all criteria identifies a non-ITDC SSC. When applying these criteria to determine the effect on an SSC, the scope of the criteria below must be carefully applied.

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3. Includes the following:
    - Those SSCs required to safely store and handle radioactive waste and spent fuel.
    - Those SSCs required to protect workers and the public from the consequences of the remaining (or new) DBA's.
    - Those SSCs required to safely store new fuel until it is shipped offsite.
    - Those systems which monitor or control radiological effluent release paths.

4. Preserve SSCs associated with maintaining exposures ALARA.

5. This evaluation assures that the appropriate regulatory change mechanism is used for effecting the change. This includes changes associated with the Security Plan, Quality Assurance Program, Emergency Planning, Operations Training, Permits, License Conditions, rules, etc.

3.2.4.2 Authorizations, Restrictions and Limitations on use of the SSC reclassification criteria

The SSC reclassification criteria will be used as a basis to change various Zion processes, provided that the change involves an SSC that is non-ITDC and, provided that plant procedures contain an acceptable method for approving the change.

3.2.4.3 Boundaries and Interfaces for ITDC SSCs

SSCs identified as ITDC are required to meet the following criteria:

> "A system, subsystem, train, component, or device is capable of performing its specified function(s)."

Implicit in this definition is the assumption that the necessary attendant instrumentation, controls, power sources or equipment, or other auxiliary equipment that are required to support the available SSC, are capable of performing their support function, as necessary.

3.3 WIND LOADING DESIGN

Station structures which are not Seismic Class I were designed to withstand the effects of 100 mile-per-hour (mph) winds. Seismic Class I structures, with the exception of the Containment, were designed for 300 mph wind loads. The Containment was designed to withstand the force caused by a tornado with a peripheral tangential wind velocity of 300 mph and forward progression of 60 mph. For further information on this subject, refer to Section 3.8.1.2.5.

3.4 WATER LEVEL (FLOOD) DESIGN

Flooding by groundwater infiltration is prevented by the heavily reinforced concrete walls; and by the capability of providing portable means of water removal.

It is not expected that the seismic effects will produce the type of cracking that would allow water infiltration. Additional flexural cracking may occur but complete through cracking will not.

For further information on this subject, refer to Sections 2.4.2 and 2.4.5.

3.5 MISSILE PROTECTION

3.5.1 Missiles Generated by Natural Phenomena

3.5.1.1 Criteria

Components required to maintain containment integrity in order to meet the site criteria of 10CFR100 are protected against loss of function due to damage by the missiles shown in Table 3-1. The Seismic Class I structures have been checked for Missiles 1 through 11 by the modified Petry Formula.

3.5.1.2 Design

Missiles originating from sources external to the reactor containment are also discussed in Sections 3.5.1.4 and 3.8.1.2.5.

All removable slabs that can potentially become missiles are tied down if their own weight is insufficient. Typical tie down details are shown on Figures 3-1 and 3-2.

Partition or block walls are protected from tornadoes by the Class I structures.

3.5.1.3 Aircraft Hazards

Refer to Section 2.2.3.

3.5.1.4 Structures, Systems, and Components to be Protected from Externally Generated Missiles

All essential equipment has either been designed to withstand a credible tornado including a single large missile generated thereby, or has been placed in a structure which will withstand the tornado and missile. Where sufficient redundancy exists, equipment may be physically separated without protection against tornado missiles.

3.5.1.5 Barrier Design Procedures

The general structural stability of the structures and equipment has been checked in addition to safety from local penetration by missiles. A list of the missiles considered is given in Table 3-1.

The method of analysis considers conservation of momentum and conservation of energy. The energy, E, absorbed is calculated as follows:

$$E = (1/2)[(M_1 + M_2)(V_3)^2]$$

where:

M_1	=	mass of missiles
M_2	=	effective mass of target structure
V_1	=	initial velocity of missile
V_2	=	initial velocity of target structure
V_3	=	final velocity of target structure
	=	$(M_1V_1 + M_2V_2)/(M_1 + M_2)$

Modified Petry formula is used to calculate the missile penetration and the structural deflection is obtained by an iterative procedure.

The force or load, F, due to the missile impact is then obtained as:

$$F = E/d$$

where:

E = the energy absorbed
d = missile penetration plus structure deflection

3.6 SEISMIC QUALIFICATION OF SEISMIC CLASS I EQUIPMENT

3.6.1 Seismic Qualification Criteria

For the Design Basis Earthquake (DBE), Seismic Class I equipment is designed to assure that it does not lose its capability to perform its function; i.e., maintain stored irradiated fuel in a safe condition.

For the DBE, there may be permanent deformation of the equipment provided that the capability to perform its function is maintained.

Table 3-3 provides a list of Seismic Class I systems and components.

3.7 SEISMIC DESIGN

3.7.1 Seismic Input

3.7.1.1 Design Response Spectra

The seismic loading conditions are established by the Design Basis Earthquake (DBE).

The DBE is selected to be the largest potential ground motion based on site seismic and geological factors and uncertainties. Refer to Section 2.5.2.2.

The criteria adopted for seismic analyses for equipment are defined in Section 3.7.2.

Section 3.7.3 describes the seismic analysis performed for Seismic Class I piping.

The DBE is based on a horizontal ground acceleration of 0.17g and a vertical acceleration of 0.11g. Figure 3-3 shows the DBE Response Spectra.

Figures 3-4 through 3-21 show the local dynamic building response spectra used for seismic class I equipment.

3.7.1.2 Design Time History

All equipment and floor response spectra were generated by the time-history method. Time-history responses of all parts of a structure which support Seismic Class I components were calculated, and these time-history motions were used to generate floor response spectra. The scaled N-S El Centro 1940 accelerogram was used as the basis for developing equipment seismic design criteria. The maximum ground acceleration of record was adjusted so that the actual earthquake spectra is higher than the site response spectra.

Figure 3-22 shows a spectra obtained from the scaled time-history records and the site spectra for the DBE with 5% damping.

3.7.1.3 Critical Damping Values

The floor response spectra for the DBE was developed for the Reactor Containment and the Auxiliary Building, based on the values indicated below for 2% critical damping value, which is due to the ground acceleration of 0.17g for the DBE.

The following percentage of critical damping was used in the seismic analysis by Stone and Webster for the work done under I.E. Bulletin 79-14:

Piping	DBE
Reactor Containment	1.0
All other	1.0
Components and Equipment	2.0
Concrete Structures	5.0

3.7.2 Seismic System Analysis

3.7.2.1 Seismic Analysis Methods

In general, all Seismic Class I components fall into one of two categories, rigid or flexible. If the component is rigid and rigidly restrained, it responds as does its attached building without amplification. Usually, the threshold of rigidity varies between 15 to 30 Hz, depending on restraint or support and component damping response spectrum used and building foundation media. Therefore, adequate seismic restraints and proper analytical models are provided for the Class I components so that the component falls into the rigid category and also stays within the allowable stress limit.

The value used in the analysis and testing of components was always higher than 15 Hz and, in many cases, was even higher than 30 Hz depending on specific building response characteristics.

The following are general seismic design methods, employed for components other than those furnished with the NSSS to assure the adequacy of Seismic Class I components. They are:

1. If the component is structurally simple so that it can be defined as a one degree of freedom system, make the dynamic model consist of one mass and one equivalent spring. Using the value of the mass and the spring constant, determine the natural frequency of this mechanical component.

2. If the component is structurally complex such that it can not be modeled as a single degree of freedom, the following procedure of analysis is used:

   a. Model the component using a multidegree of freedom representation.

   b. Determine the natural frequencies and mode shapes.

   c. Calculate the modal participation factor for each mode.

   d. Determine the resultant motion at each point in a given mode as the product of the modal participation factor, modal spectral motion, and displacement of the point under consideration in that mode.

   e. Determine the resultant design motion of a point by combining the motion of individual modes on a square-root-sum-of-squares (root-mean-square) basis, which is resulting from the combination of horizontal motion in any one direction as well as a simultaneous vertical motion.

   f. Determine the resultant deflections, moments, shears, and stresses based on a per mode basis and then combined on the basis of a root-mean-square and an absolute sum.

3. Testing of selected components was performed on shaker tables, or by other accepted means, with response criteria equal to or exceeding the Zion spectra for the specific location of the item being tested.

3.7.2.2 Vertical Response Loads

Vertical seismic loads were taken into consideration by designing Seismic Class I buildings and floors for a vertical load obtained from a constant vertical load factor equal to two-thirds the maximum ground acceleration of the DBE. Justification of the use of a constant vertical load factor of two-thirds of maximum ground acceleration was evaluated during the construction permit review.

In the structural design of buildings, the ratio of live-to-dead load is generally 1.5 or greater. Dead load includes the weight of all heavy equipment supported in the structures, and live load results from moving major equipment during repair and refueling. Since the live load is not present during normal operation of the plant, there exists a margin when combining vertical seismic loads with dead loads. Vertical seismic loads obtained from seismic analysis on similar plants were compared with the live loads used in the design of the Zion structures. This comparison showed that design stresses in the Zion structures are under the combination of operating loadings, and vertical seismic loadings are below allowable stress levels.

3.7.2.3 Interaction of Noncategory I Structures with Category I Structures

Structurally interconnected Seismic Class I and Seismic Class II buildings, namely the Seismic Class I Fuel Handling Building, Auxiliary Building, Control Room and Diesel Generator Building and portions of the Crib House, and the Seismic Class II Turbine Building and portions of the Crib House were incorporated in one seismic model to account for the effects of Seismic Class II structures on the seismic response of Seismic Class I structures. There are no Seismic Class I and Seismic Class II structures adjacent to each other that could produce a potential "hammering" effect. Under the DBE, the maximum relative displacement between the Reactor Containment and the Auxiliary Building was calculated to be 0.58 inches, which is less than the one inch separation between the Containment and adjacent structures. The calculated displacement included the effect of relative displacement of supporting soil as well as deformation of the structures.

Seismic Class II structures that were independent of Seismic Class I structures or did not have Seismic Class I equipment located within them were designed as Seismic Class II structures.

The Turbine Building, which is adjacent to a Seismic Class I structure, was designed to remain intact under the effects of both the DBE and the credible tornado. Stresses in the frame during both of these conditions was limited to yield stress. Under tornado conditions, siding is removed and the wind acts on the exposed superstructure.

The Crib House was designed to the normal Seismic Class I criteria for everything below grade and that portion containing the service water pumps above grade. The superstructure steel above these portions was Seismic Class II, but in the event of failure, the integrity of the Seismic Class I structure would not be jeopardized. Further information concerning design modeling of the Auxiliary Building can be found in Section 3.8.2.

3.7.2.4 Development of Floor Response Spectra

The floor response spectra used in the equipment design criteria are derived from the time-history motion of the building model. Since the motion of the building is affected by only the damping in the building model, response spectra comparison are shown for damping values used in the time-history analysis of the building.

The response spectrum curves for each particular location have sharp peaks which correspond to the fundamental frequency of the supporting structures. Frequencies of a structure cannot be precisely determined because of material properties variations, lumping of masses, idealization of stiffness, damping, and nonlinear response characteristics of the actual structure. The peaked curves obtained by plotting response data were enveloped with smooth curves which allow for a shift of the peaks on the frequency scales and account for the uncertainties in the frequency calculations.

The smoothed curves were based on the floor response spectra generated for x-excitation and y-excitation independently. The two curves were superimposed upon each other, and one smooth curve was drawn which was considered applicable for the design of equipment subjected to any direction of horizontal excitation. Since the peaks on the two spectra from two directions of excitation did not coincide, frequency shift between the two peaks was allowed. The smooth curves allow for additional frequency shift of 10% on the frequency scale on each side of the peaks from the two directions of excitation.

3.7.2.5 Comparison of Response

Table 3-2 shows a comparison of the accelerations at various elevations for the time-history analysis and the response spectrum analysis of a typical Seismic Class I structure.

Responses obtained from the response spectra method of analysis were used in the structural design of the buildings. Time-history analyses were used to generate floor response spectra. From Table 3-2, it is evident that the time-history method acceleration responses always exceed the acceleration responses obtained from the response spectrum method of analysis.

Therefore, the equipment design criteria is obtained from a seismic load equivalent to or greater than the seismic load specified by the site response spectra.

3.7.3 Seismic Subsystem Analysis

3.7.3.1 Determination of Number of Earthquake Cycles

The number of loading cycles used for design of Seismic Class I systems and components ranges from one to five cycles. From the viewpoint of allowable fatigue stress limits, these limited number of cycles are not significant.

The seismic criteria for the Zion site does not address a postulated number of seismic events. To facilitate piping analysis, the occurrence of one DBE was assumed. The piping system seismic designs were qualified on the basis of ANSI B31.1.0-1967 design criteria and analyses. The B31.1 code does not recognize cyclic loading under 102.3.2(d), Additive Stresses, the paragraph under which seismic stresses are considered. Additive stresses include pressure, weight, and DBE stresses. A criterion not covered by the code is that additive stresses must not exceed the yield stress.

For stainless steel, the maximum possible additive stresses for the DBE are below the endurance limit of the material. Although the maximum possible additive stresses for carbon steel are above the endurance limit, the number of stress cycles resulting from the conservatively estimated number of seismic events is well below the number of stress cycles permitted at S_{alt} = 35,000 psi.

3.7.3.2 Analytical Procedures for Piping

All Zion Seismic Class I piping has been designed to comply with the requirements of power piping code, ANSI B31.1, 1967. This code cannot significantly handle various design circumstances for the DBE. The DBE is usually considered as a postulated event, and it is considered to be part of the loading for emergency and faulted conditions. The corresponding stress limit cannot be found in the code. Therefore, yield strength of piping material at design temperature, or $2S_h$, is set as the stress limit for the emergency condition.

For the DBE, the combined stresses should be within the yield stresses of the building material.

3.7.3.3 Buried Seismic Category I Piping Systems and Tunnels

Underground reservoirs and tunnels were designed to withstand soil pressure increases resulting from earthquake loading. These earth pressure increases were calculated from concepts originally presented by Mononobe and Okabe and reviewed in "Lateral Stresses in the Ground and Design of Earth-Retaining Structures," state-of-the-art papers presented in a 1970 specialty conference sponsored by the Soil Mechanic and Foundation Division of ASCE at Cornell University, June 22-24, 1970.

3.7.3.4 Interaction of Other Piping with Category I Piping

Protection against interactions between Seismic Class I and Seismic Class II piping systems and equipment has been provided by the following methods:

1. All Seismic Class I piping and equipment has been located in Seismic Class I structures.

The following procedure is employed in evaluating seismic stress, induced by Seismic Class II piping systems on Seismic Class I piping:

1. Isolate piping between Seismic Class I and Seismic Class II regions by placing two (2) seismic restraints in the plane of global directions.

2. Consider the inertial load of Seismic Class II piping as an integrated part of Seismic Class I piping for performing dynamic response spectra analysis.

3.7.4 Seismic Instrumentation

The Seismic Monitoring Instrumentation consists of a strong motion (active) detection system and a peak recording (passive) system. In the event of an earthquake the seismic response of plant features important to safety can be determined promptly and compared to that used as the design basis.

The active system continually monitors seismic response and provides alarms and recording features. Triaxial accelerometers are installed at locations selected in accordance with Regulatory Guide 1.12. Two accelerometers are located in the Unit 2 Containment and one accelerometer is located in the Auxiliary Building. The fourth accelerometer is located outside the security fence but within the restricted area, east of the Training Building.

Five passive peak recording accelerometers are installed at various locations throughout the plant. Two additional peak recording accelerometers are located on equipment inside the Unit 2 Containment. There are no alarms or operator actions associated with the passive system.

3.8 DESIGN OF CATEGORY I STRUCTURES

3.8.1 Concrete Containment

3.8.1.1 Description of the Containment

The Reactor Containment completely encloses the entire reactor and Reactor Coolant System (RCS). It is a cylindrical concrete structure with a shallow domed roof and a flat foundation slab. The cylindrical portion is prestressed by a posttensioning system consisting of horizontal and vertical tendons. The dome has a three-way posttensioning system. The foundation slab is conventionally reinforced with high-strength reinforcing steel. The entire structure is lined with one-quarter inch welded steel plate to provide vapor tightness and assures no leakage of radioactive materials to the environment. The structure provides biological shielding for normal situations.

The Containment structure was designed and constructed in accordance with the Design Criteria shown in Section 3.8.1.4.1. These criteria are based upon American Concrete Institute (ACI) 318-63, ACI 301, and the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Sections III, VIII, and IX.

The selection and use of containment materials comply with the applicable codes and standards as stated hereinafter.

3.8.1.2 Loads and Load Combinations

3.8.1.2.1 Dead Loads

Dead load consists of the weight of the concrete wall, dome, base slab, and any internal concrete.

3.8.1.2.2 Live Loads

Live load consists of snow and ice loads on the dome and major components of equipment which are supported on the containment base slab. Equipment loads are assumed for design of internal slabs consistent with their intended use.

3.8.1.2.3 Hydraulic Uplift Forces

Uplift forces are created by the displacement of ground water by the structure.

3.8.1.2.4 Seismic Forces

A dynamic analysis is used to determine equivalent loads for design For seismic design provisions, see Section 3.7.

This analysis provided compression/tension, bending, and shear forces that are accounted for in the seismic design of the structure. Seismic rocking of the structure has been considered. Torsion in symmetrical buildings caused by wave propagation has not been considered.

3.8.1.2.5 Wind Loading and External Missiles

The forces due to wind (excluding tornadic wind) were calculated in accordance with the methods described in the American Society of Civil Engineers (ASCE) paper No. 3269 entitled "Wind Forces on Structures."

The Zion Containment structure was analyzed for tornado loading (not coincident with accident or earthquake) on the following basis:

1. Differential pressure between the inside and the outside of the Containment structure is 3 psi and a torsional moment resulting from the horizontal peripheral tangential velocity.

2. Lateral force caused by a "funnel" of wind having a peripheral tangential velocity of 300 mph and a forward progression of 60 mph. Shape factors from ASCE Paper No. 3269 were used. Gust factors and variation of wind velocity with height do not apply.

3. A tornado-driven missile equivalent to an airborne 8-inch-diameter by 12-foot-long piece of wood traveling on end at 225 mph.

3.8.1.3 Design and Analysis Procedures

3.8.1.3.1 General

A finite element computer program for individual loading cases of dead load, live load, wind, earthquake, temperature, and pressure analyzed the Containment.

The net moment, shear, and axial force on a cross section for any load combination were then obtained by algebraic addition of the effects under individual loading. The ACI-318-63 code design methods and allowable stresses were used for concrete and prestressed and non-prestressed reinforcing steel except as noted herein.

3.8.1.3.2 Computer Analysis Programs

3.8.1.3.2.1 General

The analysis of the Zion Containment vessel was performed utilizing plate and shell programs available from S&L Computer Divisions' program library. More than one validated computer program was used to obtain the design moments and forces and the results obtained showed agreement. The computer analyses provided equilibrium checks of internal forces and the external loads in every case. The checks indicated by ACI Committee 334 (Page 3) and the ACI Code 318-63, Section 2603 (a) have been fully met.

Stresses and ultimate strength were investigated at service conditions and at all load stages that may be critical during the life of the structure from the time prestress is first applied. These stresses are listed in Table 3-4 for all critical load combinations envisaged. Time-dependent deformations due to creep and shrinkage induce compressive strain in the liner. Detailed analysis of creep and shrinkage at elevated temperatures showed that the maximum strain that may occur in the liner plate at the end of the life of the plant will be less than the permissible strain.

3.8.1.3.3 Containment Behavior

The design of the Containment assures the structure responds in an elastic, low-strain manner to all loads.

3.8.1.4 Structural Acceptance Criteria

3.8.1.4.1 Structural Design Basis

3.8.1.4.1.1 General

The main considerations in developing the structural acceptance criteria was to maintain integrity and proper performance of the Containment structure under extraordinary circumstances. The basic criteria is that the structure has a low-strain, nearly elastic response such that its behavior may be completely predictable under the required loadings. The Containment structure was designed as a conventionally reinforced concrete structure for dead load, live loads (including construction loads), and a reduced wind load to account for the time prior to prestressing.

The design of the Containment utilized the basic "working stress" design. The final design was then checked utilizing a yield limit design.

3.8.1.4.1.2 Stress Tables

Shown in Table 3-4, are the sections for which concrete and reinforcing steel stresses were determined. The structural data and allowable stresses (for both working stress design and yield limit design) are also shown. The maximum stresses for both working stress design and yield limit design combinations are listed on Sheets 3 through 5. The ratio of computed and allowable stresses is shown for easy reference.

The loading conditions associated with the design basis accident caused the maximum design stresses. These loading conditions are not applicable for the defueled condition.

3.8.1.4.1.3 Foundation Design Criteria

Based on the soil investigation conducted by Dames & Moore (D&M), the following criteria have been used for the design of the concrete mat foundation for the Containment:

- Ultimate soil-bearing capacity	40,000 psf
- Factor of safety for permanent loads	3
- Factor for safety for permanent loads in combination with short term loads such as accident pressure or earthquake, wind, and tornado	2.5

In consideration of the above factors, the allowable soil-bearing pressures are:

For permanent loads	13,000 psf
For short term loads	16,000 psf

The hydrostatic uplift for a ground water elevation up to El 585' is considered in the design.

The maximum soil pressures and actual factors of safety were found to be as shown in Table 3-6.

3.8.1.5 Materials, Quality Control, and Special Construction Techniques

The four major components used for the construction of the Containment are:

1. Concrete,
2. Reinforcing Steel,
3. Prestressing Steel Tendons, and
4. Plate Steel Liner.

Specifications and working drawings for these materials and their installation are of such scope and detail that, together with the quality assurance program, the quality of work is commensurate with the desired integrity of the Containment structure. The materials critical to the defueled condition are the concrete and the reinforcing steel.

3.8.1.5.1 Concrete

The compressive strength of concrete is as follows:

Base Slab	-	5000 psi @ 90 days
Walls & Dome	-	5500 psi @ 90 days

3.8.1.5.2 Reinforcing Steel

Reinforcing steel in the base slab, cylinder wall, the domed roof, and around the openings to control shrinkage and tensile cracks is deformed billet steel bars. This steel has a minimum yield strength of 60,000 psi; a minimum tensile strength of 90,000 psi; and a minimum elongation of 7% in an eight-inch specimen. Splicing of reinforcing bar sizes larger than No. 11 is by Cadweld mechanical splices.

3.8.1.5.3 Quality Control

Quality of both materials and construction of the containment vessel is assured by a continuous program of quality control and inspection. Table 3-7 delineates the records to be maintained.

3.8.2 Other Seismic Category I Structures

3.8.2.1 Description of Structures

General layouts of Class I structures are found in Figures 1-3 through 1-16 of the Zion DSAR. Typical reinforcement steel arrangements for main members are shown in Figures 3-23 through 3-28. The design of Seismic Class I structures other than Containment are discussed in this section. Containment structure design is discussed in Section 3.8.1.

3.8.2.2 Loads and Load Combinations

Table 3-5 identifies the load combinations and the design criteria applied to these structures.

In areas of the plant where removable shield blocks are used, the blocks are tied down as shown in Figure 3-29. This precludes the blocks from becoming missiles during seismic events.

3.8.2.3 Design and Analysis Procedures

The Auxiliary-Turbine Building was modeled as a fixed base model. Free field motion was directly input to the base of the building-only model without considering the translational soil-structure interaction. In order to determine the effect of soil-structure interaction, an independent study was made by employing an interaction model (Figure 3-30). In this model, both the Reactor and the Auxiliary-Turbine Buildings were embedded separately in the soil mass.

3.8.2.4 Foundations

This information is covered in Section 3.8.1.4.1.3.

3.8.2.5 Materials

The compressive strength of the concrete used in the construction of the structures was 3500 psi @ 90 days. In selected areas of the structures, where required by design or construction convenience, the compressive strength of the concrete used was 5000 psi @ 90 days. For reinforcing steel information, see section 3.8.1.5.2.

3.9 FUEL STORAGE AND HANDLING

3.9.1 New Fuel Storage

3.9.1.1 Design Bases

The design basis for new fuel storage is discussed in Section 3.9.2

3.9.1.2 New Fuel Storage Facility Description

New fuel assemblies and control rods are stored in a separate area designed to hold 132 new fuel assemblies. The new fuel assemblies are stored in racks in parallel rows having a center-to-center distance of 21 inches. The new fuel racks are provided with locking devices which preclude any transfer of new fuel assemblies without proper authorization.

3.9.1.3 Design Features Important to the Defueled Condition

The new fuel storage facility is considered ITDC since it is necessary to ensure the safe storage of the remaining unirradiated fuel assemblies. After all of the unirradiated fuel assemblies have been shipped offsite, the new fuel storage facility will no longer be considered ITDC.

3.9.2 Spent Fuel Storage

3.9.2.1 Design Bases

3.9.2.1.1 Prevention of Fuel Storage Criticality

Criterion: Criticality in the new and spent fuel storage pits shall be prevented by physical systems or processes. Such means as geometrically safe configurations shall be emphasized over procedural controls.

The new fuel storage rack accommodates two-thirds of a core (132 fuel assemblies). There are three sections of racks with each section made up of two rows. The two parallel rows in each section have a nominal center-to-center spacing of 21 inches and each section is separated by a distance of 44 inches to assure that $k_{eff} < 0.95$, even if water filled the new fuel storage vault, provided that the stored fuel has a maximum of 57.4 grams U-235 per axial centimeter of fuel assembly length. The new fuel storage vault is protected from flooding by its free flood drain.

The spent fuel storage pool is designed for 3012 assemblies, plus the required spent fuel shipping cask area. Borated water is used to fill the spent fuel storage pool. The fuel is stored in a vertical array with sufficient center-to-center distance between assemblies to assure k_{eff} <0.95, even if unborated water is used to fill the pool, provided that the fuel has a maximum loading of 57.4 grams U-235 per axial centimeter of fuel assembly length.

Detailed instructions are available for use by refueling personnel. In addition to the instructions, safety limits, conditions, and the design of the fuel handling equipment incorporating built-in interlocks and safety features provide assurance that no incidents occur during the fuel handling operations that result in a hazard to public health and safety.

3.9.2.1.2 Fuel Storage Decay Heat

Criterion: Reliable decay heat removal systems shall be designed to prevent damage to the fuel in storage facilities that could result in radioactivity release which results in undue risk to the health and safety of the public.

The spent fuel pool water provides reliable and adequate cooling medium for spent fuel transfer. The spent fuel storage pool is provided with a Spent Fuel Pool Cooling System which is discussed in detail in Section 3.9.4.

3.9.2.1.3 Spent Fuel Storage Radiation Shielding

Criterion: Adequate shielding for radiation protection shall be provided in the design of spent fuel storage facilities.

Adequate shielding for radiation is provided during spent fuel handling and storage operations under water. This permits visual control of the operation at all times while maintaining low radiation levels. Pool water level is indicated. Water removed from the pool must be pumped out since there are no gravity drains.

Gamma radiation in the Fuel Handling Building is monitored. A high level signal is alarmed locally and is annunciated in the Control Room.

3.9.2.1.4 Protection Against Radioactivity Release From Spent Fuel Storage

Criterion: Provisions shall be made in the design of fuel storage facilities such that no undue risk to the health and safety of the public could result from an accidental release of radioactivity.

All fuel storage facilities are contained and equipment designed so that accidental releases of radioactivity directly to the atmosphere are monitored and will not exceed the guidelines of 10CFR100.

3.9.2.1.5 Monitoring Fuel Storage

Criterion: Monitoring and alarm instrumentation shall be provided for fuel storage and associated handling areas for conditions that might result in loss of capability to remove decay heat and to detect excessive radiation levels.

An area radiation monitor of the gamma scintillation type is provided to monitor the spent fuel pool area. This is more fully described in Chapter 4. Temperature and level instruments are provided to guard against the loss of cooling capability.

3.9.2.2 Spent Fuel Storage Facility Description

The spent fuel storage pool is a reinforced concrete structure with seam-welded stainless steel plate liners. This Class I structure is designed to withstand the anticipated earthquake loadings and to prevent liner leakage even in the event the reinforced concrete develops cracks.

The spent fuel storage pool is designed for the underwater storage of spent fuel assemblies and control rods after their removal from the reactor. The pool depth is such that the surface dose level will not be increased by more than approximately 2.5 mR when moving a fuel assembly over storage racks. It is designed to accommodate 3012 fuel assemblies. The spent fuel pool is constructed of reinforced concrete. The entire interior basin face and transfer canal are lined with stainless steel.

Spent fuel assemblies are handled by the spent fuel handling tool (a long handled tool) suspended from an overhead monorail electric hoist and manipulated by an operator standing on a movable bridge over the pool. Controls have been established such that no loads heavier than the weight of a single spent fuel assembly plus the tool for moving that assembly shall be carried over fuel stored in the spent fuel pool. In addition, the spent fuel handling tool, the burnable poison tool, the rod cluster control changing fixture and the thimble plug shall not be carried at heights greater than two feet over fuel stored in the spent fuel pool.

Storage racks are provided to hold spent fuel assemblies. Fuel assemblies are placed in vertical cells and contiguously grouped in parallel rows. The spent fuel storage racks are Seismic Class I equipment and will remain functional during and after a DBE. They are not anchored to the Spent Fuel Pool floor or walls, or structurally interconnected. Each rack module is provided with leveling pads which support the rack. The fuel rack structure is a folded metal plate assembly welded to a baseplate and supported on four legs. Center to center spacing of region 1 cells is 10.78" in the East-West direction and 10.54" in the North-South direction. Region 2 storage cells have a 9.144" center to center spacing in both directions. Additionally, the storage racks contain an amount of Boral which is a neutron absorber. This assures the necessary spacing between assemblies to prevent criticality, even if the pool was inadvertently filled with unborated water. Regions 1 and 2 of the spent fuel storage pool are shown in Figure 3-31. Control rod clusters are stored in the fuel assemblies. Fuel assemblies stored in the spent fuel pool must have no more than 57.4 grams U-235 per axial centimeter of fuel assembly length. Most abnormal storage conditions will not result in an increase in k_{eff}. However, it is possible to postulate events, such as the inadvertent misloading of a fuel assembly with a burn-up and enrichment combination outside of the acceptable area or dropping an assembly between the pool wall and the fuel racks, which could lead to an increase in reactivity. However, credit can be taken for the presence of approximately 500 ppm of boron in the pool water as is required when fuel is being moved in the Spent Fuel Pool by the plant Technical Specifications. The reduction in k_{eff} caused by the boron more than offsets the reactivity addition caused by these postulated events. A minimum boron concentration of 160 ppm is adequate to assure that the limiting k_{eff} of 0.95 is not exceeded.

The fuel assemblies are a canless type, with the basic assembly consisting of a rod cluster control guide thimble mechanically attached to grids and a top and bottom nozzle. Fuel rods are supported at several points along their length by spring-clip grids. There are four types of fuel assemblies that were used by Zion: Low Parasitic (LOPAR), Optimized Fuel Assemblies (OFA), VANTAGE 5, and VANTAGE 5 with Intermediate Flow Mixer (IFM) designs. The fuel rods are cold worked, partially annealed Zircaloy tubes containing slightly enriched uranium pellets. Rod cluster control assemblies (RCCAs), secondary sources, thimble plugs, and burnable absorber rods, if required, were inserted into the guide thimbles of the fuel assemblies. The absorber sections of the control rods were fabricated of a silver-indium-cadmium alloy sealed in stainless steel tubes. The material in the discrete burnable absorber rods is in the form of an aluminum oxide-boron carbide annulus sealed in Zircaloy called a Wet Annular Burnable Absorber (WABA). As of August 12, 1998, there are 2226 spent fuel assemblies stored in the spent fuel pool.

A new fuel elevator is located in the pool that was used to transfer new fuel assemblies into the pool for subsequent handling with the spent fuel pool handling crane. The elevator is equipped with alarms to inform the operator of any malfunction of the elevator during movement of new fuel. To prevent the inadvertent lifting of irradiated fuel, the new fuel elevator is key interlocked to prohibit raising when the elevator is loaded with greater than 1400 lbs. Raising of the elevator when loaded with a fuel element activates an audible alarm.

A separate walled off area is provided at the end of the pool for the storage of the spent fuel cask. The walls prevent the cask from falling into the spent fuel storage area. The base mat of the fuel storage pool in the cask storage area has been designed so that structural integrity will not be lost in the event of a cask drop.

In the unlikely event that some leakage from the spent fuel pool were to occur, protective features have been provided to prevent radioactive material release to the environs from either loss of water from the storage pool or mechanical damage to the irradiated fuel.

The below listed features were incorporated in the design of the spent fuel pool to meet the design intent of AEC Safety Guide 13:

1. All spent fuel storage facilities are located in a Seismic Class I structure. In addition, the spent fuel racks within the fuel pool are Seismic Class I.

2. Although no longer required to be functional or credited in any accident analysis, the ventilation system provided in the Fuel Handling Building is equipped with filtration devices to limit the potential release of radioactive materials.

3. All piping connections to or from the spent fuel pool are above the level of the spent fuel racks.

4. Level instrumentation, with alarms, and radiation monitoring devices have been provided for the spent fuel pool.

5. Makeup water for the pool is available from a tank onsite. Backup sources are available from additional water supplies.

6. Interlocks are provided to prevent cranes capable of carrying heavy loads from entering the area of the spent fuel pool where fuel is stored. These interlocks are described in detail in Section 3.9.3.

3.9.2.3 Design Features Important to the Defueled Condition

The spent fuel pool is necessary for the safe storage of nuclear fuel. Thus, this structure is considered to be ITDC. Several consideration and analyses determine the safety of the spent fuel pool in the original design for Zion Station. These include:

Thermal Analysis,
Radiological Analysis,
Fuel Assembly Structural and Material Consideration,
Fuel Pool Structural and Material Considerations, and
Criticality Analysis.

Reference 1 provides a more detailed assessment of the design features of the spent fuel racks.

The passive design features of the spent fuel pool minimizes the potential for significant losses of pool water and thereby assures that the fuel is safely stored and the public and plant workers are adequately protected. In the permanently defueled condition, potential events which could result in a significant loss of water from the spent fuel pool are discussed in Chapter 5.0 One of these events is a loss of spent fuel cooling. This event assumes a loss of pool inventory as a result of boiloff of the water volume. An evaluation has been performed to assess the effects of a thermal increase on the spent fuel pool structure (Reference 2). The results of this evaluation concluded that for dead load, live load, and a water temperature of 212 degrees F, that the stresses associated with the spent fuel pool are within allowable limits and that an increase in the bulk water temperature to 212 degrees F has no adverse consequences to the pool structure.

3.9.3 Fuel Handling Systems

3.9.3.1 Design Basis

The Fuel Handling System provides a safe, effective means of transporting and handling fuel. The system is designed to minimize the possibility of mishandling or of misoperations that could cause fuel damage and potential fission product release.

3.9.3.2 System Description

Spent fuel is handled with equipment designed to handle it underwater from the time it leaves the spent fuel storage racks until it is placed in a cask for shipment from the site. Underwater transfer of irradiated fuel provides an effective, economic, and transparent radiation shield, as well as a reliable cooling medium for the removal of decay heat.

The portions of the Fuel Handling System needed in the permanently defueled condition are located in the fuel handling building and consists basically of those components, tools and structures necessary for performing fuel movement operations. Prior to fuel handling operations, preoperational checkouts of the fuel handling equipment are performed to ensure proper performance of the equipment to be operated and to familiarize plant personnel with operation of the equipment. The major components and structures of the Fuel Handling System are discussed below:

3.9.3.2.1 Failed Fuel Cans

Suspected defective fuel assemblies were placed in a failed fuel can and sealed to provide an isolated chamber for testing for the presence of fission products.

The failed fuel cans are stainless steel cylinders with lids that can be bolted in place remotely. An internal gas space in the lid provides for water expansion and for collection and sampling of fission product gases. Various remotely operable quick-disconnect fittings permit connection of the can to sampling loops for continuous circulation through the can.

If sampling showed that fission products indicative of a cladding failure were present, the sampling lines were closed off by valves on the can and the enclosed fuel assembly was removed to the spent fuel storage racks to await future shipment. Design of the cans will allow the defective fuel to be stored and shipped while sealed in the failed fuel can.

3.9.3.2.2 Spent Fuel Pool Bridge

The spent fuel pool bridge is a wheel mounted walkway spanning the spent fuel pool which carries two electric monorail hoists on an overhead structure. The fuel assemblies are moved within the spent fuel pool by means of a long-handled tool (the spent fuel handling tool) suspended from the hoist. The hoist travel, tool, and sling length are designed to limit the maximum lift of a fuel assembly to a safe shielding depth. The two hoists are electrically interlocked to allow operation of only one hoist at a time.

3.9.3.2.3 Fuel Building Crane

The fuel building crane is a 125-ton electric overhead traveling bridge crane, designed to allow for lifting and carrying a load 25% above the rated capacity. This is a specification design consideration and does not affect the crane rating. The structural design conforms to the applicable requirements of the Electrical Overhead Crane Institute, Inc. (EOCI) Specification and applicable portions of the American Institute of Steel Construction (AISC) Specification for all design provisions not covered by the EOCI Specification. An additional design consideration allows for lifting and carrying a 230-ton load nine feet from the centerline of the north crane rail. This requirement resulted in crane and building runways capable of taking a load far in excess of the rated capacity at that particular location. The crane has been designed to withstand seismic conditions. The main hook is a "sister hook" type fitted with safety clamps. The hook is forged steel and has been radiographed and magnetic particle inspected. The lifting tackle and gearing was designed with a factor of safety not less than five. The load holding capability for the main hoist cable has a factor of safety of 6.2. Each of the 14 cables has a breaking strength of 48.3 tons.

The crane is provided with three brakes, an eddy current speed control brake and two motor brakes. Each motor brake is rated at 550 ft-lbs and is capable of holding the load. Electrical power is required to unload the motor brakes. Loss of power results in locking the load in position. The stall-out torque of the motor (275% of full load running torque) is 750 ft-lbs. The two motor brakes together are capable of holding the load at the stall-out torque condition.

3.9.3.2.4 Fuel Building Crane Interlocks

The fuel building crane has been designed with safety interlocks and limit switches which guard against any over-travel of both the bridge and trolley, and limit both the upper and lower travel of the hoist. These switches are activated whenever the crane apparatus goes beyond these limits and whenever a high radioactivity signal is transmitted by the radiation monitor. No load and a fully raised main hoist are further requirements for travel over the spent fuel storage pool. These restrictions ensure that no accidental load will be carried over the pool. The interlocks provided are further described below.

3.9.3.2.4.1 Interlock/Limit Switch Function

The bridge and trolley are provided with limit switches of the automatic-reset type to prevent over-travel in either direction. The main hoist has limit switches to stop the hook in its highest and lowest safe positions. Each limit switch is wired so that the drive motor can be energized in the reverse direction after its limit switch has opened. Two limit switches serve to restrict the upward travel of the hoist hooks, while a block-type switch is used on the cable, and screw type on the drum. These switches are adjusted so that if one fails to operate the remaining one will shut off the current.

Electrical limit switches backed up by fail-safe mechanical stops located on all four rails will not permit any trolley movement over the restricted pool area. If operation over this area is necessary, the operator must override the above mentioned limits with controls located on the bridge. Trolley movement is interlocked through the use of a load cell on the main hook and a position sensor. When the main hook is in its uppermost position and unloaded, the trolley can pass over the restricted area with the auxiliary hoist in operation.

A mechanical system of stops to prevent crane movement over the fuel pool area consists of a system of bumpers and limit switches. Targets will be provided on the crane bridge to contact special bumpers mounted on the building. Electrical limits are provided on the hoist to sense position and loading. The only time the target can be hoisted out of the way is when the main hoist is in its highest position with an empty hook. Additional limit switches are provided on the target hoists which will not allow operation of the main hoist until the targets are in position. A similar target bumper arrangement is provided for the trolley. The sensing of the hoist position and the load on the hook is done with electric limit switches. An override switch box with red warning lights is located on the bridge.

In addition, an auxiliary relay with contacts in the raising control circuit of both hoists is provided such that, when it is energized by a fuel radiation monitor, it will prevent further raising of the hoists.

3.9.3.2.4.2 Hoist Limit Switches - Operation

The hoist limit switch is a safety device which prevents the bottom block from coming in contact with any part of the trolley. All limit switches are similar in that they open circuits to stop the hoisting motion when the bottom block is raised above a preset upper limit.

The hoist limit switches automatically reset when the bottom block is lowered below the preset upper limit. Two types of limit switches are used on crane applications. They are the weight-operated limit switch and the geared limit switch.

The basic operation of any weight-operated limit switch is as follows:

1. When the bottom block is below the preset upper limit, the reset counterweight or bar maintains the limit switch in its normal operating position.

2. When the bottom block approaches its preset upper limit, it contacts the reset counterweight or bar. Further upper movement at the bottom block lifts the reset counterweight or bar, allowing the operating lever or sheave to rotate. As the operating lever or sheave rotates it turns a shaft on which the actuating cams are mounted. Therefore, as the shaft rotates, the cams rotate until they open the normally closed contacts of the limit switch. This stops the hoist motor and applies the motor brake.

3. If the bottom block drifts beyond the preset upper limit, the reset counterweight or bar continues to rise and the actuating cams rotate still further. Eventually, the plugging cams close the plugging circuit contacts. This reverses the hoist drum and lowers the bottom block below the preset upper limit.

The adjustable geared limit switch opens the HOIST circuit when the bottom block reaches the preset upper limit and opens the LOWER circuit when the bottom block reaches a preset lower limit. The limit switch is driven by the hoist drum and is actuated after a predetermined number of drum revolutions.

Both the HOIST and LOWER circuits are connected through sets of normally closed contacts in the limit switch. Both the upper and lower limits of bottom block travel are preset at the factory.

3.9.3.3 Design Features Important to the Defueled Condition

The Fuel Handling System, as described in section 3.9.3, is considered ITDC since it is associated with the safe storage and handling of nuclear fuel.

3.9.4 Spent Fuel Pool Cooling and Cleanup System

3.9.4.1 Design Basis

The Spent Fuel Pool Cooling System is designed to remove heat from the spent fuel pool generated by the stored spent fuel elements. The system serves the spent fuel pool, which is shared between the two units.

System piping is arranged so that failure of any pipeline does not drain the spent fuel pool below the top of the stored fuel elements (Reference 3).

3.9.4.1.1 Fuel and Waste Storage Decay Heat

Criterion: Reliable decay heat removal systems shall be designed to prevent damage to the fuel in storage facilities, and to waste storage tanks that could result in radioactivity release, which results in undue risk to the health and safety of the public.

The Spent Fuel Pool Cooling System has two cooling trains. Either of these trains is capable of handling the heat load residing in the spent fuel pool. During normal conditions, the pump and spent fuel pool heat exchanger handle the decay heat load and maintain the temperature at less than 120°F, with one train operating.

3.9.4.1.2 Codes and Classifications

All piping and components of the system are designed to the applicable codes and standards listed in Table 3-8.

3.9.4.2 System Description

Each of the two cooling loops in the Spent Fuel Pool Cooling System (see Figure 3-32) consists of a pump, heat exchanger, filter, demineralizer, piping and associated valves and instrumentation. Each pump draws water from the pool, circulates it through the heat exchanger, and returns it to the pool. Component cooling water cools the heat exchanger. The availability of two full cooling trains allows prolonged outages of any active or passive component in the system, the only possible consequence being an increase in water temperature.

Whenever a leaking fuel assembly exists in the spent fuel storage pool, a small quantity of fission products may enter the spent fuel cooling water. Purification loops are provided for removing these fission products and other contaminants from the water. The clarity and purity of the spent fuel pool water is maintained by passing approximately 100 gpm of each loop's flow through a filter and demineralizer. Skimmers are provided to prevent dust and debris from accumulating on the surface of the water. The water chemistry of the spent fuel pool is controlled via Chemistry Department procedures.

The Spent Fuel Pool is separated from the fuel transfer canal by a common wall. Access to the transfer canal from the Spent Fuel Pool is provided by a removable weir gate, the bottom of which is approximately 2'-3" above the top of the stored fuel. An inflatable seal is incorporated into the design of the weir gate to prevent leakage from the Spent Fuel Pool into the transfer canal when the transfer canal is empty. Pressurization of the weir gate inflatable seal is accomplished by instrument air or via dedicated nitrogen bottles.

The most serious failure of this system would be complete loss of water in the spent fuel storage pool. To protect against this possibility, the spent fuel storage pool cooling connections enter near the water surface level so that the pool cannot be gravity drained.

The active components of the system are in continuous use and no additional periodic tests are specified. Periodic visual inspections and preventive maintenance are conducted following normal industrial practice.

3.9.4.3 Components

Spent Fuel Pool Cooling System component design data are listed in Table 3-9.

3.9.4.3.1 Spent Fuel Pool Heat Exchangers

The spent fuel pool heat exchangers are of the shell and U-tube type with the tubes welded to the tube sheet. Component cooling water circulates through the shell, and spent fuel pool water circulates through the tubes. The tubes are austenitic stainless steel and the shell is carbon steel.

3.9.4.3.2 Spent Fuel Pool Pumps

The two spent fuel pool pumps circulate water in the spent fuel pool cooling loops. All wetted surfaces of the pump are austenitic stainless steel or equivalent corrosion resistant material. The pumps are operated manually from a local station.

3.9.4.3.3 Spent Fuel Pool Filters

The spent fuel pool filters remove particulate matter from the spent fuel pool water. The filter cartridge is of synthetic fiber, and the vessel shell is austenitic stainless steel. Different filter cartridges can be installed, if needed, to improve water clarity.

3.9.4.3.4 Spent Fuel Pool Strainers

A stainless steel strainer is located at the inlet of each spent fuel pool cooling suction line for removal of relatively large particles which might otherwise clog the spent fuel pool demineralizer.

3.9.4.3.5 Spent Fuel Pool Demineralizers

Each demineralizer is sized to pass about 100 gpm of the loop circulation flow to provide adequate purification of the spent fuel pool water for unrestricted access to the working area and to maintain water clarity.

3.9.4.3.6 Spent Fuel Pool Skimmer

A spent fuel pool skimmer pump, strainer, and filter are provided for surface skimming of the spent fuel pool water. This subsystem maintains the needed clarity for visual observations of the spent fuel pool water.

3.9.4.3.7 Spent Fuel Pool Cooling System Valves

Manual stop valves are used to isolate equipment, and manual throttle valves provide flow control. Valves in contact with spent fuel pool water are austenitic stainless steel or equivalent corrosion-resistant material.

3.9.4.3.8 Spent Fuel Pool Cooling System Piping

All piping in contact with spent fuel pool water is austenitic stainless steel. The piping is welded except where flanged connections are used at the pump, heat exchanger, and filter to facilitate maintenance.

3.9.4.3.9 Spent Fuel Pool Sump Recessed Area

A sump recessed area in the spent fuel pool allows for complete draining of the sump with a submersible pump for cleaning, inspection, and maintenance of the spent fuel pool.

3.9.4.4 Spent Fuel Pool Make-up Capability

Various equipment and components are available to provide make-up water to the spent fuel pool. Make-up to the spent fuel pool would normally be required to account for natural evaporation. A quantity of borated water is maintained in a Refueling Water Storage Tank located in the Auxiliary Building. This tank can hold a sufficient amount of water to supply make-up to the spent fuel pool for several hours to account for routine or non-routine boil-off. A 100 gpm Refueling Water Purification pump, operated manually from a local station, is available to transfer water from a Refueling Water Storage Tank to the spent fuel pool. Other make-up sources include water from a Condensate Storage Tank via a Demineralized Water Flushing pump and the Fire Protection header via hoses.

The spent fuel pool has been analyzed for loss of cooling (see Chapter 5). Sufficient time exists from the time cooling is lost and boiling occurs that compensatory measures can be taken, including supplying make-up water, to prevent fuel damage and off-site releases that exceed USEPA Protective Action Guidelines or 10CFR100 limits. The equipment available for providing make-up to the spent fuel pool is, therefore, not considered ITDC.

3.9.4.5 Design Features Important to the Defueled Condition

This system is associated with the storage of nuclear fuel and helps ensure adequate decay heat removal (cooling function) while maintaining exposures to plant personnel ALARA (cleanup function). Those portions of the Spent Fuel Cooling and Cleanup System which provide cooling and cleanup capability to the spent fuel pool are considered ITDC. These are as follows:

- Spent fuel pool pumps (as required)
- Spent Fuel Pool heat exchangers (as required)
- Spent Fuel Pool demineralizers (as required)
- Associated piping, valves, filters, and strainers
- Spent Fuel Pool weir gate, including seal and nitrogen pressurization bottles if transfer canal is drained and weir gate is installed (this is being listed here rather than in section 3.9.2 since its failure, which is discussed in chapter 5, could lead to a loss of Spent Fuel Pool cooling).

3.9.5 Spent Fuel Cask Drop Analysis

The design of the spent fuel storage area precludes damage from occurring as a result of a dropped spent fuel shipping cask. Figure 1-8 shows the arrangement of structures and components for the storage and handling of new and spent fuel assemblies. Figure 3-33 provides a sketch which shows the movement of the spent fuel cask from the cask area in the spent fuel storage pool to the transport loading area. An elevation drawing is shown in Figure 3-34. Guard walls are provided in the spent fuel storage pool. These walls, which surround the cask area, rise the full height of the pool and are structurally designed to withstand the impact from a falling spent fuel cask, including the mass of the wire rope, load block, hook, and lifting device. If the cask is positioned over the cask area and tips and falls, it will land on the guard walls. Since the center of gravity of the cask is within the guard walls, as noted on Figure 3-33 the cask cannot tip over into the spent fuel storage pool. If the cask should roll, the slot between the wall will stop the cask since the opening is smaller than the cask dimensions. Therefore, if the cask does not fall straight down, either because the drop occurs over a pool edge and the cask is deflected, or the trunnion or a yoke on one side of the cask fails and produces a lateral force, the spent fuel cask cannot damage any spent fuel. In addition, the fuel building crane is restricted from operation over the spent fuel storage pool by electrical and mechanical interlocks.

An analysis was performed on the integrity of the fuel pool floor. The analysis took into account the highest elevation from which the cask could be dropped. The drag effects of the water were taken into account to determine the energy at impact with the floor. A 9-foot 0-inch-deep slab was provided to distribute the impact force to the foundation. Through-the-slab cracking will not occur and therefore the possibility of leakage is eliminated.

The details of this specific spent fuel cask drop analysis are presented here.

3.9.5.1 Objective of Analysis

Investigation of cask displacement in a plane along the axis of lower block (East West) when unfavorable (West) end of cable breaks. A similar analysis was performed for lateral displacement in the north-south direction that resulted in a 7 inch displacement. This analysis is for the NLI 10/24 cask which weighs 110 Tons including yoke and lifting cables.

3.9.5.2 Statement of Physical Problem

The analysis was done on the assumption that the cask will swing about the most unfavorable cable when the cable on the other extreme end breaks. Since inclusion of downward movement of cask will result in smaller lateral displacement above the pool (the maximum lateral displacement will remain above the cask storage area), the downward movement of the cask was neglected for lateral displacement computations. The system consisting of upper and lower blocks; and cask and yoke will have two kinds of motion:

1. Pendulum swinging about the intersection between the horizontal plane through the center line of the upper block and the vertical plane through the two most eastern cables.

2. Rotational motion of cask and yoke system about its own center of gravity. This motion occurs due to the fact that center of pendulum motion and center of gravity of cask and yoke assembly are not in one vertical line.

Figure 3-35 shows the elevation of the cask along the axis of lower block. The cask is 6" above the pool wall. 00_1 is the axis of upper block. A B is the axis of the lower block. C is the center of gravity of yoke and cask assembly. Other dimensions for the cask position just before lowering in cask area also are shown in the figure.

For analysis, cable 0_1A is assumed to have broken. This results in the swinging of cask about point 0 which is at the other extreme (East) end of upper block. Since point 0 and C are not in the same vertical line, rotation of yoke and cask assembly about C also will occur. Extreme position of two motions are combined to get the maximum lateral displacement.

3.9.5.3 Calculational Methods and Other Assumptions

1. Details Of Impact:

   The impact of the cask with guard wall has been assumed to be plastic. Impact energy calculations are made on the basis of approximately 1/4 weight of the guard wall participating in the plastic impact. The impact is essentially vertical (in the plane of guard wall), and the guard wall will act as a column.

   The impacted mass of the wall is 14.84 kips/ft/Sec.^{2}

   The impact of cask takes place at an angle of 6° 12' and results into a vertical force of 7750 kips and a horizontal force of 842 kips.

2. Punching Shear:

   The punching shear stress value at distance d/2 away from impacted area is 400 psi where "d" is the thickness of wall at the point under consideration.

   The vertical compressive stress at the section is approximately 2.13 ksi. The maximum allowable shear based on shear friction is 750 psi. Thus, the actual punching shear stress is within the allowable stress.

   Although the impact of cask with guard wall occurs as indicated in Figure 3-36, for conservative calculations of strain energy capacity of guard wall, it is assumed to occur at the corner of the wall as shown in Figure 3-37.

3. Reaction Shear:

   Reaction shear along the negative yield line is computed on the basis of the ultimate load capacity of the panel for given yield line pattern. Actual shear stress along the yield line is 116 psi, while allowable shear is 122.5 psi which does not include any credit for the compressive force acting at the section. The resistance function of the wall in the horizontal direction is shown in Figure 3-38. The ultimate load capacity of the wall (258.8 kips) was computed on the basis of the yield line pattern, shown in Figure 3-37, which corresponds to the most critical point of impact.

4. Yield Line Pattern:

   Reference is made to Page 277 of "Yield Line Analysis of Slabs" by Jones and Wood. Ultimate load capacity of the slab for point load is 2m when resisting moment capacity of the slab is the same for positive yield lines as well as negative yield lines and is equal to m. If positive moment capacity of the slab is ignored as was done here, the ultimate load capacity reduces to 1.57m. Thus, the more conservative approach of not specifying any moment capacity to positive yield lines is followed.

5. Overall Behavior Of The Structure:

Structural members supporting the guard wall need be checked for the reaction and its dynamic effect due to impact loading of the guard wall. To be conservative, a Dynamic Load Factor of 2.0 can be assumed for the design of these supporting members (base slab and north wall of the pool). Since, by inspection, base slab as well as the north wall of the pool have moment capacities of more than twice that of the guard wall, there is no need for detailed design. It should be noted that these members resist the moments on the two sides of the junction with the guard wall.

3.9.5.4 Results

Calculations indicate that the time required for the pendulum system to swing from dead center to its extreme end (or one-quarter of its period of swinging) is 1.37 seconds. These calculations also show that the time required for the cask to hit the bottom of the pool, which is equivalent to falling a distance of 41.33 feet, is 1.6 seconds; whereas it only takes 0.89 seconds for the center of gravity of the cask and yoke assembly to drop below the top of the guard wall, which is equivalent to a drop of 12.79 feet. Therefore, the center of gravity of the cask and yoke assembly will be below the top of the guard wall before it reaches its extreme horizontal displacement during its first swing . Also, the calculations show that keeping the cask centerline $4^1/_2$ inches farther away from the guard wall will preclude the dropping cask from hitting the guard wall.

In addition to this analysis, an analysis was performed on the integrity of the fuel pool floor. The analysis took into account the highest elevation from which the cask could be dropped. The drag effects of the water were taken into account to determine the energy at impact with the floor. A 9-foot 0-inch-deep slab was provided to distribute the impact force to the foundation. Through-the-slab cracking will not occur and therefore the possibility of leakage is eliminated.

3.10 PLANT SUPPORT SYSTEMS

3.10.1 Component Cooling System

3.10.1.1 Design Bases

The Component Cooling System is shown in Figure 3-39.

The Component Cooling System is designed to remove heat from the spent fuel pool heat exchangers. Component cooling water flows through these heat exchangers, picks up heat from these and other various components, and flows to the component cooling heat exchangers which are cooled by the Service Water System. The component cooling loop serves as an intermediate system between the Spent Fuel Pool water and the Service Water System. This double barrier arrangement reduces the probability of leakage of potentially radioactive water to the Service Water System.

The system design provides means for the detection of radioactivity entering the system and includes provision for isolation of system components.

All piping and components of the Component Cooling System are designed to the applicable codes and standards listed in Table 3-10.

3.10.1.2 System Description

The Component Cooling System consists of five component cooling pumps, three component cooling heat exchangers, two surge tanks and associated piping and valves. Sufficient cooling capacity is provided to fulfill all system requirements. Adequate safety margins are included in the size and number of components to preclude the possibility of a component malfunction adversely affecting operation of ITDC equipment.

During normal operation, one pump and one heat exchanger is capable of transferring the required amount of heat from the spent fuel pool cooling system to the service water system. If necessary, replacement of a pump or heat exchanger is possible while the other units are in service.

Cooling water for the component cooling heat exchangers is supplied from the Service Water System (see Section 3.10.2), insuring a continuous source of cooling.

Nominal flow rates are tabulated in Table 3-11.

Since the heat is transferred from the component cooling water to the service water, the Component Cooling System serves as an intermediate system between the Spent Fuel Pool water and the Service Water System and insures that any leakage of potentially radioactive fluid is contained within the plant. The surge tanks accommodate expansion, contraction, and inleakage of water and insure a continuous component cooling water supply until a leaking cooling line can be isolated. Radiation monitors are installed in the system to detect inleakage of radioactive fluid into the component cooling system and identify the need to monitor the normally open atmospheric vent from the surge tanks.

Provisions are made to add makeup to the system via connections to the surge tanks on the suction header of the component cooling pumps.

To minimize the possibility of leakage from piping, valves, and equipment, welded joints are used wherever possible. The component cooling water could become contaminated with radioactive water due to a leak in any heat exchanger tube in the Spent Fuel Pool Cooling System.

Tube inleakage from the Spent Fuel Pool Cooling System is detected by a radiation monitor located at the component cooling heat exchanger outlets that are in service.

In the case of a postulated leak involving the spillage of water, leakage is detected in the three collecting sumps in the component cooling pump and heat exchanger area and by the level indicator of one of the surge tanks. Isolation valves are provided wherever necessary to allow continued operation under a leakage condition anywhere in the pump and heat exchanger portion of the system. Valves that are required to allow flow and/or to provide isolation capabilities will be considered acceptable as long as they can be opened and closed manually. The system allows the postulated leak to be isolated and still maintain a minimum of one pump and one heat exchanger available.

Leakage from the component cooling equipment drains to a floor sump on El 542' by way of the collecting sumps on El 560'. In addition to the sumps, adequate process instrumentation within the system will provide direct information to the Control Room on flow and pressure conditions.

The Component Cooling System is either in continuous or intermittent use during normal plant operation. Periodic visual inspections and preventive maintenance are conducted using normal industrial practice.

The operation of the system is monitored with the following instrumentation:

1. Temperature detectors in the pump suction header lines and the component cooling heat exchanger outlet lines;
2. Local and control room indication of component cooling pump discharge header pressure;
3. A temperature and flow indicator in the outlet line from the Spent Fuel Pool Cooling heat exchangers;
4. A radiation monitor at the component cooling heat exchanger outlets that are in service;
5. Two level indicators and alarms on each surge tank.

3.10.1.3 Components

Component Cooling System component design data are listed in Table 3-12. Nondestructive testing of Seismic Class I components of the Component Cooling System is described in Table 3-13.

3.10.1.3.1 Component Cooling Heat Exchangers

The three Seismic Class I component cooling heat exchangers are of the shell and tube type. Cooling water circulates through the tubes while component cooling circulates through the shell side.

3.10.1.3.2 Component Cooling Pumps

The five Seismic Class I component cooling pumps which circulate component cooling water through the component cooling loops are horizontal centrifugal units of standard commercial construction.

3.10.1.3.3 Component Cooling Surge Tanks

The Seismic Class I component cooling surge tanks accommodate changes in component cooling water volume. In addition to piping connections, each tank is provided with a means for adding a chemical corrosion inhibitor to the component cooling loop.

3.10.1.3.4 Component Cooling System Valves

The valves used in the component cooling loop are standard commercial types. The component cooling water is not normally radioactive; however, the valves are designed to minimize leakage. Self-actuated spring-loaded relief valves are provided for lines and components that could be pressurized to their design pressure by improper operation or malfunction.

The relief valves on the cooling water lines downstream of the spent fuel pool heat exchangers are sized to relieve the volumetric expansion which occurs if the exchanger shell side is isolated and high temperature coolant flows through the tube side. The set pressure equals the design pressure of the shell side of the heat exchangers.

The relief valves on the component cooling surge tanks were sized to relieve the maximum flow rate of water which could have entered the surge tank following a rupture of a reactor coolant pump thermal barrier cooling coil. This is more than adequate for system protection during operation with the plant permanently defueled. The set pressure equals the design pressure of the component cooling surge tank. The discharge of these valves is directed to the waste holdup tank.

3.10.1.3.5 Component Cooling System Piping

The Seismic Class I component cooling loop piping is carbon steel with welded joints and connections except at components which might require removal for maintenance. Component cooling water contains a corrosion inhibitor to protect the carbon steel piping.

Except for the normally closed makeup line and equipment vent and drain lines, there are no connections between the Component Cooling System and other systems. The equipment vent and drain lines have manual valves which are normally closed unless the equipment is being vented or drained for maintenance or repair operations.

3.10.1.4 Design Features Important to the Defueled Condition

The Component Cooling System is associated with the maintenance of stored nuclear fuel in a safe condition. As such, this system is considered ITDC. The requirements of the Component Cooling System in the permanently defueled condition can be met by any combination the equipment listed below as necessary to ensure adequate heat removal from the spent fuel pool heat exchangers.

- Component Cooling pumps (as required)
- Component Cooling heat exchangers (as required)
- Component Cooling surge tanks (as required)
- Associated Component Cooling system piping and valves to supply Component Cooling system water to the Spent Fuel Pool heat exchangers

3.10.2 Service Water System

3.10.2.1 Design Basis

The Service Water System supplies the equipment cooling water for the plant. The arrangement of the equipment and the flow path of the water is shown on Figure 3-40. Six pumps feed a common discharge header. The pumps, strainers, valves and piping serving the component cooling water heat exchangers are Seismic Class I and are located in Seismic Class I structures or embedded in concrete.

3.10.2.2 System Description

The six service water pumps are rated at 22,000 gpm at 210 feet TDH. The pumps are located in the Crib House and take their suction from the Crib House forebay which receives water from the lake through three, 13-foot steel intake lines. Two of the intake lines have 24-foot diameter bell-shaped inlets and are covered by a flat protective canopy. The third intake line receives water through an annular structure with 55 openings separated by as much as 96 feet. During the spring, summer, and fall months, a fishnet barrier is installed around the perimeter of the intake structure to meet the facilities' National Pollution Discharge Elimination System (NPDES) permit requirements and is removed in the winter months. It is extremely improbable that any single barge or ship on Lake Michigan could block all of the circulating water intake structure. Any two of the openings in the annular intake structure which supplies one 13-foot intake line, or a small fraction of one of the two 24-foot diameter bell-shaped inlets, each of which supply one 13-foot intake line, would be adequate to provide full service water flow for both Unit 1 and Unit 2. In the event that all three intake lines are blocked, water can be admitted to the forebay through one discharge line and its recirculation connection to the forebay.

The discharge of three service water pumps passes through two 40,000 gpm strainers with $^{1}/_{8}$-inch openings to a common header for all six pumps. The main supply headers connect to this common discharge header.

A sodium hypochlorite solution is injected into the Service Water System upsteam of the SW Strainers. This will control the Zebra Mussel population and biological activity in the SW System. A sodium bisulfite solution is injected into the Circulation Water (CW) discharge tunnels in order to neutralize the chlorinated water prior to re-entry into the lake.

The normal water supply to the Fire Protection System and the Screen Wash System is provided by the service water booster pumps. These pumps take suction from each of the main headers in the Crib House. The main headers pass under the Turbine Building after leaving the Crib House and enter the Auxiliary Building where the cooling water loops are supplied.

The following components important to the defueled condition (ITDC) are supplied from these cooling loops:

1. Component cooling heat exchangers;
2. Service water pump seals.

Pushbuttons are installed at the 4-kV buses 147, 148, 149, 247, 248 and 249 for local start of the service water pumps.

Isolation valves are provided in the loops and are provided in each of the feeds to individual coolers.

The system pressure is maintained at approximately 75 to 120 psig in the main supply header and a pump may be aligned to start when pressure drops in the main header.

The maximum service water flow required to meet the cooling needs in the permanently defueled condition is 11,108 gpm (see Table 3-14). A single service water pump is capable of delivering at least 22,000 gpm. Therefore, one service water pump is capable of supplying sufficient cooling water. Miscellaneous non-essential loads may be present in addition to the essential loads identified. There is adequate time to isolate non-essential loads as needed to address adverse Spent Fuel Pool cooling concerns (reference section 5.2.1).

The service water loop supplying the component cooling heat exchangers is provided with double isolation valves on either side of the common heat exchanger (0CC001), which, in the event of valve or line leakage, allows cooling water to be available to two of the three heat exchangers.

Detection of leakage which might affect system operation is provided by means of installed pressure, temperature, and flow instrumentation and by level in the Auxiliary Building sumps. This instrumentation also aids in identifying flow restrictions.

The Auxiliary Building is provided with water detectors in collecting sumps which will alarm in the event of water accumulation from a piping or valve leak. The operator, upon receiving this alarm, goes to the area of the alarmed sump to determine the nature and location of the leakage and will operate the appropriate valves to isolate the affected area.

3.10.2.3 Design Features Important to the Defueled Condition

The Service Water System is associated with the maintenance of stored nuclear fuel in a safe condition. As such, this system is considered ITDC. The requirements of the Service Water in the permanently defueled condition can be met by any combination of the equipment listed below to ensure adequate heat removal from the Component Cooling water heat exchangers.

- Service Water pumps (as required)
- Cribhouse forebay
- Lake intake and discharge piping, valves, and structures
- Sodium hypochlorite system (as required)
- Sodium bisulfite system (as required)
- Associated Service Water system piping and valves to supply service water to the Component Cooling system heat exchangers

3.10.3 Ventilation Systems

3.10.3.1 Control Room Heating, Ventilating, and Air Conditioning System

3.10.3.1.1 Design Bases

The design of the heating, ventilating, and air conditioning for the Control Room is based on a system with the capability to provide air filtration, heating, and/or cooling, with humidification and/or dehumidification to support routine occupancy of the control room necessary to remotely monitor and operate spent fuel cooling and its associated support systems.

3.10.3.1.2 System Description

The Control Room HVAC System arrangement consists of high efficiency filters, a charcoal filter for smoke and odor removal, a cooling and heating coil package, a humidifier, and a direct-driven vane axial fan. Air is supplied through a louverall ceiling. Return air passes through the control boards into a return duct system which is connected to outlets on top of the boards. The return air is mixed with outside air as required to meet minimum ventilation requirements and/or room cooling requirements. The Control Room HVAC System Equipment Room and outside air intake is located at El 617'.

In the event of smoke in the control boards, smoke detectors will annunciate in the Control Room. Concurrently, all of the supply air delivered to the conditioned spaces may be directed through a normally bypassed charcoal filter for smoke and odor adsorption.

Mechanical cooling for the Control Room HVAC System is provided by means of two 100% capacity water-cooled refrigeration units. Each refrigeration unit is connected to its respective air handling unit.

3.10.3.1.3 Normal Operation

Each Control Room HVAC System is controlled to provide ventilation, heating, and/or cooling on a year-round basis. Two full-capacity air handling units are provided, one of which is standby.

Each air handling unit is connected to a full-capacity refrigeration unit. During normal operation, a minimum amount of outdoor air is introduced to the system for the purpose of odor dilution. Return air from the conditioned spaces is ducted back through a return fan and is recirculated through the air handling unit. A standby return air fan is provided. Each system is provided with separate controls.

3.10.3.1.4 Design Features Important to the Defueled Condition

The Control Room Ventilation System was designed to handle a loss of coolant accident. Therefore, it is sufficiently designed to accommodate the significantly reduced source term in the permanently defueled condition. The consequences of the accidents in the defueled condition are significantly below the 10CFR100 guidelines. In addition, no credit for control room ventilation isolation is taken in the safety analysis since the dose consequences to control room inhabitants is significantly low without ventilation isolation. In the event of evacuation, cooling of the stored irradiated fuel in the spent fuel pool can be monitored locally.

The Control Room Ventilation System is not considered ITDC.

3.10.3.2 Auxiliary Building Ventilation

3.10.3.2.1 Design Bases

The Auxiliary Building Ventilation system is designed to maintain acceptable ambient air temperatures for equipment operation and personnel habitability, provides air flow in a cascading fashion from areas of lesser contamination potential to areas of greater contamination potential (for ALARA considerations), and provides a bulk exhaust flow for ease of effluent sampling.

3.10.3.2.2 Normal Operation

The Auxiliary Building Ventilation system supplies filtered, conditioned outside air to the various areas of the Auxiliary and Fuel Handling Buildings and exhausts filtered air back to the outside. The supply and exhaust air flows are balanced to maintain air flows in the Auxiliary and Fuel Handling Buildings in a cascading fashion from areas of lesser contamination potential to areas of greater contamination potential. The exhaust fans draw filtered air from the common exhaust plenum and discharge air to the Auxiliary Building vent stack past a radiation sampling monitor. The exhaust system can operate to maintain the required pressure gradients by vortex control dampers and the operation of one or more exhaust fans. Individual filter units treat the exhaust from miscellaneous areas of the Auxiliary Building prior to discharge via the main exhaust fans. See figures 3-41 and 3-42.

Each supply and exhaust fan may be manually started and stopped from the Control Room. System variables pertaining to normal operation are indicated on the main control room panel. Abnormal conditions, such as high temperature, low temperature, low building differential pressure, and high pressure drop across filters are annunciated either locally or on the main control room panel.

During periods of very cold weather, the Auxiliary Building Ventilation system may be secured to prevent freezing conditions in the Auxiliary and Fuel Handling Buildings. Compensatory measures are taken to ensure potential spread of radioactive material from contaminated areas to non-contaminated areas is identified and controlled. With no exhaust airflow through the vent stack, the ODCM requirements and Radiation Protection Procedures for radioactivity sampling will be followed to ensure appropriate quantification of effluent releases.

3.10.3.2.3 Design Features Important to the Defueled Condition

Neither the Fuel Handling Accident in the Fuel Building nor the Radioactive Waste Handling Event credit ventilation or filtration to prevent or mitigate the consequences of the accidents (see Chapter 5). The Auxiliary Building Ventilation System does provide an ALARA function and facilitates sampling and analyses of gaseous effluents. The components Important to the Defueled Condition required to ensure these functions are met are:

- Auxiliary Building Ventilation system supply and exhaust fans (as required)
- Auxiliary Building Ventilation system exhaust fan inlet vortex dampers (as required)
- Auxiliary Building Ventilation system exhaust HEPA filter banks
- Auxiliary Building Vent Stack effluent monitor (see Chapter 4)

3.10.3.3 Containment Purge

3.10.3.3.1 Design Bases

The Containment Purge system is designed to maintain acceptable environmental conditions in the Containment Buildings for personnel access and to prevent the spread of radioactivity from the Containment in the event of high Containment activity.

3.10.3.3.2 Normal Operation

The Containment Purge System, when required, supplies filtered, conditioned air to the Containment and exhausts filtered air back outside. It also has the capability to operate in a vacuum or pressure relief mode to handle normal pressure changes in Containment which result from Containment air temperature changes, barometric pressure changes, etc.

The supply and exhaust lines for the Containment Purge system each pass through two butterfly valves that are normally closed. A debris screen is installed in the opening of the supply and exhaust line to prohibit foreign material from entering the line and preventing the butterfly valves from closing. These valves are interlocked with the radiation monitoring system such that they will automatically close upon a high containment activity. The exhaust air passes through a HEPA filter bank.

The vacuum and pressure relief system consists of a line penetrating the Containment with two butterfly valves that are normally closed. Debris screens are installed in the line to prohibit foreign material from entering the line and preventing the butterfly valves from closing. These valves are interlocked with the radiation monitoring system such that they will automatically close upon a high containment activity.

See figures 3-43 and 3-44.

3.10.3.3.3 Design Features Important to the Defueled Condition

The Containment Purge system is associated with maintaining exposures ALARA and with personnel comfort and habitability. The features deemed Important to the Defueled Condition for these functions during venting/purging operations are:

- Containment Purge supply and exhaust butterfly valves
- Vacuum and pressure relief butterfly valves
- Debris screens
- Purge exhaust HEPA filter bank
- Interlocks with Containment SPING Air Monitor (see Chapter 4)

3.10.3.4 Auxiliary Ventilation Systems

The auxiliary ventilation systems are those ventilation systems that are operated to facilitate the general maintenance of the facility and whose function is deemed not to be ITDC. These ventilation systems circulate air for personnel comfort in the summer months, and in conjunction with the heating system, provide freeze protection in the winter months. Without the auxiliary ventilation systems in service, these same functions could be performed using portable fans and heaters. The auxiliary ventilation systems are comprised of the following:

- Main Turbine Building Ventilation System,
- Crib House Ventilation System,
- Portions of the Containment Ventilation System (not described as ITDC in section 3.10.3.3),
- Portions of the Auxiliary Building Ventilation System (not described as ITDC in section 3.10.3.2),
- Computer and Miscellaneous Equipment Room Ventilation System, and
- Diesel Generator Building Ventilation Systems.

3.10.4 Fire Protection System

Zion Station utilizes the defense-in-depth concept, placing special emphasis on detection and suppression in order to minimize radiological releases to the environment. This system is, therefore, considered Important to the Defueled Condition. A detailed description of the plant's Fire Protection System is contained in the Fire Protection Report.

3.10.5 Operating Control Stations

3.10.5.1 General Layout

The operating control stations consist of the Main Control Room for centralized control of the facility during defueled operations; and local stations for normal operation of the Radioactive Waste System and miscellaneous noncritical systems.

3.10.5.2 Design Basis

3.10.5.2.1 Control Room Design

The facility is equipped with a Control Room which contains controls and instrumentation for centralized operation of the facility and is occupied by qualified operating personnel.

The main control panels for the facility are totally enclosed walk-in panels, which are located in the Main Control Room. The front portion of each main panel is a duplex bench board which contains the operating controls. The rear portion consists of instrument racks containing power supplies, amplifiers, relays, etc., for the radiation monitoring and miscellaneous facility control systems. The front operating bench boards contain controls for the Component Cooling Water system and the Service Water system. The 345-kV switchyard controls are located on a vertical panel near the center of the Main Control Room. Heating, Ventilating, and Air Conditioning controls are on a vertical panel near the center of the Main Control Room. A separate general services panel, also located near the center of the Main Control Room, contains controls for the Fire Protection System.

The primary objectives in the Control Room layout are to provide the necessary controls to operate the facility with sufficient information and alarm monitoring provided, thus ensuring safe and reliable operation under defueled conditions. Deviations from predetermined conditions will be alarmed, so the operator may take corrective action.

3.10.5.2.2 Annunciator and Audible Alarm System

A visual annunciator system with audible signals is provided to alert the operator to off-normal conditions requiring corrective action. Audible alarms will be sounded in appropriate areas throughout the facility if high radiation conditions are present.

3.10.5.2.3 Radwaste System Control Panels

The liquid and solid radwaste control panels are located in the Auxiliary Building. These panels contain all the controls and instruments to control and monitor the Radioactive Liquid and Solid Waste Disposal Systems.

3.10.5.2.4 Miscellaneous Local Control Panels

Miscellaneous noncritical systems are controlled from local panels and control stations throughout the facility. Off-normal conditions on systems controlled from local panels are alarmed on the local panel annunciators.

3.10.5.2.5 Design Features Important to the Defueled Condition

The controls, instrumentation, annunciators, and alarms associated with the equipment identified as Important to the Defueled Condition for the storage and control of spent fuel in a safe condition, for the handling of radioactive waste, and for monitoring and controlling radiological effluent release paths is considered Important to the Defueled Condition.

3.10.6 Lighting Systems

Normal lighting for the facility is energized from the 480 V switchgear buses.

Stand-by lighting is also provided to supplement lighting in essential equipment areas and fire routes. These lighting units are each equipped with dual lamps and a battery. The lighting units are plugged into convenience outlets and turn on automatically if power to the receptacle fails.

DC emergency lighting is provided in the Control Room, at stairwells, and at points leading to the facility exits. These fixtures are energized from the 125 V batteries only when the AC lighting fails.

DC lighting is provided on doors exiting from the facility and on doors leading to the facility exits. Each is equipped with a battery and battery charger arrangement.

Lighting required per the Fire Protection Report is considered Important to the Defueled Condition.

3.10.7 Communications System

Normal and emergency communication systems are described in the Zion Annex of the Generating Stations Emergency Plan. These systems include those required to contact external emergency management agencies, officials and other government entities, and the general public. The communication systems relied upon per the Zion Annex of the Generating Stations Emergency Plan is, therefore, considered Important to the Defueled Condition.

3.11 Electrical Systems

3.11.1 Design Basis

The Electrical Power System to the station is designed to distribute electrical power to structures, systems, and components (SSCs) important to the defueled condition (ITDC) and other SSCs that support other activities that may be conducted at Zion Station.

3.11.2 System Description

3.11.2.1 Offsite Power System

Figure 3-45 shows the physical layout of the 345-kV switchyard and transmission facilities. The figure shows six transmission lines, two system auxiliary transformers and two main power transformer banks terminating on the 345-kV bus consisting of 10 circuit breakers. The transmission lines are installed two lines to a tower and two of these lines leave the switchyard on a separate right-of-way.

The control power for the 345-kV switchyard breakers is supplied by two 125-Vdc feeds (one fed from a Unit 1 battery and the other from a Unit 2 battery). The feeds from each battery establish separate trip circuits for the two trip coils in each breaker in the switchyard.

3.11.2.2 Onsite Power System

3.11.2.2.1 AC Power Systems

The Auxiliary Power System provides a reliable source of power to structures, systems, and components (SSCs) important to the defueled condition (ITDC) and other SSCs that support other activities that may be conducted at Zion Station.

The basic arrangement of the plant electrical system is shown on the Single Line Diagram, Figure 3-46 for Unit 1 and Figure 3-47 for Unit 2.

Auxiliary power at 4160 V is provided by the system auxiliary transformer (142 for Unit 1 and 242 for Unit 2). The system auxiliary power transformers are rated at 55MVA (force oil air rating).

3.11.2.2.1.1 4160-V System

Power from the auxiliary transformers is distributed at four main 4160-V switch-groups (buses 142, 143, 144, and 145 for Unit 1 and buses 242, 243, 244, and 245 for Unit 2). Buses 142, 143, and 144 in turn feed 4160-V buses 147, 148, and 149 respectively (buses 242, 243, and 244 feed buses 247, 248, and 249 respectively).

Plant auxiliaries which have large power requirements, such as the Service Water and Component Cooling pumps will be fed directly from 4160-V buses.

3.11.2.2.1.2 480-V System

The smaller plant auxiliaries are supplied from the 480-V unit substations which in turn derive their power from the main 4160-V buses.

The 480-V unit substation transformers are rated 1500 kVA, 4160 V, delta 480/277 V, wye, 3-phase. The 480-V switchgear is the draw-out type.

Motor control centers are fed from the 480-V unit substation load breakers and are strategically located throughout the Station. There are no motor control centers located within the Reactor Containment Building. The 480-V motor control centers are equipped with thermal magnetic circuit breakers for nonmotor loads and magnetic breakers and starters with thermal overload protection for the motor loads.

The 480-V switchgear and motor control centers are metal-enclosed. They are provided with grounding and have the mechanical safeguards necessary to assure personnel protection and prevent or limit equipment damage during system fault or overload conditions.

3.11.2.2.1.3 120-Vac Instrument and Control Power System

The general instrumentation and control power at 120 Vac can be obtained from instrument inverters or 480- to 120-Vac, dry-type transformers and associated circuit breaker distribution panels which are an integral part of the 480-V system motor control centers. Motor starter control power is obtained from individual control power transformers associated with each motor control center motor starter.

3.11.2.2.1.4 Cable Derating

The allowable current carrying capacities (ampacities) for the various power cables and control cables (where applicable) were computed using Reference 11 such that the specific ampacity for each size cable was determined by applying the appropriate derating factor (0.6 for 25-42 conductors) from Table VIII, in accordance with note 3 (page V), to the ampacity of the identical cable in isolated conduit in air (as shown on pages 264 and 313), thus obtaining the ampacity for cables in solid metal trays without maintaining spacing.

3.11.2.2.1.5 Cable Tray Loading

The quantity of cable in any cable tray (power, control, or instrumentation) will not exceed the number determined by the most limiting restriction of the following three restrictions:

1. Conductor Temperature (Heat Generation)

   The conductor temperatures are held within the cable rating by assigning conductor ampacities which include the effect of appropriate derating factors as described in Section 3.11.2.2.1.4. The maximum number of conductors allowed by this restriction is dictated by the derating factor selected (e.g., a derating factor of 0.6 limits the maximum number of conductors to 42, whereas a derating factor of 0.5 allows an additional amount of conductors).

2. Tray Capacity

   The depth of cable fill should not exceed the depth of the tray. Evaluations for cable trays with cables above the top of the side rails should be documented and approved.

3. Structural (Load Bearing) Capacity of Trays and Supports

   The trays were designed to carry a distributed load of 40 pounds per square foot, plus a 200-pound man (concentrated load) located in the middle of an 8-foot span, with total deflections not to exceed $^1/_2$ inches. Tests were performed and documented by the tray vendor to confirm the adequacy of the cable tray design.

   The total loading, when the installation is complete, will not exceed the allowable stress for the materials used under either the static or seismic loading conditions.

Of the above three restrictions, the limiting restriction depends on the conditions of the particular tray. For example, the loading of a power tray containing only small (e.g., 1-inch-diameter) cables would normally be limited by the conductor temperature restraint; whereas the loading of a power tray containing only large (e.g., 3-inch-diameter) cables would normally be limited by the tray capacity restraint. The structural capacity restraint is seldom limiting in the final design because this restraint can usually be relieved by installing additional supports.

The loading of control and instrument cable trays is almost always limited by the tray capacity restraint because these conductors are normally used in circuits where the currents to be carried are far below the actual ampacity rating of the conductors.

3.11.2.2.1.6 Reliability of Power Supplies

Power to all ITDC related 4160 Vac and 480 Vac equipment is from the following three sources:

1. A normal source from the system auxiliary transformer via buses 142, 143, 144, and 145 for Unit 1 and buses 242, 243, 244, and 245 for Unit 2. Buses 142, 143, and 144 normally supply buses 147, 148, and 149 respectively and buses 242, 243, and 244 normally supply buses 247, 248, and 249 respectively,

2. A reserve source of offsite generated power from the opposite unit's system auxiliary transformer via bus 241 for Unit 1 buses 147, 148, and 149 and bus 141 for Unit 2 buses 247, 248, and 249. Tie buses and manually controlled circuit breakers are permanently installed for this connection,

3. A standby source from onsite diesel generators feeding buses 147, 148, and 149 for Unit 1 and buses 247, 248, and 249 for Unit 2.

Electrical interlocks consisting of mechanically actuated auxiliary breaker position switches associated with the reserve power source and standby power source feed circuit breakers are provided in the breaker close circuitry. These interlocks prevent an operator from closing both the reserve source and standby source feed breakers for each bus, which if not prevented, could result in paralleling the standby and reserve power sources.

The Onsite AC power system has the capability to permit the energization of the Spent Fuel Pool pumps from an alternate power source under prolonged complete loss of offsite power.

3.11.2.2.2 DC Power Systems

3.11.2.2.2.1 125-Vdc Power System

Each unit is provided with two sources of 125-Vdc power (each with its own battery, battery charger and distribution bus), plus a fifth physically separate and electrically isolated source of 125-Vdc power. Figure 3-48 shows (in one-line form) that this fifth 125-Vdc source (Battery 011) supplies dc power to two 125-Vdc distribution buses (011-1 for division 17 Unit 1 loads and 011-2 for division 27 Unit 2 loads).

The five batteries are each housed in separately ventilated rooms within the Auxiliary Building and are provided with reinforced battery racks. Separate ventilating (exhaust) ducts are provided for each Battery Room (111, 112, 211, and 212). Each duct rises more than 10 feet vertically (and independently) above the battery room ceiling (a path distance of at least 20 feet between the Battery Rooms) where they join a common duct to the suction plenum for two full-capacity redundant exhaust fans. Thus adequate ventilation is provided for each Battery Room at all times. The ventilation of Battery Room 011 is accomplished via independent ducts and exhaust fans. The battery room ventilation is supplied from the Computer and Miscellaneous Equipment Room Ventilation (OV) system. This ventilation feature is not considered important to the defueled condition since portable fans and heaters can perform the heating and cooling functions and can also keep the hydrogen gas produced by the batteries below explosive limits.

The DC System is seismically qualified for the Design Basis Earthquake (DBE). The qualification reports for the battery cells, racks, chargers, and the dc distribution panels and cabinets are contained in References 4 through 10, respectively.

The DC System at Zion is designed to allow the cross-tying of dc buses between units. The tie between buses 111 and 211, buses 112 and 212 (dc buses for Unit 1 and Unit 2), and buses 111 to 011-2, battery 011, 011-1 to 211, are each provided with two normally open, manually operated air circuit breakers mechanically interlocked with a key lock.

During normal operation, the batteries are kept fully charged by the battery chargers.

The five batteries and associated distribution panels supply the 125-Vdc control power to the switchgear as shown in Table 3-15.

3.11.2.3 Design Features Important to the Defueled Condition

Electrical equipment necessary to perform the following functions is regarded as Important to the Defueled Condition:

1. Adequate power from the switchyard to supply at least one System Auxiliary Transformer (Transformer 142/242) and adequate 4160-V, 480-V, and 120 Vac distribution bus equipment for the following reasons:

    a. Provide power to the Fuel Handling system as discussed in section 3.9.3
    b. Provide power to the Spent Fuel Pool Cooling system as discussed in section 3.9.4
    c. Provide power to the Component Cooling system as discussed in section 3.10.1
    d. Provide power to the Service Water system as discussed in section 3.10.2
    e. Provide power to the Auxiliary Building Ventilation system as discussed in section 3.10.3.2
    f. Provide power to the Containment Purge system equipment as discussed in section 3.10.3.3
    g. Provide power to the Liquid Radwaste system equipment as discussed in section 4.5.2
    h. Provide power to the Solid Radwaste system equipment as discussed in section 4.5.3
    i. Provide power to the Process Radiation Monitoring equipment as discussed in section 4.6.2
    j. Provide power to the Area Radiation Monitoring equipment as discussed in section 4.6.3

    Note: 480 V to 120 V inverters, to supply instrument power as discussed in section 3.11.2.2.1.3, are not considered ITDC.

2. 125 Vdc distribution bus 111, and its battery, to realign the switchyard.

3.11.3 Fire Protection for Cable Systems

The Zion Station Fire Protection Report provides fire protection information and the effect of postulated fires on plant cable systems.

3.12 References, Section 3.0

1. Spent Fuel Pool Modification for Increased Storage Capacity, Revision 0, dated November 15, 1991

2. Zion Station Calculation No. 22S-0-110S-0060, "Evaluation of the Zion Spent Fuel Pool for an Accident Temperature of 212 Degrees F."

3. November 18, 1996 ComEd Response to NRC Final Report on Spent Fuel Storage Pool Safety Issues.

4. Gould Co. Calculation SO 7-0432124-EQ dated 1-8-71

5. Power Conversion Inc. letter dated 5-25-71 and Gaynes Testing Lab report on Job #7115, dated 3-11-71.

6. General Electric Co. letter dated 2-26-71.

7. General Electric Co. Report #70ICS101, dated 2-18-71.

8. Gould Co. Calculation SO 7-043123-EQS, dated 1-8-71.

9. Gould Co. letter dated June 14, 1971 summarizing results of test performed by TII Testing Lab, Inc., College Point, NY.

10. Gaynes Testing Lab Report #71448A dated November 9, 1971.

11. AIEE/IPCEA Power Cable Ampacities, Volume I – Copper Conductors, (AIEE Publication No. S-135-1, IPCEA Publication No. P-46-426) – 1962.

TABLE 3-1

LIST OF MISSILES FOR WHICH SEISMIC CLASS I STRUCTURES HAVE BEEN DESIGNED

Missile	Item	Length (feet)	Weight (lbs)	Speed (mph)	Impact Area (inches)^2
1	8" Diameter wood pole	12	190	225	50.5
2	2 1/2" Diameter sch 40 pipe	8	46	195	6.5
3	6" Diameter sch 40 pipe	6.7	127	225	34.2
4	8" Diameter sch 40 pipe	7.8	224	225	58
5	10" Diameter sch 40 pipe	8.1	385	225	92
6	12" Diameter sch 40 pipe	8.1	500	225	126
7	4 x 12 FIR	12	115	255	8
8	Automobile		4000	255	20 (ft)^2
9	7 x 9 cross tie	8.5	185	255	63
10	Piece of concrete housing plug and drive shaft out of reactor	6"x12"x12"	75	255	72
11	Plug		11	520 (ft/sec)	5.7
	Shaft	300 (inches)	120	250 (ft/sec)	2.4

TABLE 3-2

ZION AUXILIARY-TURBINE BUILDING
Time-History vs Response Spectrum Analysis
Comparison of Accelerations at Various Elevations

	Y-EXCITATION		X-EXCITATION	
	Acceleration in g		Acceleration in g	
Elev.	Time-History Analysis	Response Spectrum Analysis	Time-History Analysis	Response Spectrum Analysis
580	.1986	.0926	.1780	.0659
592	.2215	.1104	.1838	.0899
617	.2861	.1836	.3256	.1094
630	.3910	.2171	.3893	.1142
642	.4792	.2627	.4467	.1649
642	.5116	.2238	.5393	.2462
651	.4890	.2708	.4539	.1416
651	.4890	.2750	.4539	.1416
666	.4901	.2750	.4670	.1888
666	.8102	.4726	.9804	.2102
712	.2499	.1917	.5486	.2446

TABLE 3-3

SEISMIC CLASS I SYSTEMS AND COMPONENTS

PIPING SYSTEMS

- Component Cooling
- Service Water (partial)
- Liquid Radwaste (partial)
- Fire Water (partial)

COMPONENTS

- Spent fuel pool cooling loop pump, strainers, valves, and piping which are in Seismic Class I structures or concrete
- Spent fuel storage pool, including spent fuel storage racks
- Spent fuel pit bridge and hoist
- Auxiliary & Fuel Building Crane
- Hangers, Supports & Snubbers for Seismic Class I piping systems
- Valves in Seismic Class I piping systems
- Radiation Monitoring (partial)

TABLE 3-4 (1 of 5)

SUMMARY OF CONCRETE AND REINFORCING STEEL STRESSES

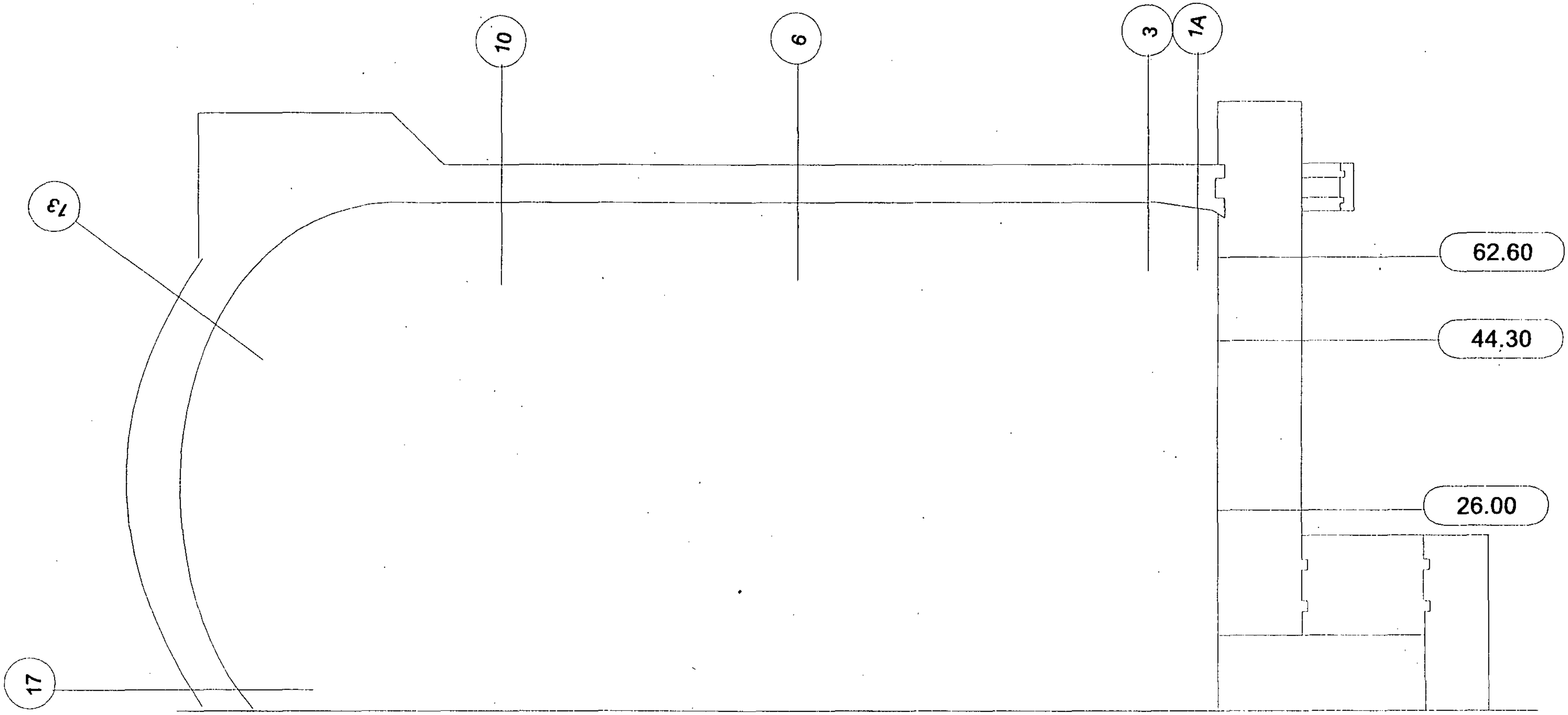


TABLE 3-4 (2 of 5)

STRUCTURAL DATA

Section Location	Concrete f_c'-psi	Concrete t-in	Reinforcing Steel Per Cent p_{mo}	p_{ho}	p_{mi}	p_{hi}
26.00	5000	108	1.66	0.45	0.98	0.32
44.30	5000	108	1.44	0.67	0.61	0.32
62.60	5000	108	1.34	0.58	0.22	0.13
1A	5500	62	0.67	0.88	0.42	0.22
3	5500	42	0.60	0.46	0.21	0.26
6	5500	42	0.27	0.27	-----	-----
10	5500	54	0.53	0.29	0.31	0.24
13	5500	48	0.40	0.23	0.17	0.27
17	5500	33	0.36	0.36	-----	-----

All reinforcing is A-432 steel.
f_y = 60 ksi.

NOTES

1. The load combinations I, II, III and IV are for working stress analysis. The load combinations V, VI and VII are for yield limit analysis.
2. The computed axial stresses σ_{ca} are nominal stresses.
3. The computed fiber stresses σ_{cf} and σ_s are based on a cracked section analysis, if the load case T_A is included in the combination. The fiber stresses σ_{cf} are shown for the inside face unless noted by an asterisk.
4. The steel stresses noted by (**) are nominal stresses, disregarding the concrete tensile capacity.
5. The symbol NA represents "not applicable".

NOTATIONS

D	DEAD LOAD
F	PRESTRESSING FORCE
P	INTERNAL PRESSURE
E	DESIGN BASIS EARTHQUAKE
E'	MAXIMUM CREDIBLE EARTHQUAKE
T_A	ACCIDENT TEMPERATURE
f_c	ULTIMATE CONCRETE STRENGTH
f_y	YIELD STRENGHT OF REINFORCING STEEL
ϕ	CAPACITY REDUCTION FACTOR
t	THICKNESS OF CONCRETE SECTION
p	REINFORCING PERCENTAGE
m	SUBSCRIPT FOR MERIDIONAL DIRECTION
h	SUBSCRIPT FOR HOOP DIRECTION
o	SUBSCRIPT FOR OUTSIDE FACE
i	SUBSCRIPT FOR INSIDE FACE
f	SUBSCRIPT FOR FIBER STRESS
a	SUBSCRIPT FOR AXIAL STRESS
r	SUBSCRIPT FOR RADIAL DIRECTION
f_c	ALLOWABLE CONCRETE STRESS
f_s	ALLOWABLE REINFORCING STEEL STRESS
υ_c	ALLOWABLE NOMINAL CONCRETE SHEAR STRESS (FOR REINFORCED CONCRETE)
υ_s	SHEAR STRESS CARRIED BY THE REINFORCING STEEL
υ	ALLOWABLE CONCRETE SHEAR STRESS INCLUDING SHEAR REINFORCING (IF ANY)
τ	COMPUTED NOMINAL CONCRETE SHEAR STRESS
σ_c	COMPUTED CONCRETE STRESS
σ_s	COMPUTED REINFORCING STEEL STRESS
+	TENSILE STRESS
-	COMPRESSIVE STRESS
f'_s	TENSILE STRENGTH OF PRESTRESSING STEEL
f'_{ci}	INITIAL ULTIMATE CONCRETE STRENGTH

ALLOWABLE STRESS WORKING STRESS DESIGN

CONCRETE Containment	Fiber	f_{cf} = 3300 psi
	Axial	f_{ca} = 1650 psi
	Shear	υ_c = 81 psi
Base Slab	Fiber	f_{cf} = 2250 psi
	Axial	f_{ca} = Not Applicable
	Shear	υ_c = 78 psi
REINFORCING #18 and #14	Flexure	f_s = 20,000 psi
#11 and smaller	Flexure	f_s = 24,000 psi
	Shear	f_s = 20,000 psi
		υ_s varies with the area of reinforcing steel

YIELD LIMIT DESIGN

CONCRETE Containment	Fiber	$f_{cf} = \phi f'_c$ = (0.9) (5500) = 4950
	Axial	$f_{ca} = \phi f'_c$ = (0.85) (5500) = 4670
	Shear	υ_c = (0.85) (148) = 126
Base Slab	Fiber	$f_{cf} = \phi f'_c$ = (0.9) (5000) = 4500
	Axial	$f_{ca} = \phi f'_c$ = (0.85) (5000) = 4250
	Shear	υ_c = (0.85) (141) = 120
Reinforcing Steel	Flexure	$f_s = \phi f_y$ = (0.90) (60,000) = 54,000 psi
	Shear	$f_s = \phi f_y$ = (0.85) (60,000) = 51,000 psi
		υ_s varies with the area of reinforcing steel

TABLE 3-4 (3 of 5)

SECTION	LOAD COMBINATION	CONCRETE COMPUTED σ cmf	σ chf	σ cma	σ cha	τ r	CONCRETE COMP./ALLOWABLE σ cf/f cf	σ ca/f ca	τ/υ	REINFORCING STEEL COMPUTED σ sm	σ sh	REINFORCING STEEL COMP./ALLOWABLE σ sm/f s	σ sh/f s
R = 26.00 ft.	I = D + F + 1.15P	-195	-61			-11.4	0.088		0.146	2,978	1,708	0.149	0.085
	II = D + F + T_A	-415*	-147*			-5.9	0.180		0.075	10,186	5,089	0.509	0.254
	III = D + F + P + T_A	-508	-286			-3.8	0.222		0.049	7,750	7,984	0.387	0.399
	IV = D + F + P + T_A ± E	-889	-410			-14.8	0.392		0.190	13,561	11,449	0.678	0.572
	V = D + F + 1.5P + T_A	-768	-370			-2.6	0.169		0.022	11,717	10,335	0.216	0.191
	VI = D + F + 1.25P + T_A ± 1.25E	-1,113	-483			-16.8	0.246		0.140	16,985	13,504	0.341	0.249
	VII = D + F + P + T_A ± E'	-1,270	-534			-25.5	0.281		0.212	19,372	14,915	0.379	0.275
R = 44.30 ft.	I = D + F + 1.15P	-356	-262	NOT APPLICABLE	NOT APPLICABLE	-16.6	0.156	NOT APPLICABLE	0.213	5,406	5,792	0.270	0.289
	II = D + F + T_A	-453	-142*			-35.0	0.199		0.449	6,885	5,198	0.344	0.259
	III = D + F + P + T_A	-709	-512			-4.4	0.312		0.057	10,781	11,341	0.539	0.567
	IV = D + F + P + T_A ± E	-1,121	-818			-11.9	0.496		0.153	17,047	18,102	0.852	0.905
	V = D + F + 1.5P + T_A	-838	-677			11.0	0.184		0.092	12,733	14,980	0.234	0.276
	VI = D + F + 1.25P + T_A ± 1.25E	-1,289	-976			12.9	0.285		0.108	19,585	21,607	0.383	0.421
	VII = D + F + P + T_A ± E'	-1,534	-1,124			-19.4	0.340		0.162	23,312	24,862	0.429	0.458
R = 62.60 ft.	I = D + F + 1.15P	-376*	-211			41.2	0.164		0.408	18,347	4,773	0.917	0.238
	II = D + F + T_A	-1,064	-660			-53.4	0.472		0.529	15,111	14,959	0.755	0.748
	III = D + F + P + T_A	-182*	-525			45.7	0.231		0.453	8,897	11,913	0.444	0.595
	IV = D + F + P + T_A ± E	-373*	-679			88.0	0.300		0.871	18,196	15,405	0.909	0.770
	V = D + F + 1.5P + T_A	-826*	-458			95.2	0.182		0.532	40,263	10,380	0.744	0.192
	VI = D + F + 1.25P + T_A ± 1.25E	-743*	-684			123.2	0.162		0.689	36,241	15,522	0.670	0.286
	VII = D + F + P + T_A ± E'	-564*	-833			130.5	0.183		0.729	27,495	18,895	0.509	0.371

TABLE 3-4 (4 of 5)

SECTION	LOAD COMBINATION	CONCRETE								REINFORCING STEEL			
		COMPUTED					COMP./ALLOWABLE			COMPUTED		COMP./ALLOWABLE	
		σ cmf	σ chf	σ cma	σ cha	τ r	σ cf/f $_{cf}$	σ ca/f $_{ca}$	τ/υ	σ sm	σ sh	σ sm/f $_{s}$	σ sh/f $_{s}$
1A	I = D + F + 1.15P	-1,024*	-285*	-178	-240	-60	0.310	0.145	0.741	12,895	2,183	0.645	0.109
	II = D + F + T_A	-1,897	-947	-466	52	159	0.575	0.288	0.640	11,594	19,923	0.579	0.996
	III = D + F + P + T_A	-413	-727	-165	-77	-4	0.218	0.100	0.049	784	8,294	0.039	0.414
	IV = D + F + P + T_A ± E	-652	-727	-297	-77	-4	0.218	0.180	0.049	691	8,294	0.034	0.414
	V = D + F + 1.5P + T_A	-1,286*	-524	-14	-142	-85	0.249	0.030	0.675	42,200	4,913	0.780	0.091
	VI = D + F + 1.25P + T_A ± 1.25E	-670*	-628	-255	-109	-45	0.135	0.055	0.357	37,272	6,339	0.680	0.118
	VII = D + F + P + T_A ± E'	-897*	-727	-445	-77	-4	0.181	0.095	0.031	21,357	8,294	0.396	0.154
3	I = D + F + 1.15P	-400*	-364	-218	-358	-43	0.121	0.217	0.316	1,013	4,336	0.050	0.216
	II = D + F + T_A	-2,013	-851	-664	-136	103	0.606	0.400	0.570	4,799	9,185	0.239	0.459
	III = D + F + P + T_A	-848	-650	-202	-94	0	0.254	0.122	0	4,380	7,429	0.219	0.371
	IV = D + F + P + T_A ± E	-1,074	-650	-338	-94	0	0.324	0.205	0	16,767	7,429	0.838	0.371
	V = D + F + 1.5P + T_A	-	-548	29	-73	-51	0.109	0.016	0.405	10,189**	6,574	0.190	0.121
	VI = D + F + 1.25P + T_A ± 1.25E	-853	-599	-319	-83	-26	0.173	0.068	0.206	21,129**	6,997	0.390	0.130
	VII = D + F + P + T_A ± E'	-1,386	-650	-597	-94	0	0.280	0.123	0	34,477	7,429	0.636	0.137
6	I = D + F + 1.15P	-130	-252	-135	-260	0	0.076	0.157	0	-1,805	-3,493	0.090	0.174
	II = D + F + T_A	-1,419	-2457	-581	-1,188	0	0.743	0.720	0	719	-1,253	0.035	0.062
	III = D + F + P + T_A	-493	-911	-118	-307	0	0.276	0.186	0	2,924	2,241	0.146	0.112
	IV = D + F + P + T_A ± E	-720	-911	-216	-307	0	0.276	0.186	0	9,948	2,241	0.497	0.112
	V = D + F + 1.5P + T_A	-538	-	113	134	0	0.109	NA	0	37,665	53,007**	0.696	0.981
	VI = D + F + 1.25P + T_A ± 1.25E	-507	-452	-125	-86	0	0.102	0.026	0	47,658**	4,206	0.882	0.078
	VII = D + F + P + T_A ± E'	-943	-911	-326	-307	0	0.190	0.070	0	32,787	2,241	0.606	0.041

TABLE 3-4 (5 of 5)

SECTION	LOAD COMBINATION	CONCRETE								REINFORCING STEEL			
		COMPUTED					COMP./ALLOWABLE			COMPUTED		COMP./ALLOWABLE	
		σ cmf	σ chf	σ cma	σ cha	τ r	σ cf/f cf	σ ca/f ca	τ/υ	σ sm	σ sh	σ sm/f s	σ sh/f s
10	I = D + F + 1.15P	-88	-139	-53	-140	-20	0.042	0.085	0.139	-247	-1,740	0.012	0.087
	II = D + F + T_A	-1,454	-802	-391	-234	-133	0.440	0.240	0.740	6,940	3,578	0.347	0.179
	III = D + F + P + T_A	-911	-536	-39	-33	-57	0.276	0.023	0.419	17,077	11,373	0.853	0.568
	IV = D + F + P + T_A ± E	-909	-536	-59	-33	-57	0.272	0.035	0.419	19,049	11,373	0.952	0.568
	V = D + F + 1.5P + T_A	-	-	137	67	-20	NA	NA	0.158	24,494**	19,952	0.454	0.370
	VI = D + F + 1.25P + T_A = 1.25E	-752	-499	74	16	-39	0.152	NA	0.350	25,306	18,648	0.467	0.344
	VII = D + F + P + T_A ± E'	-903	-536	-81	-33	-57	0.182	0.017	0.451	21,301	11,373	0.395	0.248
13	I = D + F + 1.15P	-380	-226	-310	-232	9	0.115	0.188	0.060	3,109	2,947	0.155	0.147
	II = D + F + T_A	-1,935	-1,000	-726	-361	104	0.585	0.440	0.580	3,026	2,460	0.151	0.123
	III = D + F + P + T_A	-974	-576	-267	-181	37	0.294	0.161	0.271	4,235	3,994	0.211	0.199
	IV = D + F + P + T_A ± E	-974	-576	-267	-181	37	0.294	0.161	0.271	4,235	3,994	0.211	0.199
	V = D + F + 1.5P + T_A	-555	-518	-34	-88	3	0.112	.018	0.024	10,411	6,635	0.192	0.123
	VI = D + F + 1.25P + T_A = 1.25E	-653	-524	-151	-135	20	0.132	.032	0.158	6,030	4,664	0.111	0.086
	VII = D + F + P + T_A ± E'	-974	-576	-267	-181	37	0.192	.057	0.294	4,235	3,994	0.078	0.074
17	I = D + F + 1.15P	-393*	-527*	-330	-322	32	0.160	0.200	0.382	-5,182	-6,555	0.254	0.327
	II = D + F + T_A	-2,277	-2,266	-1,082	-1,076	0	0.658	0.655	0	-2,167	-2,152	0.108	0.107
	III = D + F + P + T_A	-930	-857	-335	-328	28	0.282	0.203	0.332	1,326	833	0.066	0.041
	IV = D + F + P + T_A ± E	-930	-857	-335	-328	28	0.282	0.203	0.332	1.326	833	0.066	0.041
	V = D + F + 1.5P + T_A	-494	-494	42	50	42	0.098	NA	0.334	26,659	29,289**	0.493	0.542
	VI = D + F + 1.25P + T_A = 1.25E	-524	-424	-148	-140	35	0.106	0.0318	0.278	1,871	964	0.034	0.018
	VII = D + F + P + T_A ± E'	-930	-857	-535	-328	28	0.183	0.072	0.222	1,326	833	0.024	0.016

TABLE 3-5

SEISMIC CLASS I LOAD COMBINATIONS FOR THE FUEL HANDLING AND AUXILIARY BUILDINGS, THE CRIB HOUSE, AND REACTOR BUILDING INTERNAL STRUCTURES

LOAD COMBINATION	DESIGN CRITERIA*
$DL + LL + T_O$	WORKING STRESS
$DL + LL + T_O + W$	1. ACI 318-63
$DL + T_O + E + P'$	2. AISC Manual of Steel Construction (6th Edition)
$DL + T_O + E' + R$	ULTIMATE STRENGTH DESIGN
$DL + T_O + W'$	1. ACI 318-6 USD
$DL + T_O + M$	2. Yield Strength of Steel

DL = dead load & permanent equipment & piping load
LL = live load
T_O = Thermal loading Max. outside 100°F
Min. outside 0°F
Ambient inside 70°F
Fuel Storage Pool 110°F
Refueling Storage Tank 70° to 135°F
E = Design Basis Earthquake
E' = Maximum Credible Earthquake
P' = 14 psi - Reactor internal structures accident internal design
M = Missile impact
R = pipe rupture effect including dynamic effect
W = design wind
W' = maximum credible tornado

NOTE: R as defined above includes both the rupture reaction from restraints and also the effects of jet impingement loading on various structures. The impingement area was considered as a cone dispersing from the break with a central total angle of 20°.

* The slenderness ratio for compression members in ceiling mounted supports for cable trays, conduits and HVAC ductwork is limited to 300.

TABLE 3-6

MAXIMUM SOIL PRESSURES AND ACTUAL FACTORS OF SAFETY
(Horizontal Excitation Only)

Loads	Max. Soil Pressure	Factor of Safety
Permanent Loads (D + F)	7,700 lb/ft^2	5.2
Working Stress (D + F + P + T)	12,500 lb/ft^2	3.2
Yield Limit (D + F + T $\pm$ E')	17,200 lb/ft^2	2.3

where:

D	=	Dead Load
F	=	Appropriate Prestressing Load (varies with time between initial and final prestress loads)
P	=	Design Pressure
T	=	Thermal Loads Based on a Temperature Corresponding to a Pressure P
E'	=	Design Basis Earthquake (DBE) Load

TABLE 3-7

QUALITY ASSURANCE RECORDS TO BE MAINTAINED FOR CONTAINMENT VESSEL

Civil

Concrete cylinder test reports
Concrete design mix reports
Aggregate test reports
Batch plant operation reports
Cement grab sample reports
Mix water chemical analysis
Mill test reports on reinforcing steel
Mill test reports on cadweld sleeve material
Tensile test reports on reinforcing steel
Tensile test reports on cadwelds
Mill test reports on structural steel
Reports of high-strength bolt torque testing
Mill test for high strength bolts
Mill test reports on containment liner and accessories
Inspection logs for channel pressure tests
Documentation for containment vessel pressure test and leak test
Soil compaction test reports
Optimum moisture content reports (soils)

Welding

Weld procedures and procedure qualifications
Welder's qualification papers
Applicable welding specifications
Non-destructive testing procedures
Non-destructive testing records
Weld repair procedures
Weld material analyses records
Heat treatment records

General

Trip reports
Deviation reports
Independent testing service reports
Documentation of design evaluations
Documentation of bid evaluations
Documentation of fabricator and erector quality assurance program evaluations
Documentation of erection procedure evaluations
Documentation of deviation evaluations
Documentation of test procedure evaluations
Documentation of audits

TABLE 3-8

SPENT FUEL POOL COOLING SYSTEM CODE REQUIREMENTS

Spent Fuel Pool Heat Exchanger	(tube side)	ASME III, Class C
	(shell side)	ASME VIII
Spent Fuel Pool Filter		ASME III, Class C
Spent Fuel Pool Piping and Valves		USAS B31.1

TABLE 3-9 (1 of 3)

SPENT FUEL POOL COOLING SYSTEM COMPONENT DESIGN DATA

General		
System cooling capacity, Btu/hr		29.8×10^6
Spent fuel pool volume ft^3		80.0×10^3
SPENT FUEL POOL HEAT EXCHANGER		
Number (shared)		2
Design heat transfer, Btu/hr		14.9×10^6
	Shell	Tube
Design pressure, psig	150	150
Design temperature, °F	200	200
Design flow rate, lb/hr	1.49×10^6	1.14×10^6
Design inlet temperature, °F	95	120
Design outlet temperature, °F	105	106.9
Fluid	Component cooling water	Spent fuel pool water (borated demineralized water)
SPENT FUEL POOL PUMP		
Number (shared)		2
Design pressure, psig		150
Design temperature, °F		200
Design flow rate, gpm		2300
Minimum developed head, ft		125
Temperature of pumped fluid, °F (Nominal)		80 to 180
Fluid		Spent fuel pool water (borated demineralized water)
NPSH, ft		15
Material		Austenitic stainless steel
SPENT FUEL POOL SKIMMER PUMP		
Number (shared)		1
Design pressure, psig		50
Design temperature, °F		200
Design flow rate, gpm		100
Minimum developed head, ft		50
Temperature of pumped fluid, °F (Nominal)		75 to 150
Fluid		Spent fuel pool water
NPSH, ft		15
Material		Austenitic stainless steel

TABLE 3-9 (2 of 3)

SPENT FUEL POOL COOLING SYSTEM COMPONENT DESIGN DATA

SPENT FUEL POOL DEMINERALIZER	
Number (shared)	2
Type	Flushable
Vessel design pressure,	
Internal, psig	200
External, psig	15
Vessel design temperature, °F	250
Design flow rate, gpm Maximum	100
Minimum D/F	10
Normal flow, gpm	100
Normal operating temperature, °F	120
Normal operating pressure, psig	Approximately 50
Resin type	Anion and/or cation
SPENT FUEL POOL FILTER	
Number (shared)	2
Type	Replaceable (Cage Assembly or single element)
Internal design pressure, psig	200
Design temperature, °F	250
Rated flow, gpm	Nom. 100, Max. 150
Filtration requirement	98% retention of particles above 25 micron
SPENT FUEL POOL SKIMMER FILTER	
Number (shared)	1
Type	Replaceable (Cage Assembly or single element)
Internal design pressure, psig	200
Design temperature, °F	250
Rated flow, gpm	100
Filtration requirement	98% retention of particles above 25 micron

TABLE 3-9 (3 of 3)

SPENT FUEL POOL COOLING SYSTEM COMPONENT DESIGN DATA

SPENT FUEL POOL STRAINER	
Number (shared)	2
Design flow, gpm	2300
Filtration size slot spacing, inches	0.2
Fluid	Borated demineralized water
SPENT FUEL POOL SKIMMER STRAINER	
Number (shared)	1
Type	Basket
Rated flow, gpm	100
Design pressure, psi	50
Design temperature, °F	200
Perforation, inch	$^{1}/_{8}$

TABLE 3-10

COMPONENT COOLING SYSTEM CODE REQUIREMENTS

Component Cooling Heat Exchangers	ASME VIII
Component Cooling Surge Tank	ASME VIII
Component Cooling Loop Piping and Valves	USAS B31.1

TABLE 3-11

COMPONENT COOLING SYSTEM NOMINAL FLOW REQUIREMENTS (GPM)

	NORMAL
Spent Fuel Pool Heat Exchangers[1]	3000.(max)
TOTAL	3000.(max)
Number of pumps in service	1
Number of pumps installed	5
Pump capacity (maximum efficiency)	4600 each

NOTES:

1. This item can be removed from service intermittently, dependent upon the amount of fuel in the pool, pool water temperature, and demands of other services.

TABLE 3-12

COMPONENT COOLING SYSTEM COMPONENT DESIGN DATA

Component Cooling Pumps

Number (2 per unit, 1 shared)	5
Type	Horizontal Centrifugal
Rated Capacity, gpm (each)	4600
Rated Head, ft H_2O	200
Motor Horsepower, HP	300
Casing Material	Cast iron
Design Pressure, psig	150
Design Temperature, °F	200

Component Cooling Heat Exchangers

Number (1 per unit, 1 shared)	3	
Type	Shell and Tube	
Heat Transferred (each)	53.0×10^6 Btu/hr	
	Shell Side	Tube Side
Fluid	Component Cooling	Service Water
Water Inlet Temperature, °F	116.2	80
Water Outlet Temperature, °F	92.9	90
Water Flow Rate, lb/hr	2.27×10^6 (1)	5.3×10^6 (1)
Design Temperature, °F	200	200
Design Pressure, psig	150	150
Material	Carbon steel	AL-6XN(2) SB-676

Component Cooling Surge Tank

Number (per unit)	1
Design pressure	
Internal, psig	100
External, psig	14.7
Design Temperature, °F	200
Total Volume, gal.	2000
Normal Water Volume, gal.	1000
Fluid	Component Cooling Water
Material	Carbon steel

(1) CC Heat Exchangers are capable of shell side and tube side flow rates equal to twice the specified flow rates.
(2) The tube material for the # 2 Component Cooling Heat Exchanger is Admiralty Brass (SB-111)

TABLE 3-13

NONDESTRUCTIVE TESTS APPLIED TO SEISMIC CLASS I COMPONENTS
OF THE COMPONENT COOLING SYSTEM
(in addition to those specified by the design code)

Component Cooling Heat Exchanger

1. Magnetic particle inspection of all completed ferromagnetic welds in accordance with Paragraph N-626 of Section III of the ASME Code.

2. Dye penetrant inspection of all completed paramagnetic or nonmagnetic welds in accordance with Paragraph N-627 of Section III of the ASME Code.

3. Tube joint air test (soap bubble).

4. Hydrostatic test in accordance with Section VIII of the ASME Code.

Component Cooling Pump

1. Dye penetrant inspection of machined surfaces of casing in accordance with ASME Boiler & Pressure Vessel (B&PV) Code, Appendix IX.

2. Magnetic particle inspection of casting, cast surfaces only, in accordance with ASME B&PV Code, Appendix IX.

Component Cooling Surge Tank

1. Radiograph in accordance with paragraphs UW-51 & 52 of ASME, B&PV Code, Section VIII.

2. Hydrostatic test at 150 psig. Procedure per Paragraph UG-99 of Section VIII of the ASME B&PV Code.

3. Magnetic particle examination in accordance with Appendix VI of Section VIII of the ASME B&PV Code.

4. Dye penetrant examination in accordance with Appendix VIII of Section VIII of the ASME B&PV Code.

TABLE 3-14

SERVICE WATER SYSTEM FLOW REQUIREMENTS

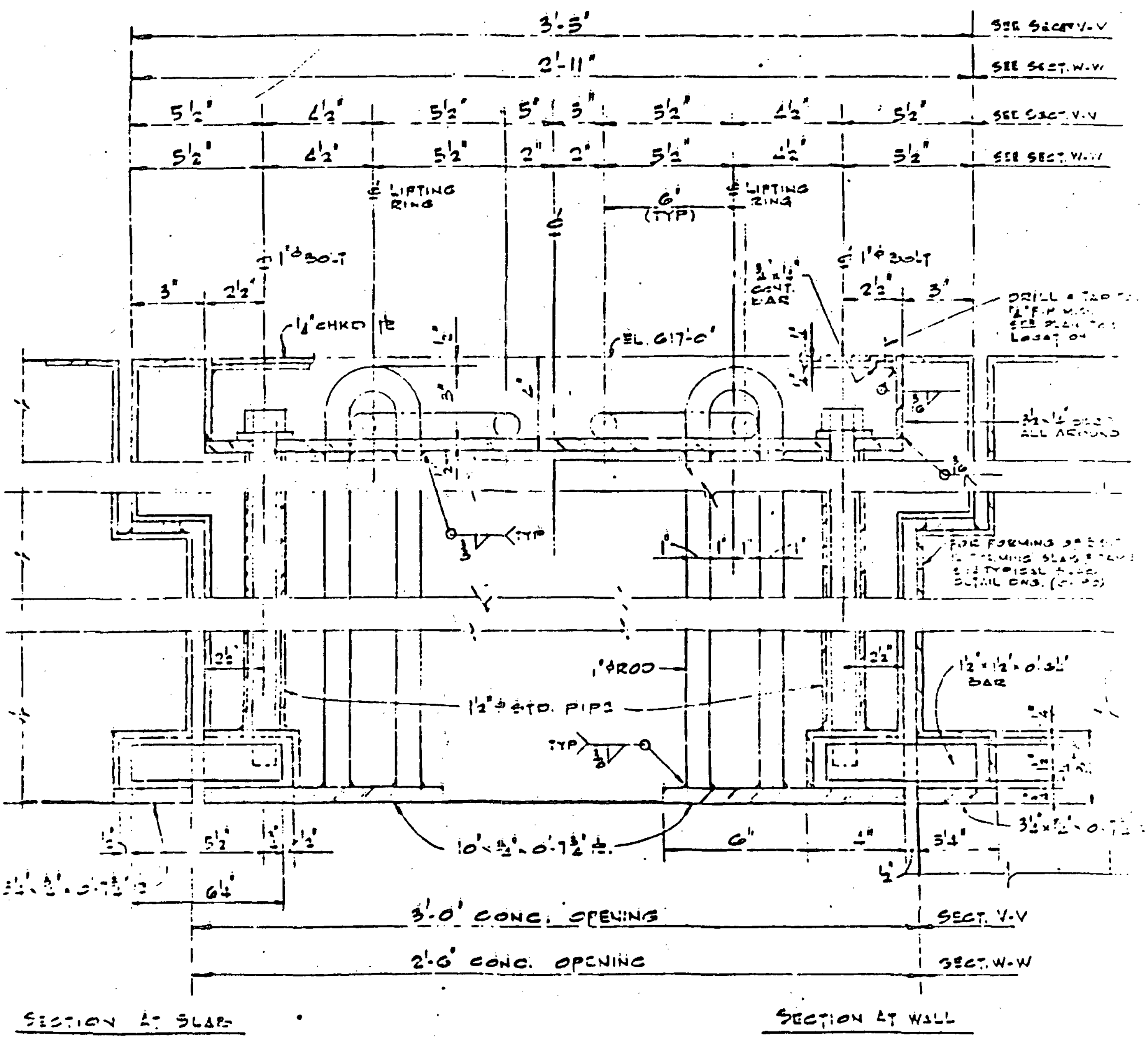
Following is the maximum total plant service water flow (in GPM) required by essential components.

	EQUIPMENT	Flow (gpm)
1.	Component Cooling water heat exchangers (total)	8000
2.	Fire Protection System	3000
3.	Service Water Pump Seals	108
	Total	11,108

TABLE 3-15

AC AND DC POWER DATA

Unit	Battery Number	Distribution Panel No.	4160 V Swgr Buses	480 V Swgr Buses	Division Number
1	111	111	148	138	18
1	112	112	149	139	19
1	011	011-1	147	137	17
2	011	011-2	247	237	27
2	211	211	248	238	28
2	212	212	249	239	29

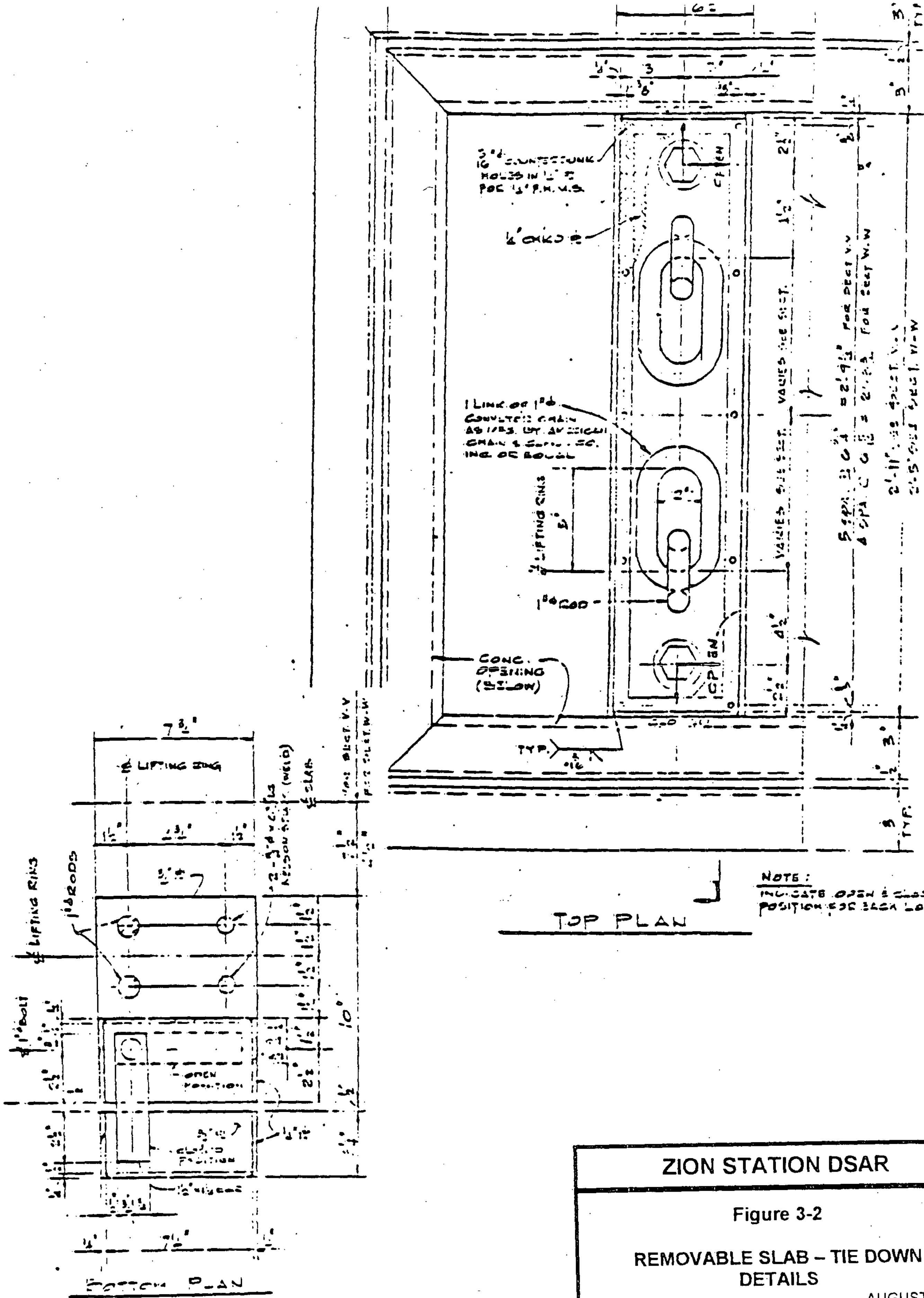


ZION STATION DSAR

Figure 3-1

REMOVABLE SLAB – TIE DOWN DETAILS

AUGUST 1998

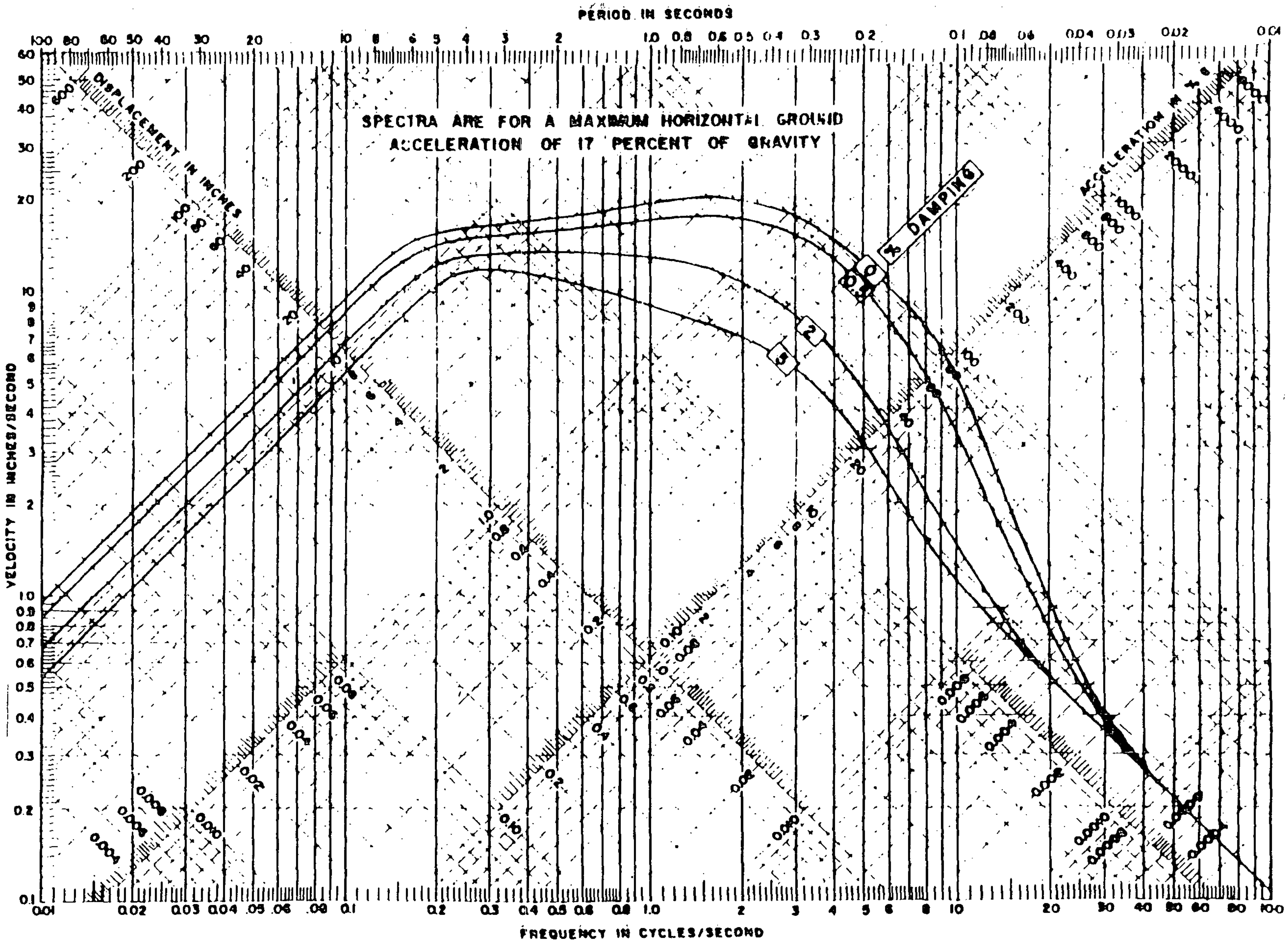


ZION STATION DSAR

Figure 3-2

REMOVABLE SLAB – TIE DOWN DETAILS

AUGUST 1998

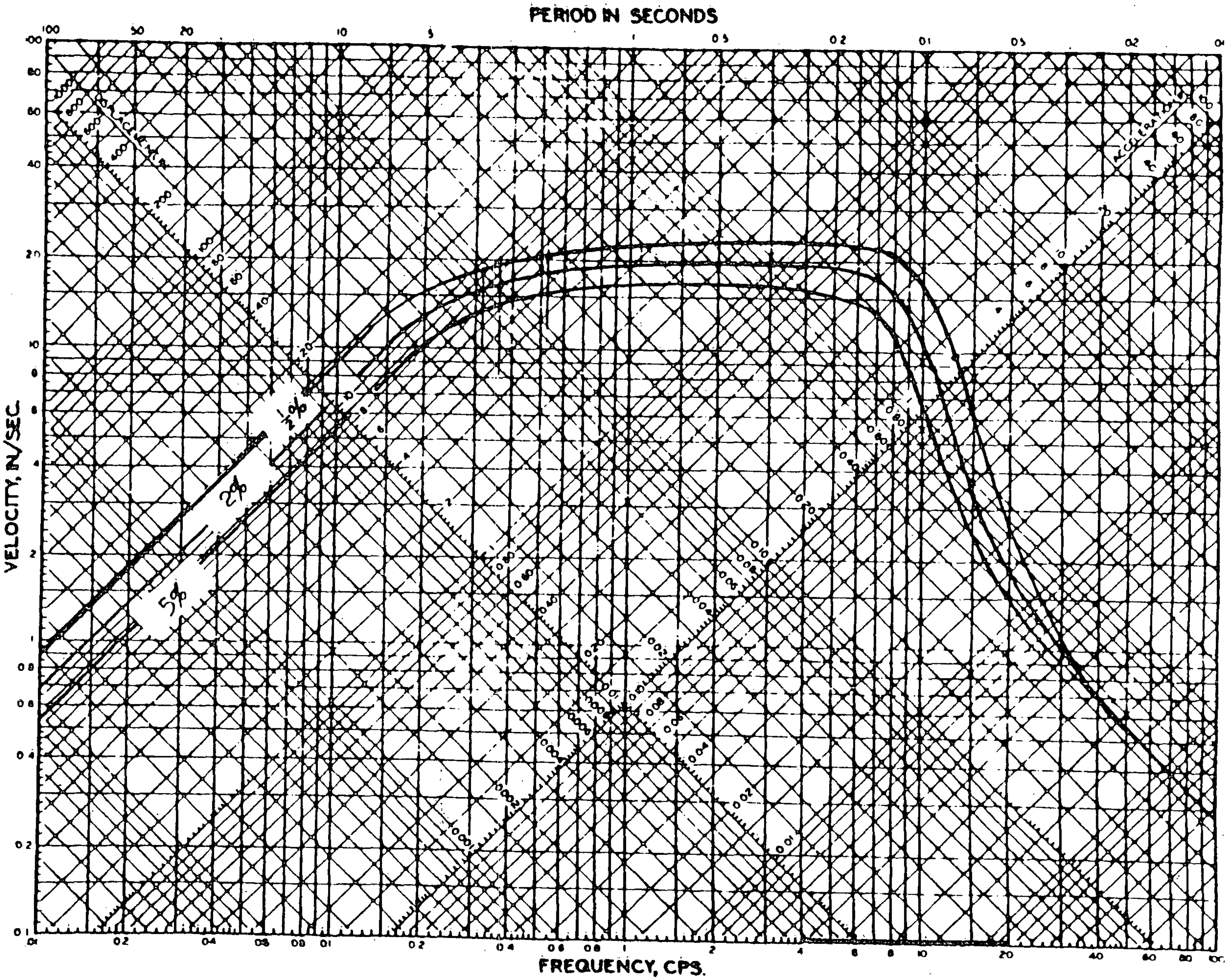


ZION STATION DSAR

Figure 3-3

DESIGN BASIS EARTHQUAKE (DBE)
RESPONSE SPECTRA

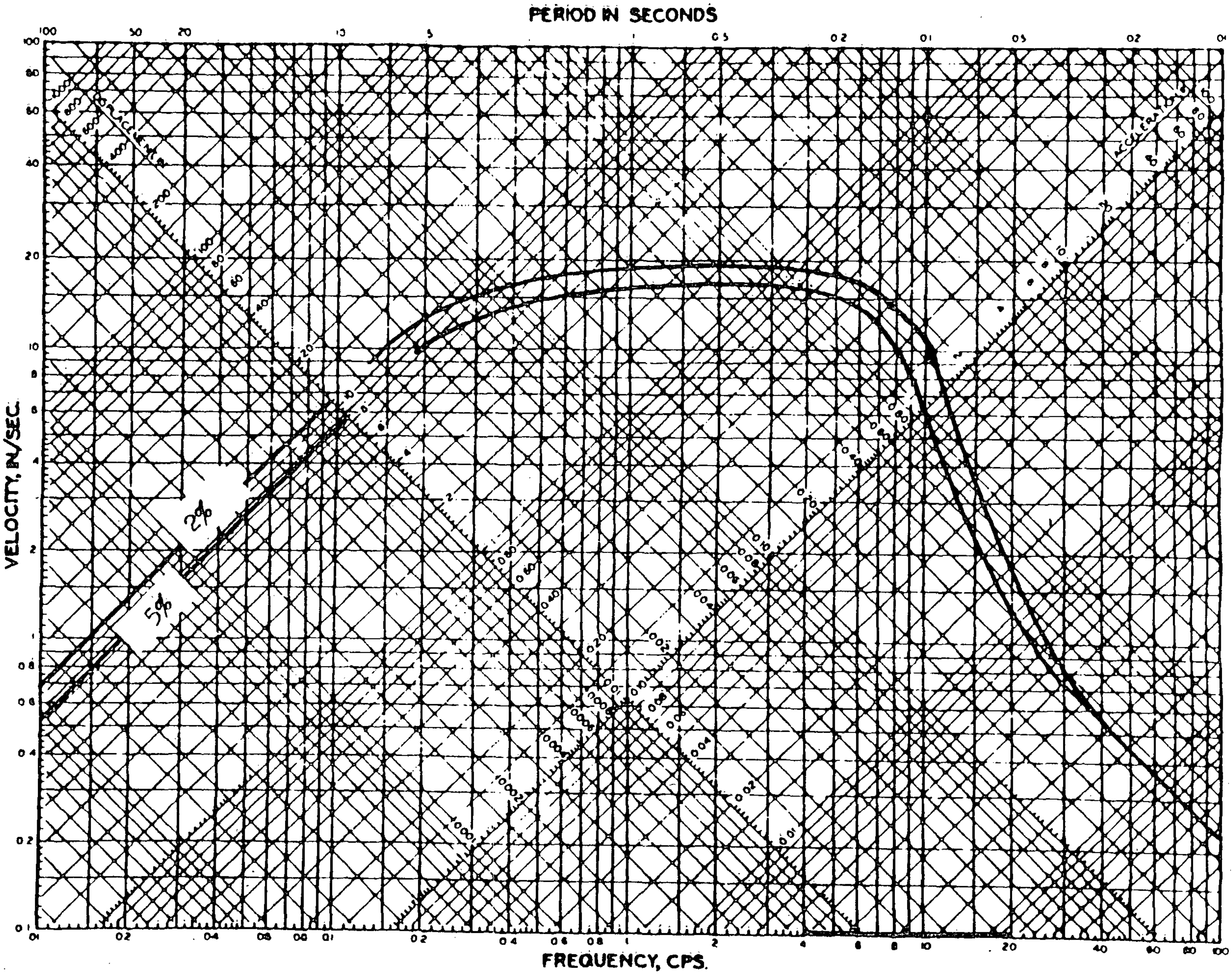
AUGUST 1998



ZION STATION DSAR

Figure 3-4
RESPONSE SPECTRA – DBE ELEVATION
642' AUXILIARY-TURBINE-DIESEL
GENERATOR BUILDING

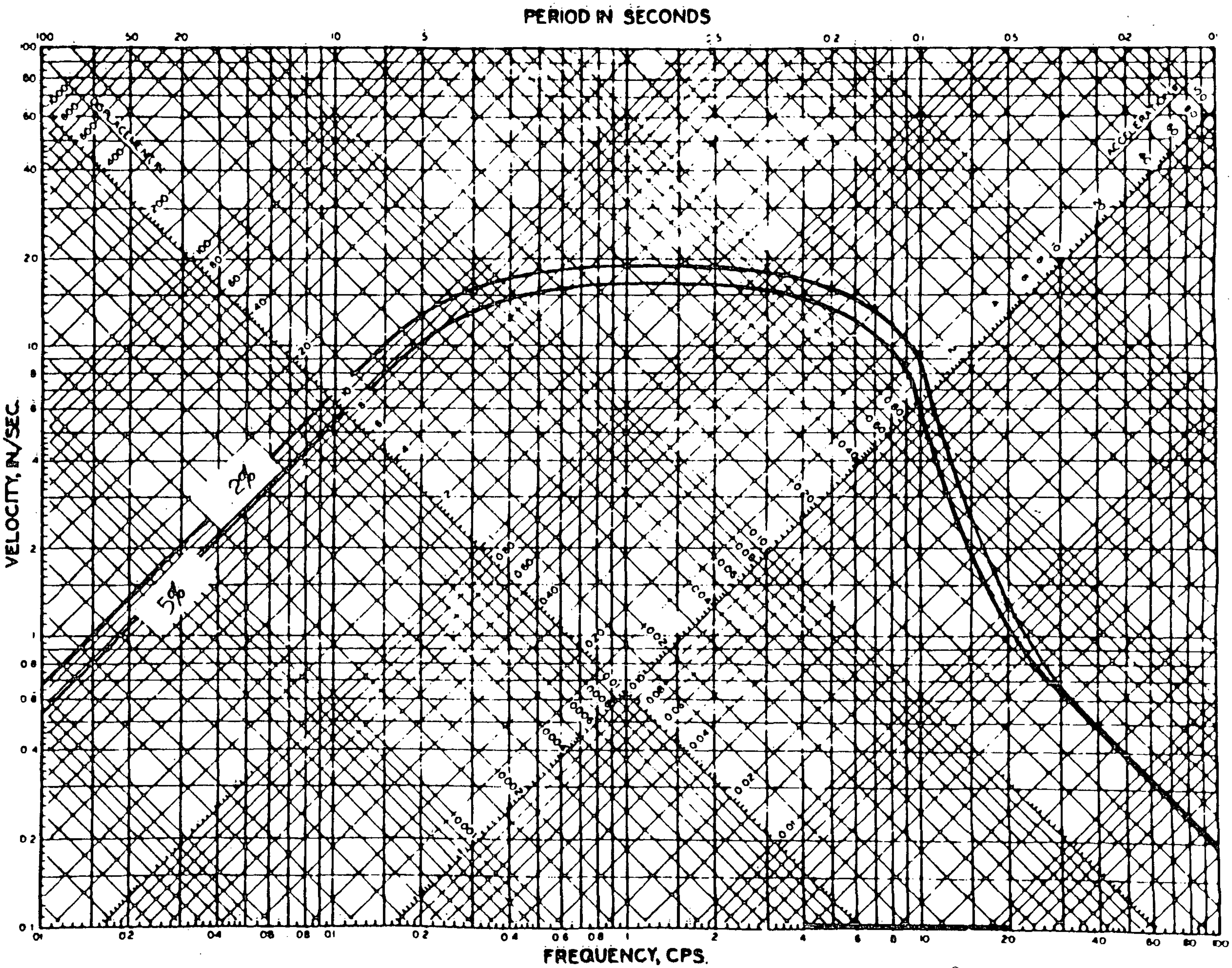
AUGUST 1998



ZION STATION DSAR

Figure 3-5
RESPONSE SPECTRA – DBE ELEVATION
630' AUXILIARY-TURBINE-DIESEL
GENERATOR BUILDING

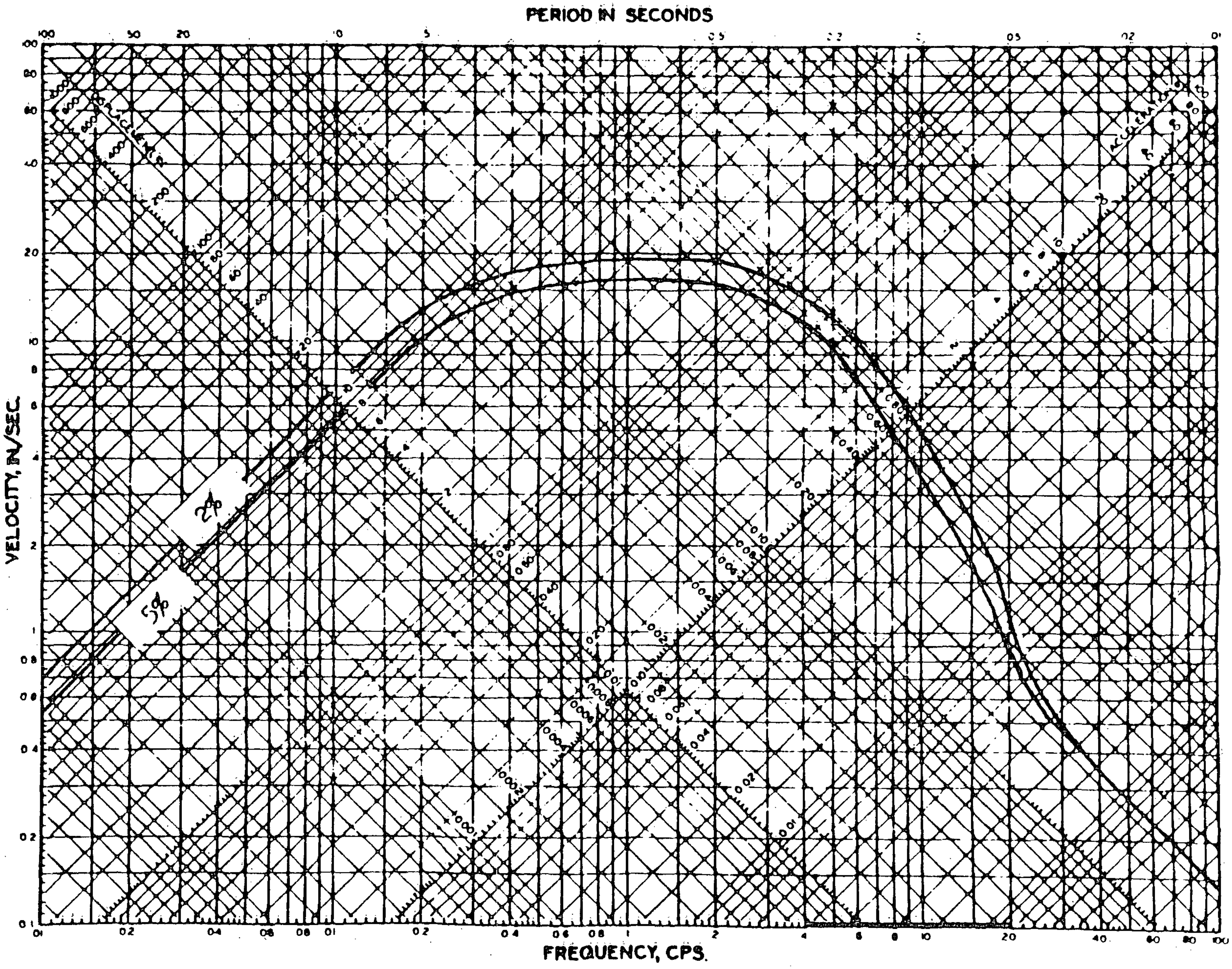
AUGUST 1998



ZION STATION DSAR

Figure 3-6
RESPONSE SPECTRA – DBE ELEVATION
617' AUXILIARY-TURBINE-DIESEL
GENERATOR BUILDING

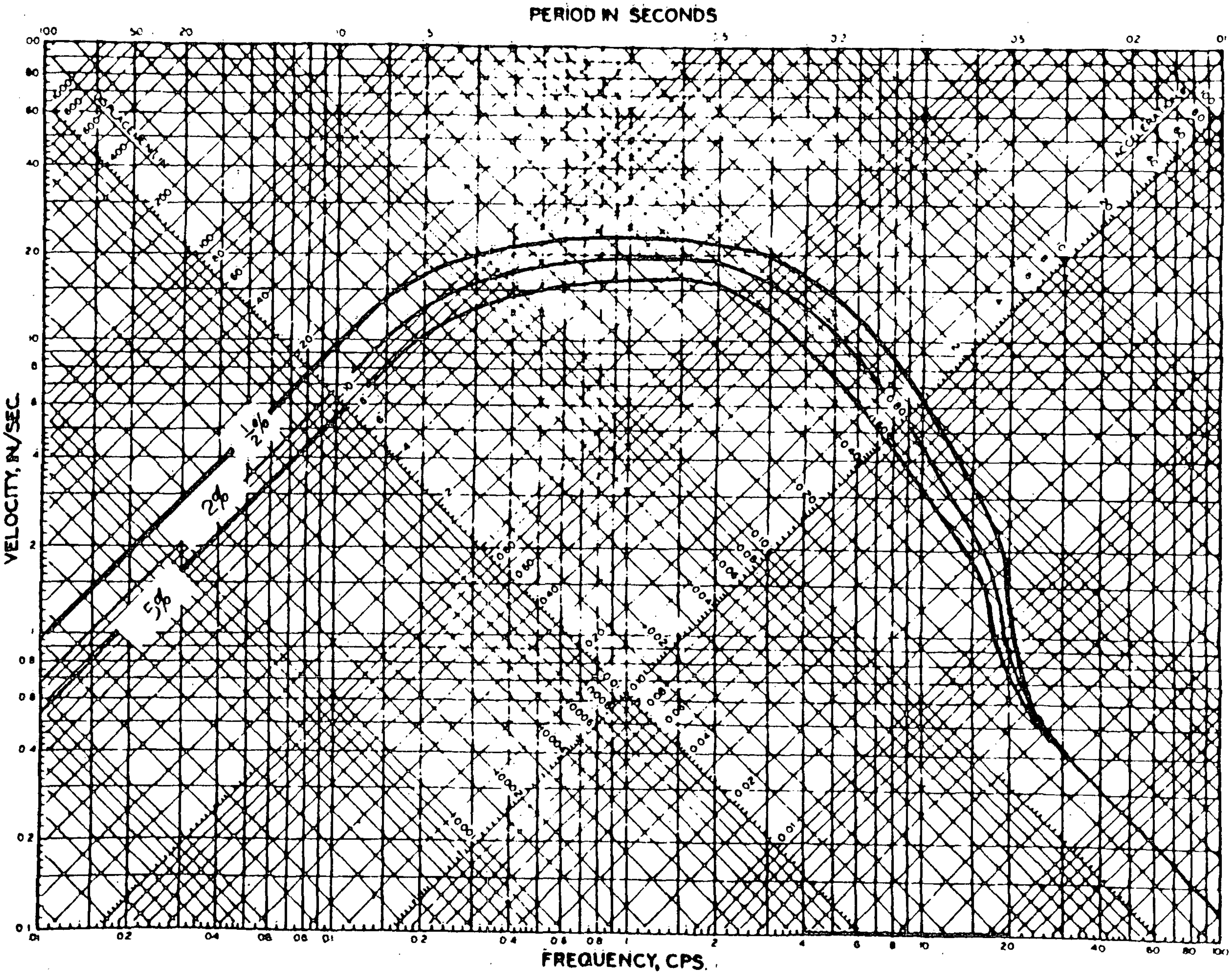
AUGUST 1998



ZION STATION DSAR

Figure 3-7
RESPONSE SPECTRA – DBE ELEVATION
592' AUXILIARY-TURBINE-DIESEL
GENERATOR BUILDING

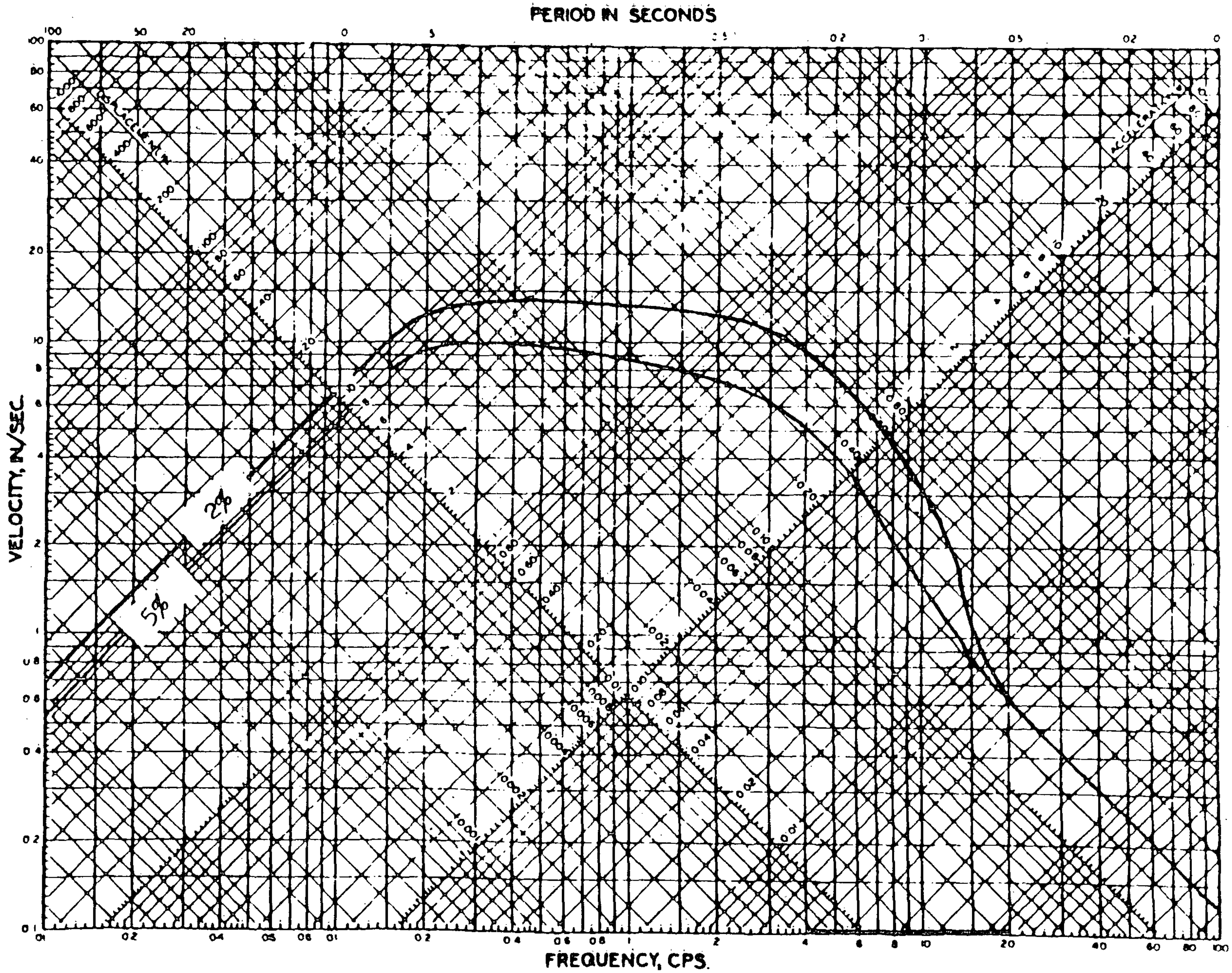
AUGUST 1998



ZION STATION DSAR

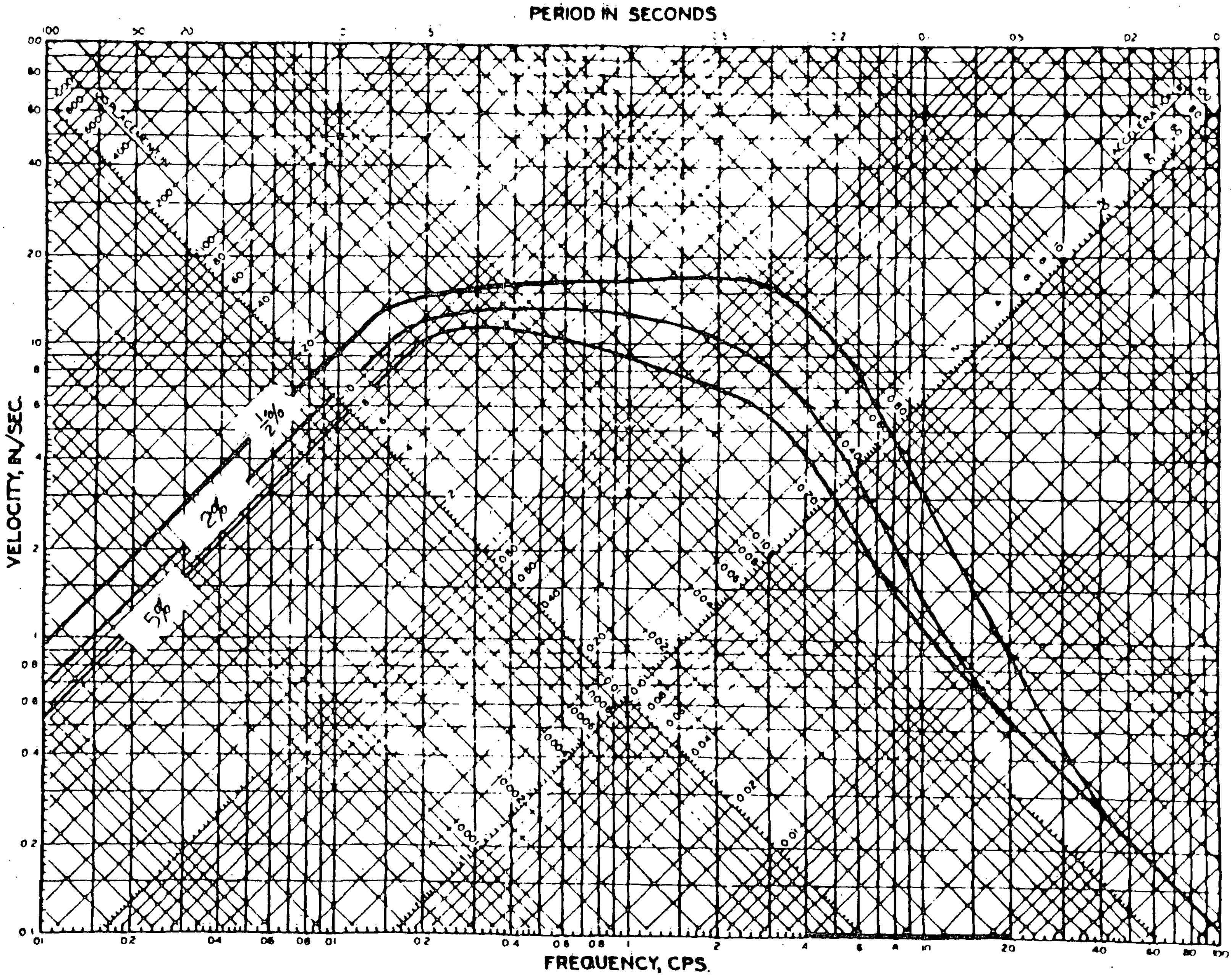
Figure 3-8

RESPONSE SPECTRA – DBE
ELEVATION 580' AUXILIARY BUILDING
AUGUST 1998



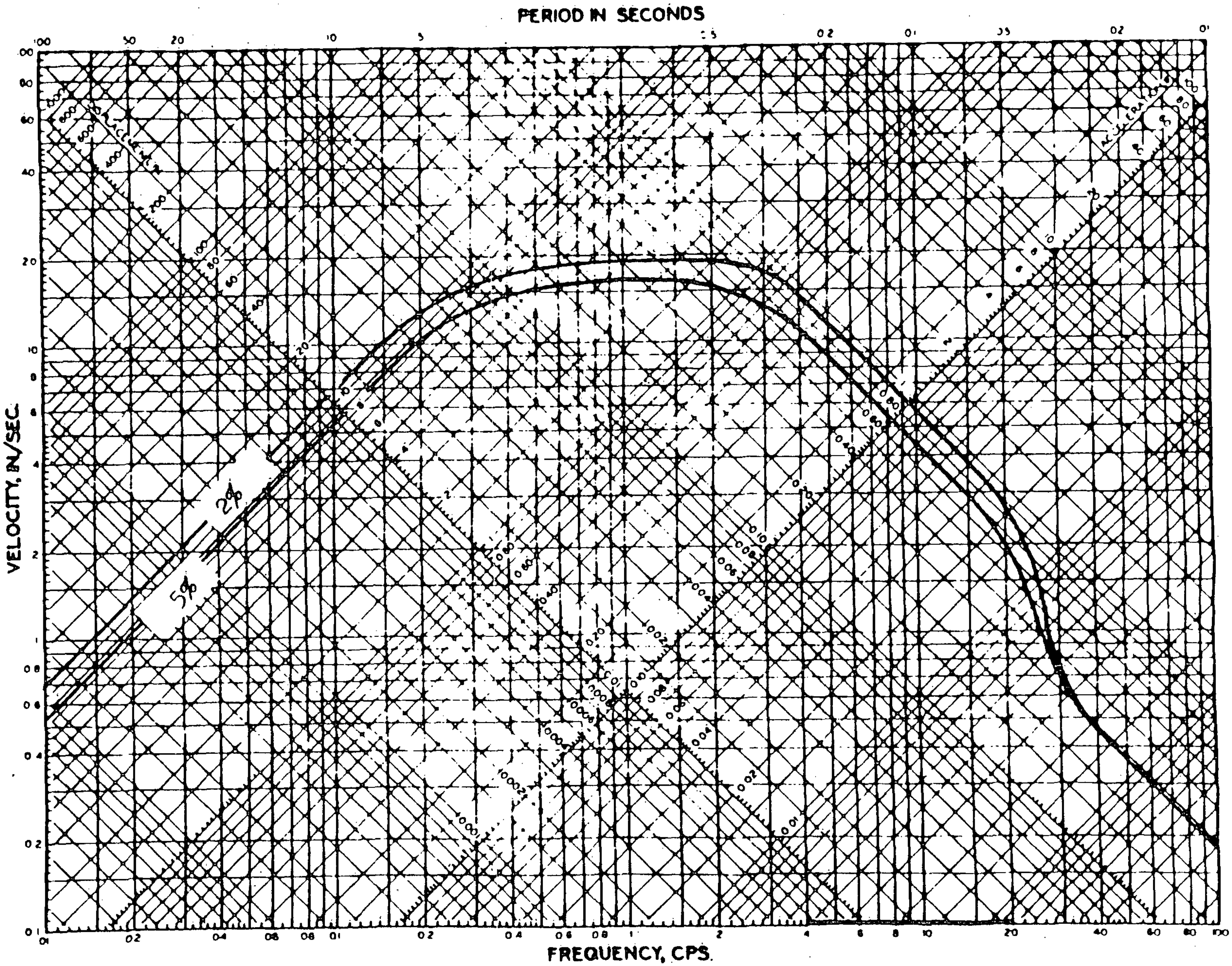
ZION STATION DSAR

Figure 3-9
RESPONSE SPECTRA – DBE ELEVATION
560' AUXILIARY-TURBINE BUILDING
AUGUST 1998



ZION STATION DSAR

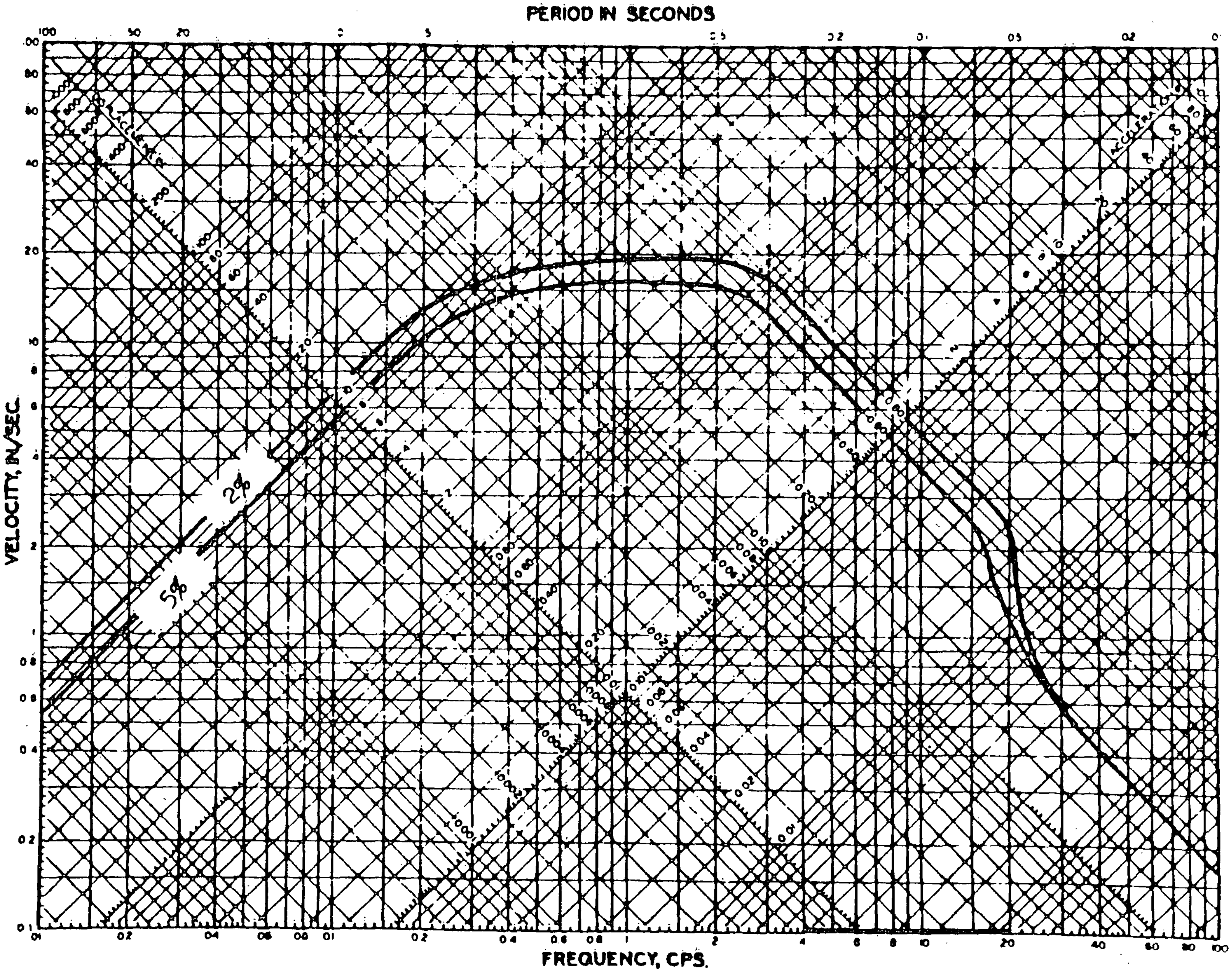
Figure 3-10
RESPONSE SPECTRA – DBE
ELEVATION 542' AUXILIARY BUILDING
AUGUST 1998



ZION STATION DSAR

Figure 3-11
RESPONSE SPECTRA – DBE
ELEVATION 617' FUEL HANDLING
BUILDING

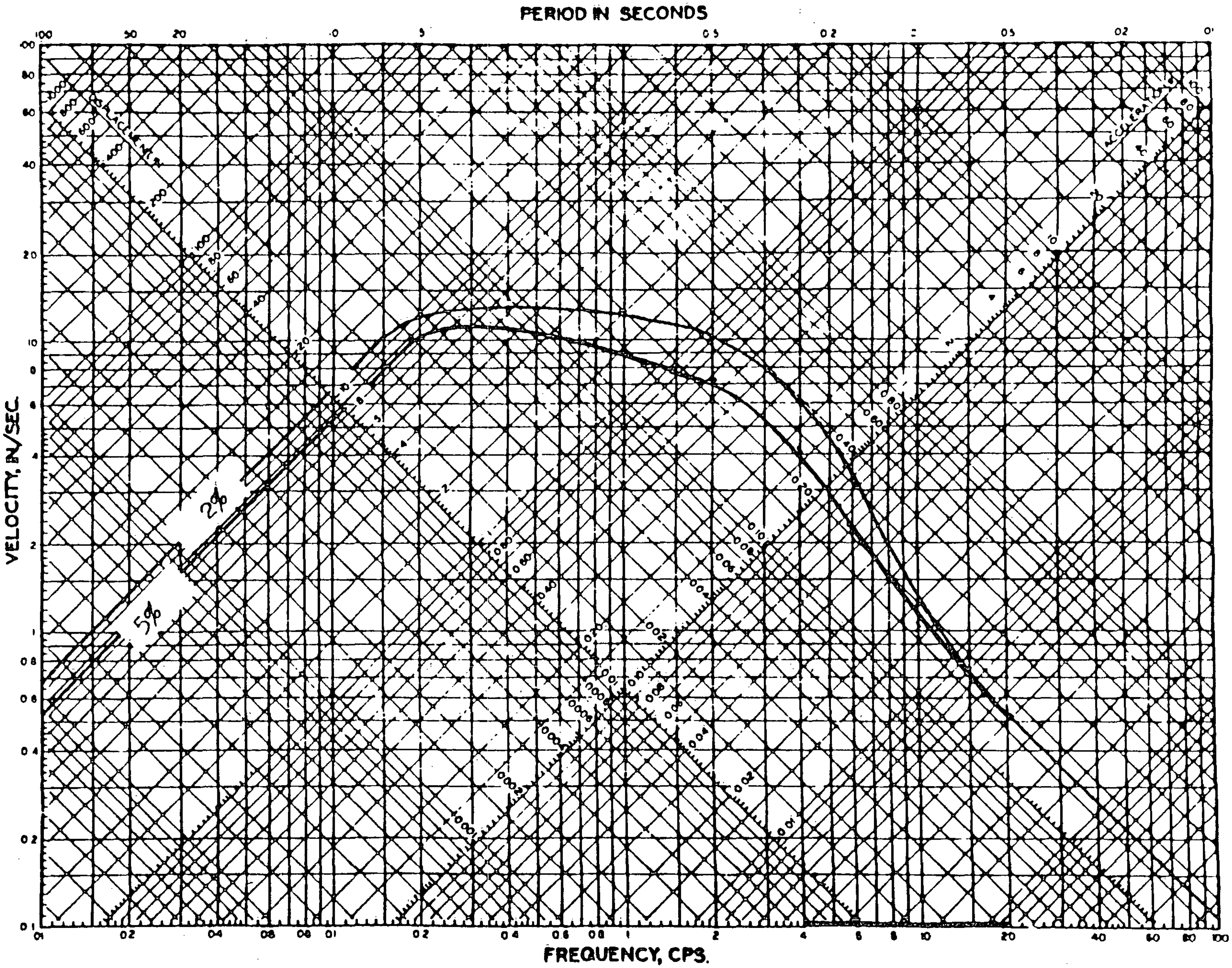
AUGUST 1998



ZION STATION DSAR

Figure 3-12
RESPONSE SPECTRA – DBE
ELEVATION 602' FUEL HANDLING
BUILDING

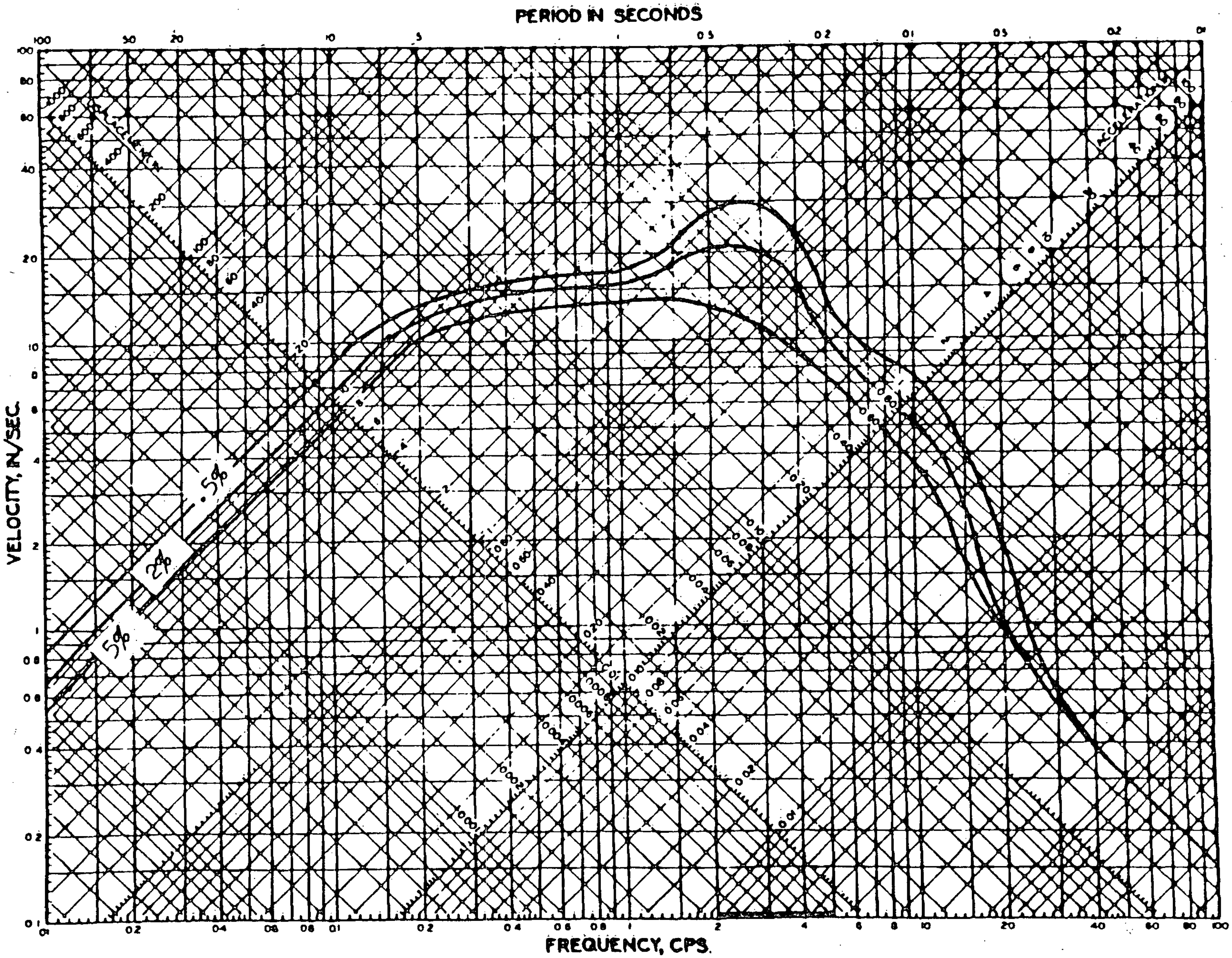
AUGUST 1998



ZION STATION DSAR

Figure 3-13
RESPONSE SPECTRA – DBE
ELEVATION 592' FUEL HANDLING
BUILDING

AUGUST 1998

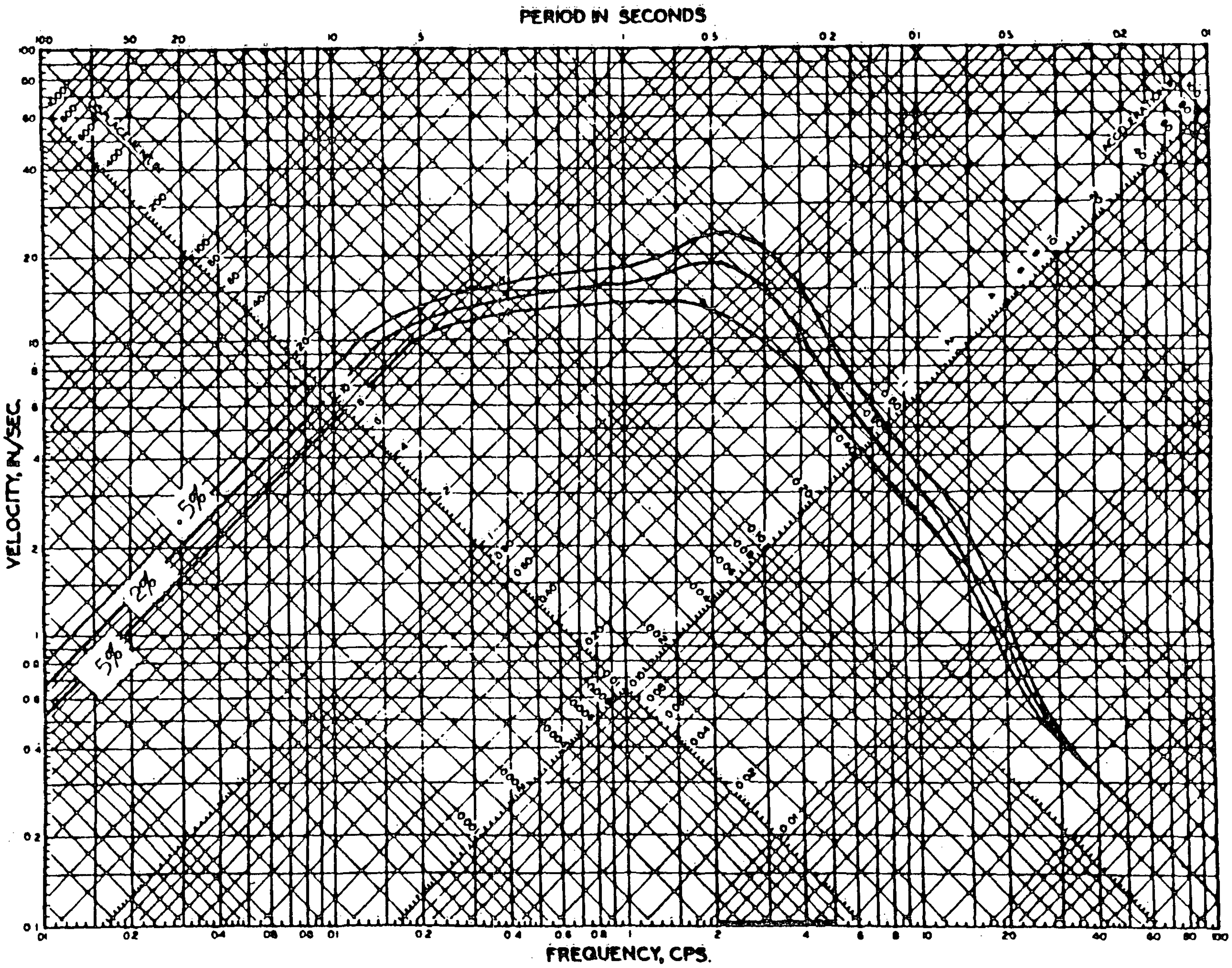


ZION STATION DSAR

Figure 3-14

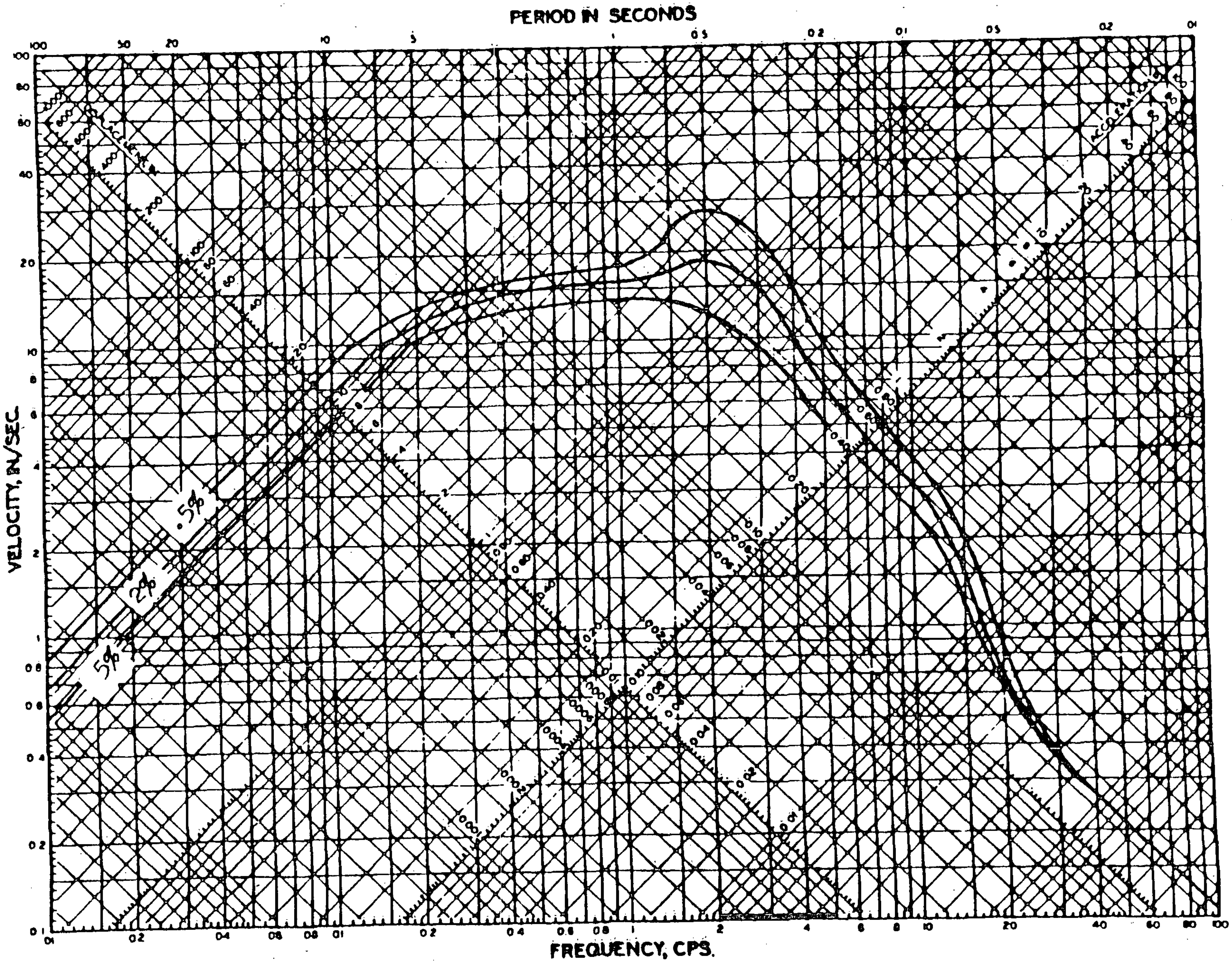
RESPONSE SPECTRA – DBE
ELEVATION 617' REACTOR BUILDING

AUGUST 1998



ZION STATION DSAR

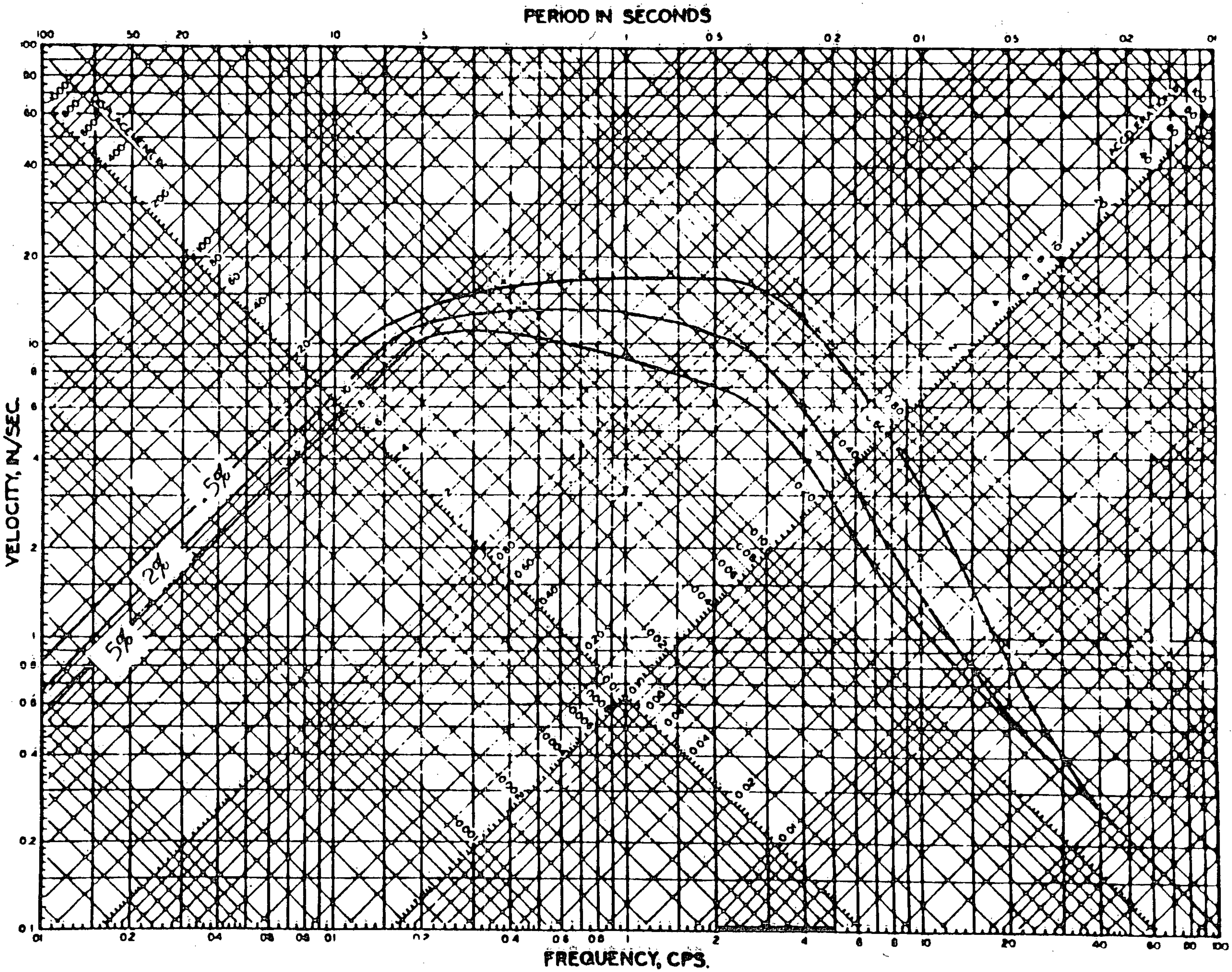
Figure 3-15
RESPONSE SPECTRA – DBE
ELEVATION 590' REACTOR BUILDING
AUGUST 1998



ZION STATION DSAR

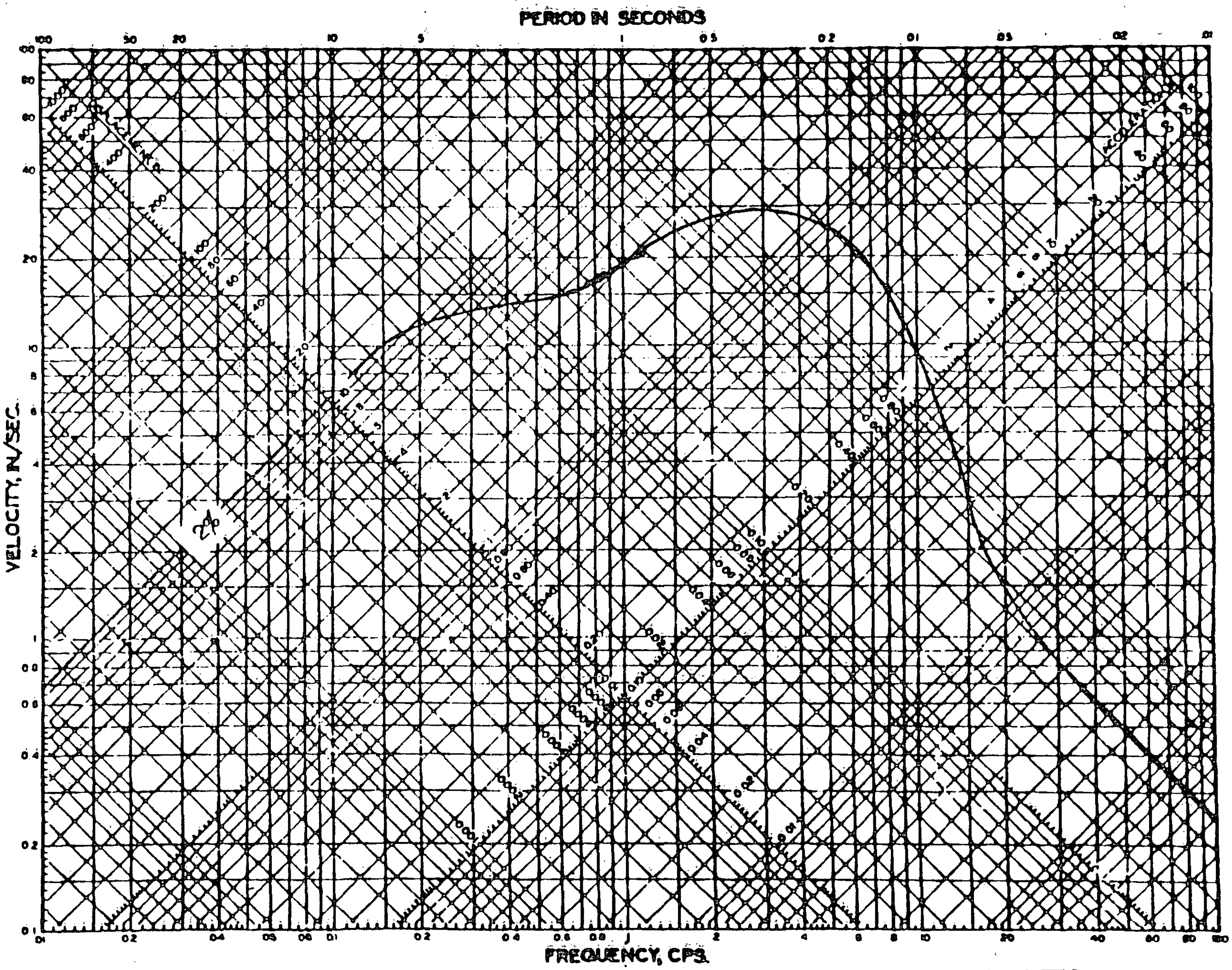
Figure 3-16
RESPONSE SPECTRA – DBE
ELEVATION 581'-10" REACTOR
BIOLOGICAL SHIELD

AUGUST 1998



ZION STATION DSAR

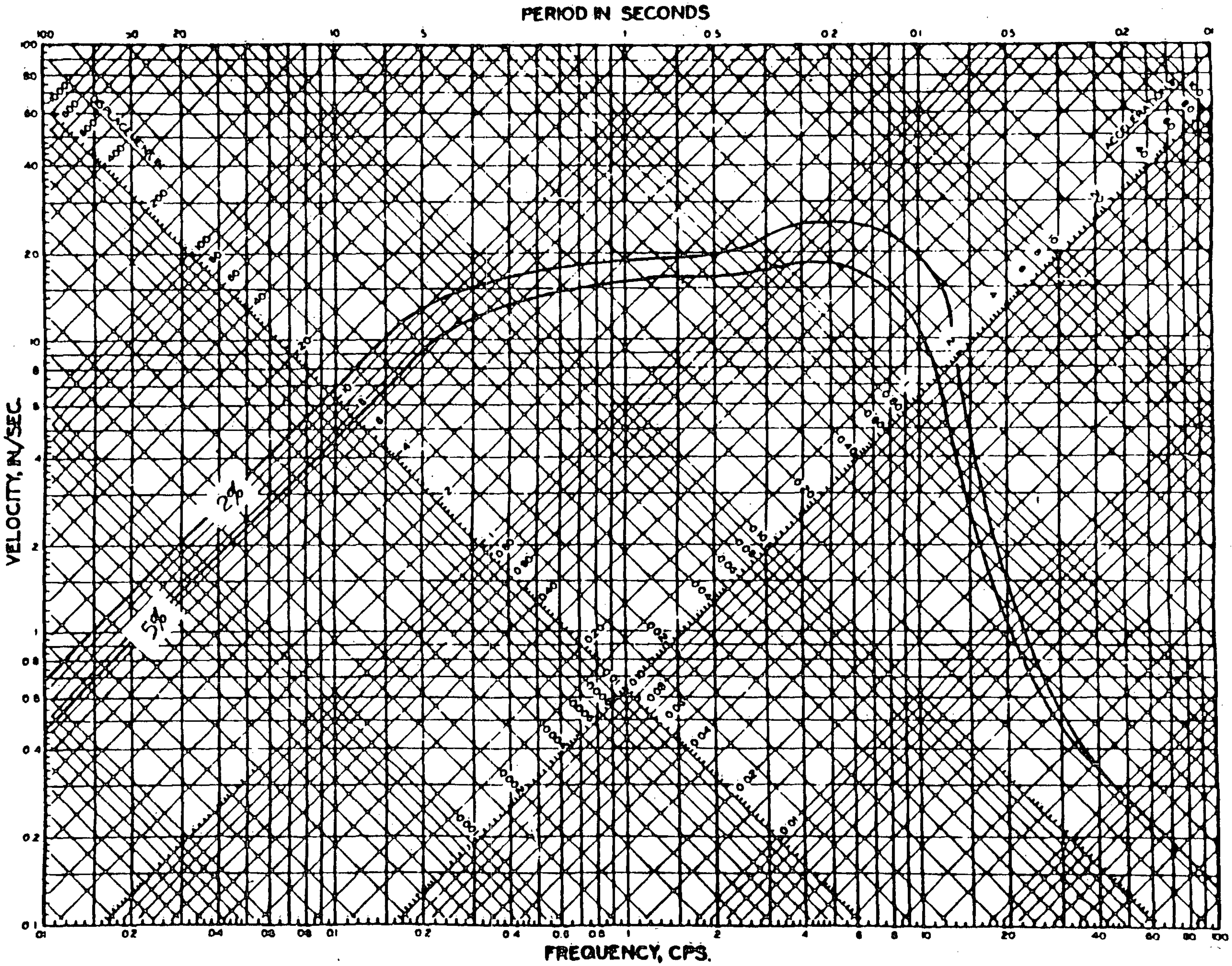
Figure 3-17
RESPONSE SPECTRA – DBE
ELEVATION 568' REACTOR BUILDING
AUGUST 1998



ZION STATION DSAR

Figure 3-18
RESPONSE SPECTRA – DBE
CONTAINMENT VESSEL
ELEVATION 626'-3"

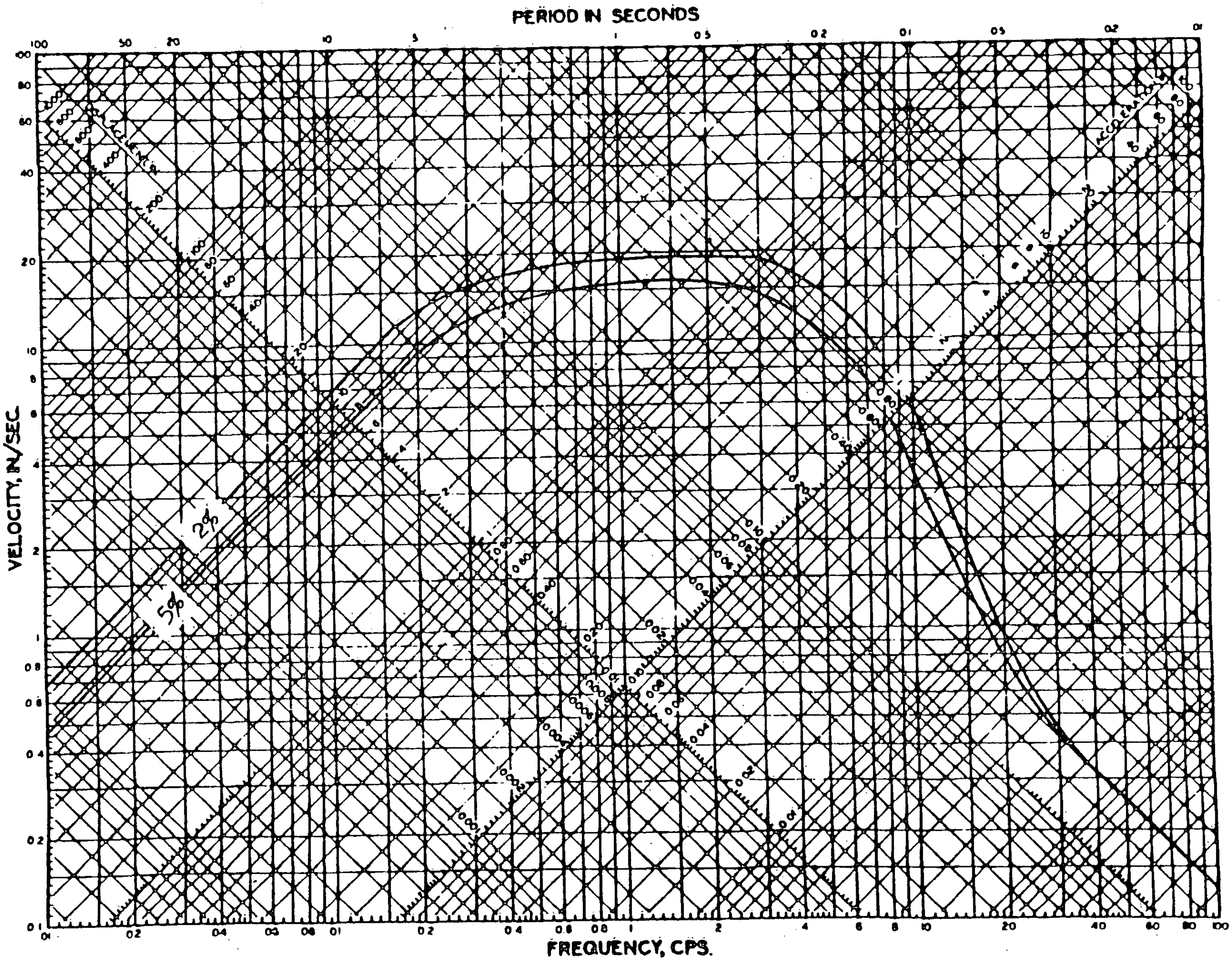
AUGUST 1998



ZION STATION DSAR

Figure 3-19
RESPONSE SPECTRA – DBE CRIB HOUSE ELEVATION 594' OPERATING FLOOR SLAB

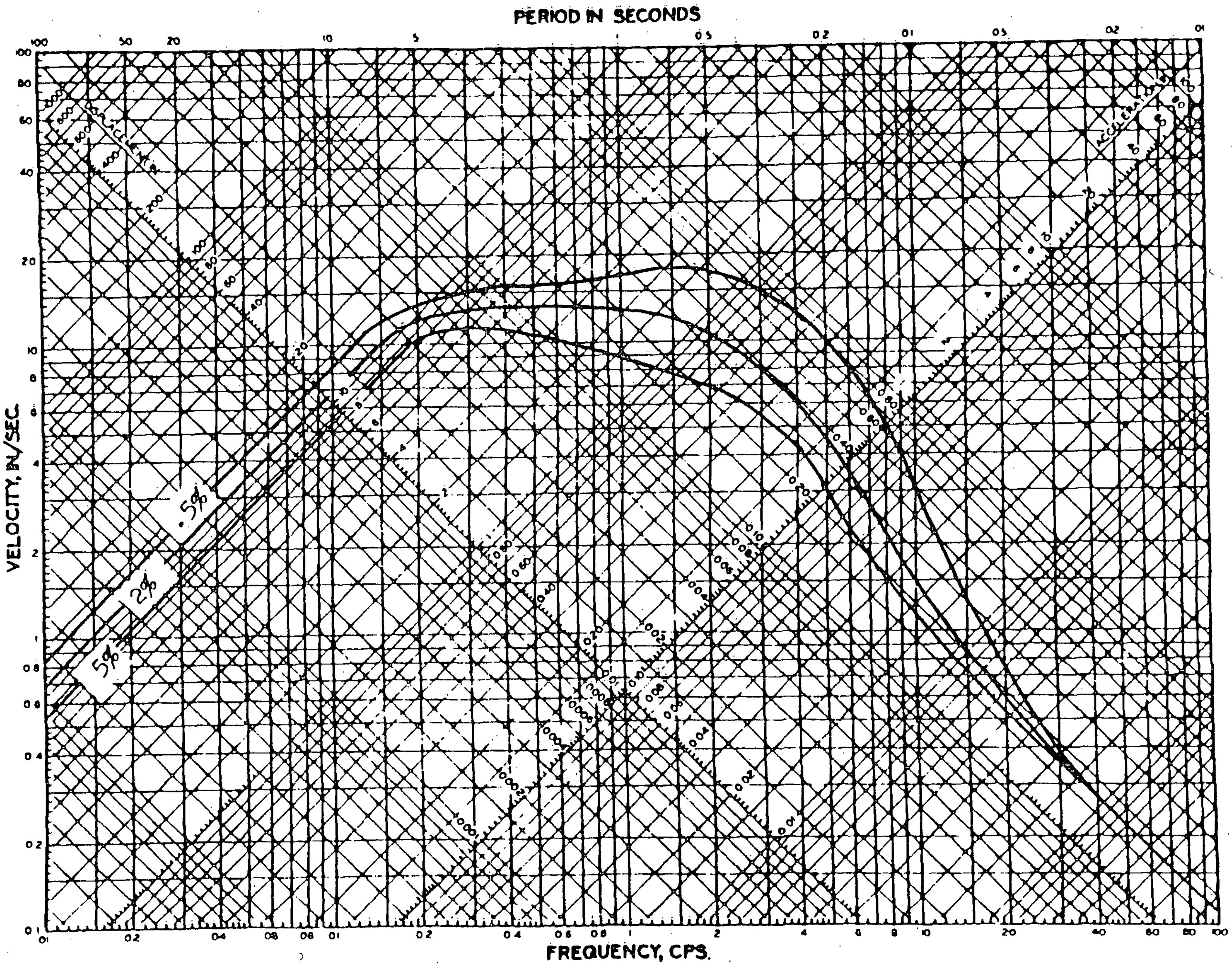
AUGUST 1998



ZION STATION DSAR

Figure 3-20
RESPONSE SPECTRA – DBE CRIB HOUSE ELEVATION 552' PUMP ROOM FLOOR

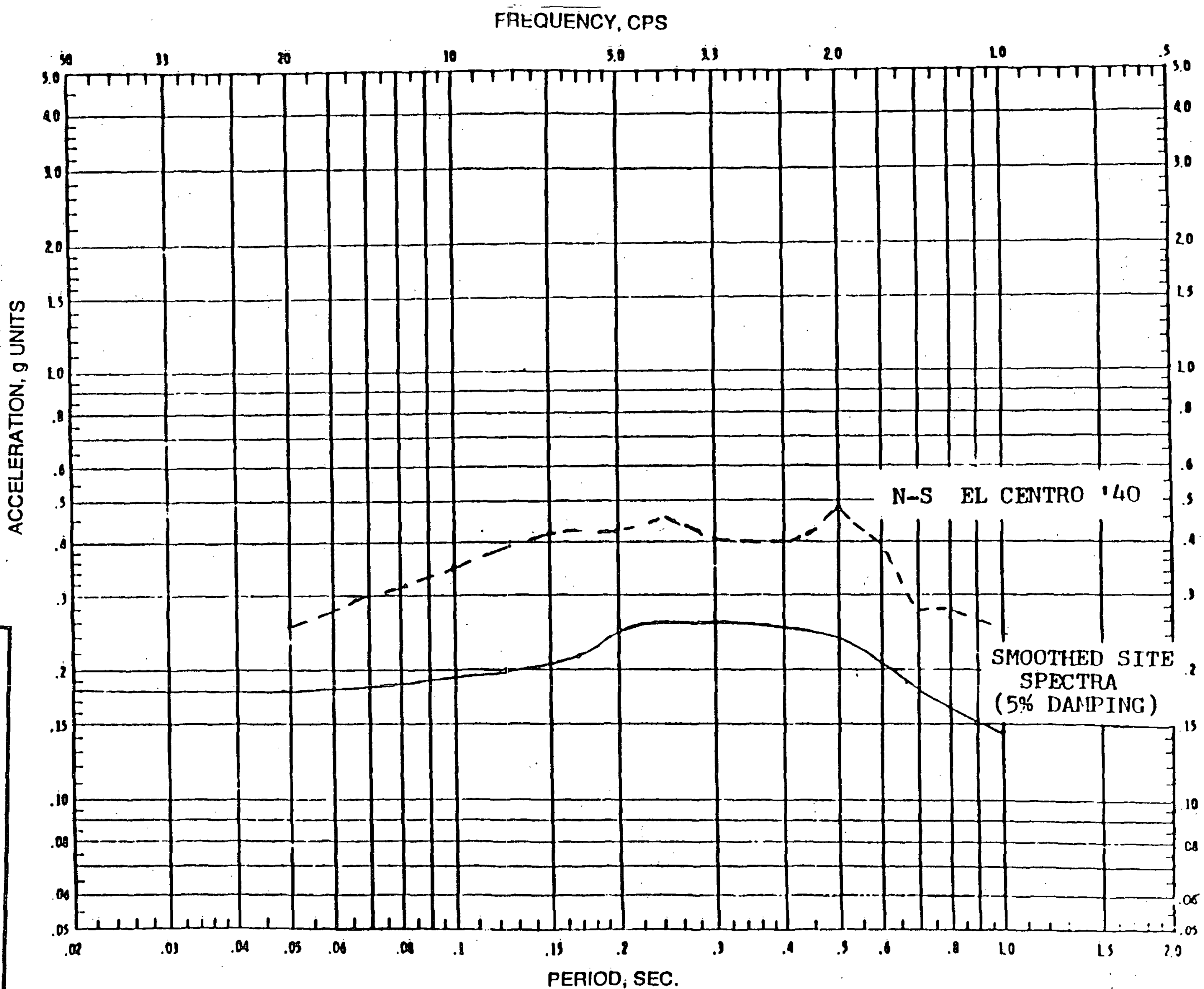
AUGUST 1998



ZION STATION DSAR

Figure 3-21
RESPONSE SPECTRA – DBE
OUTDOOR EQUIPMENT

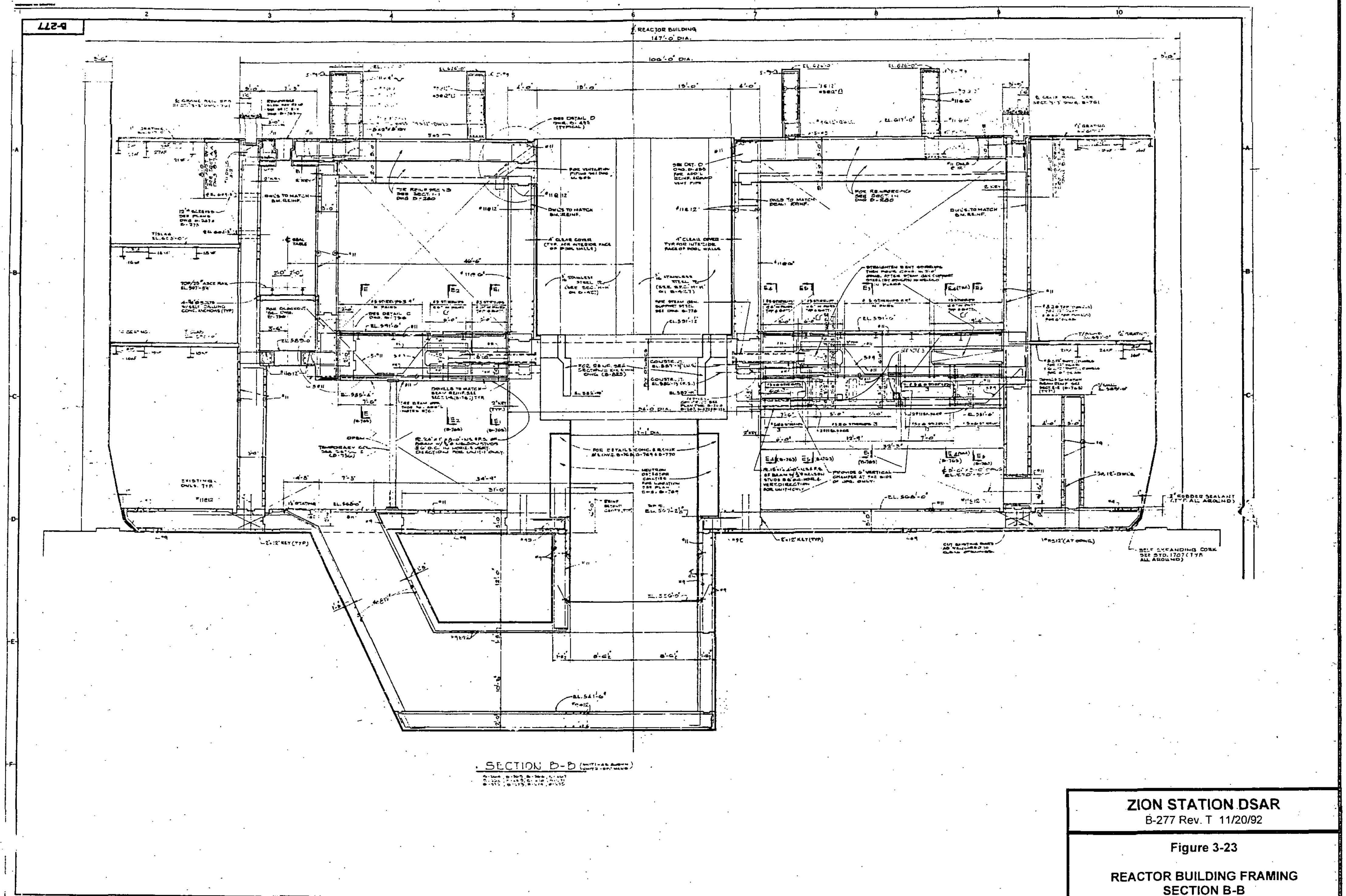
AUGUST 1998



ZION STATION DSAR

Figure 3-22
COMPARISON – ACTUAL SPECTRUM AND SITE SPECTRUM (DBE)

AUGUST 1998



ZION STATION DSAR

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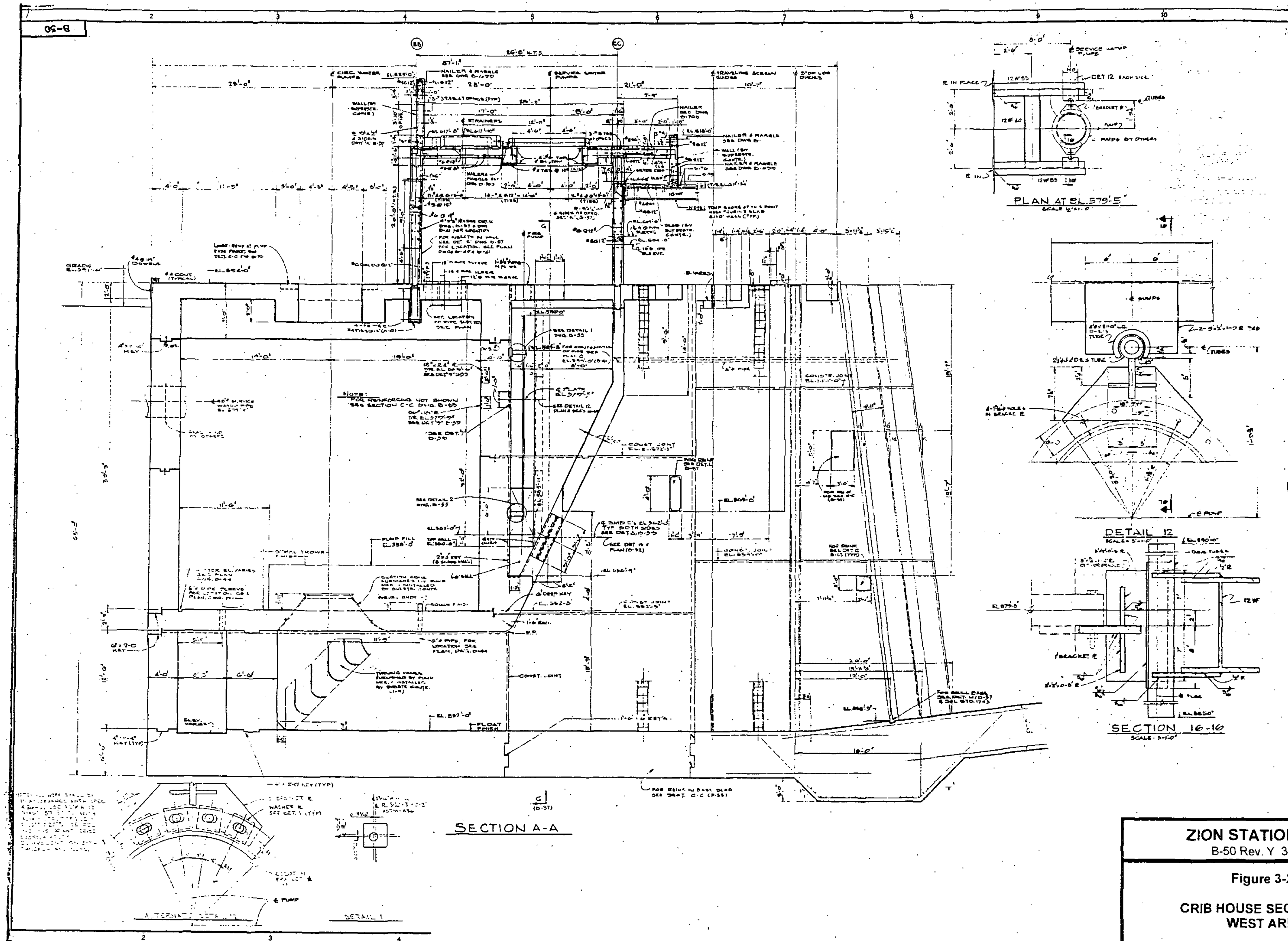
Figure 3-23

REACTOR BUILDING FRAMING
SECTION B-B

AUGUST 1998



ZION STATION DSAR

B-50 Rev. Y 3/11/93

Figure 3-24

CRIB HOUSE SECTION A-A WEST AREA

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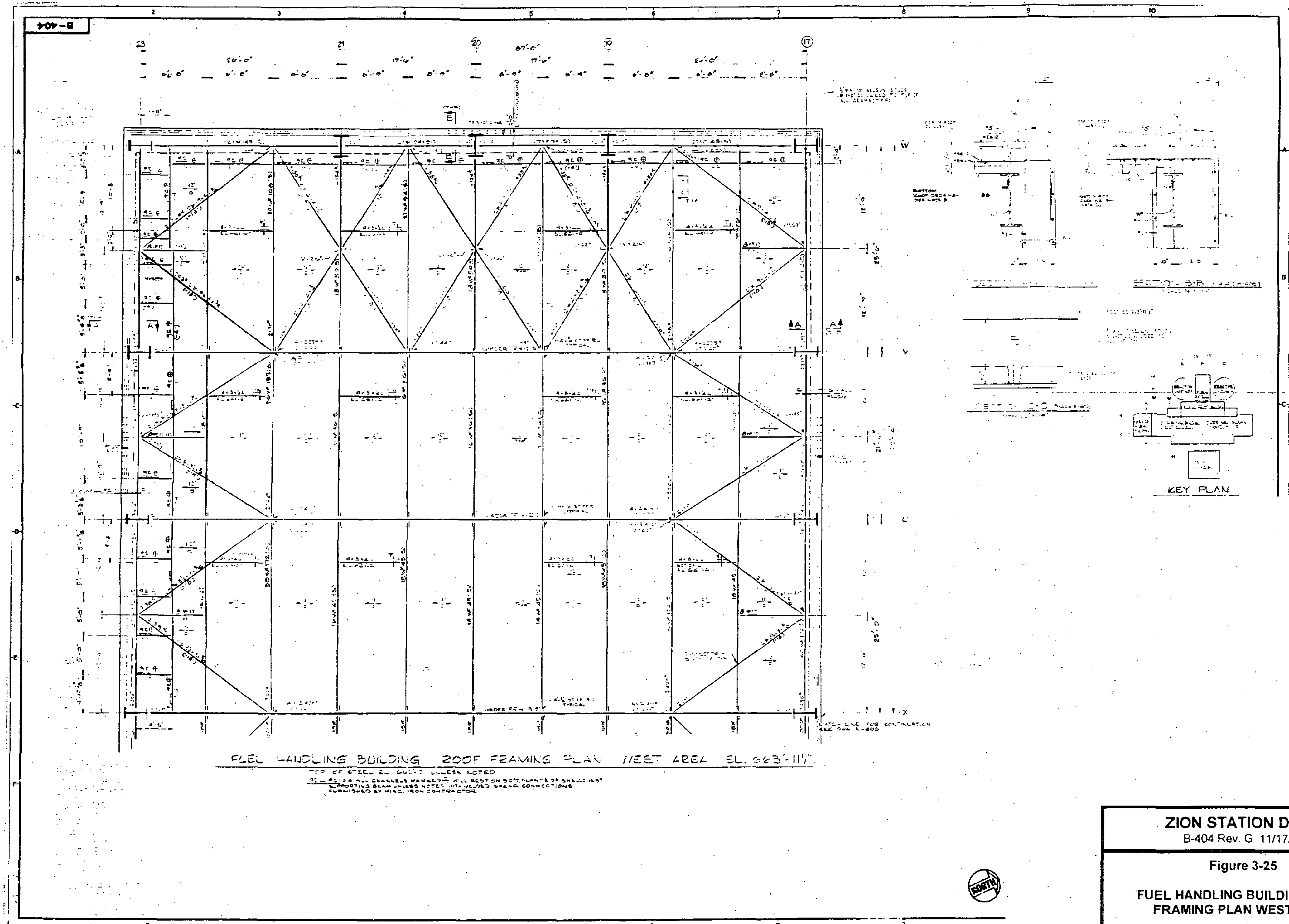

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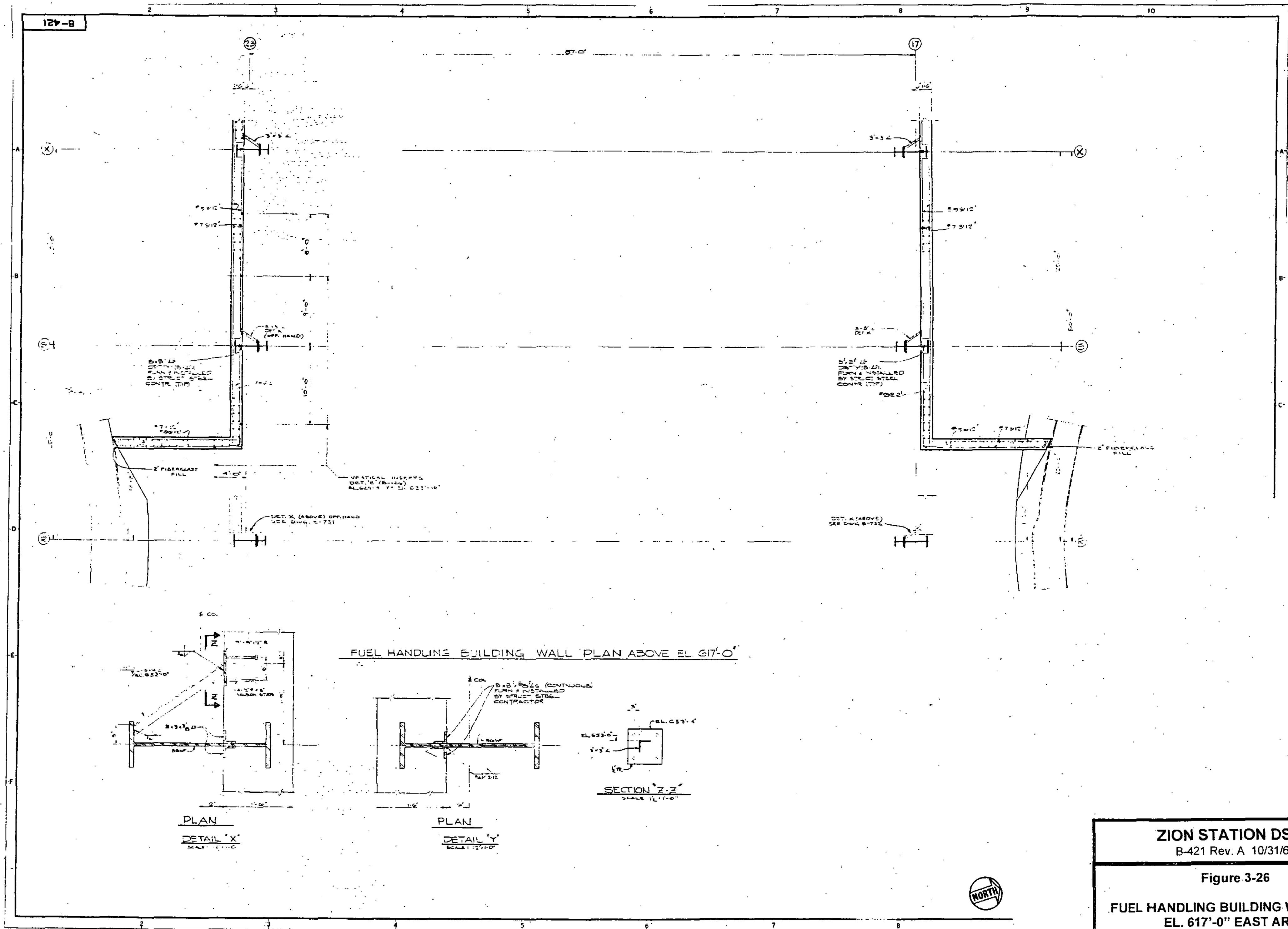
B-404 Rev. G 11/17/70

Figure 3-25

FUEL HANDLING BUILDING ROOF FRAMING PLAN WEST AREA

AUGUST 1998



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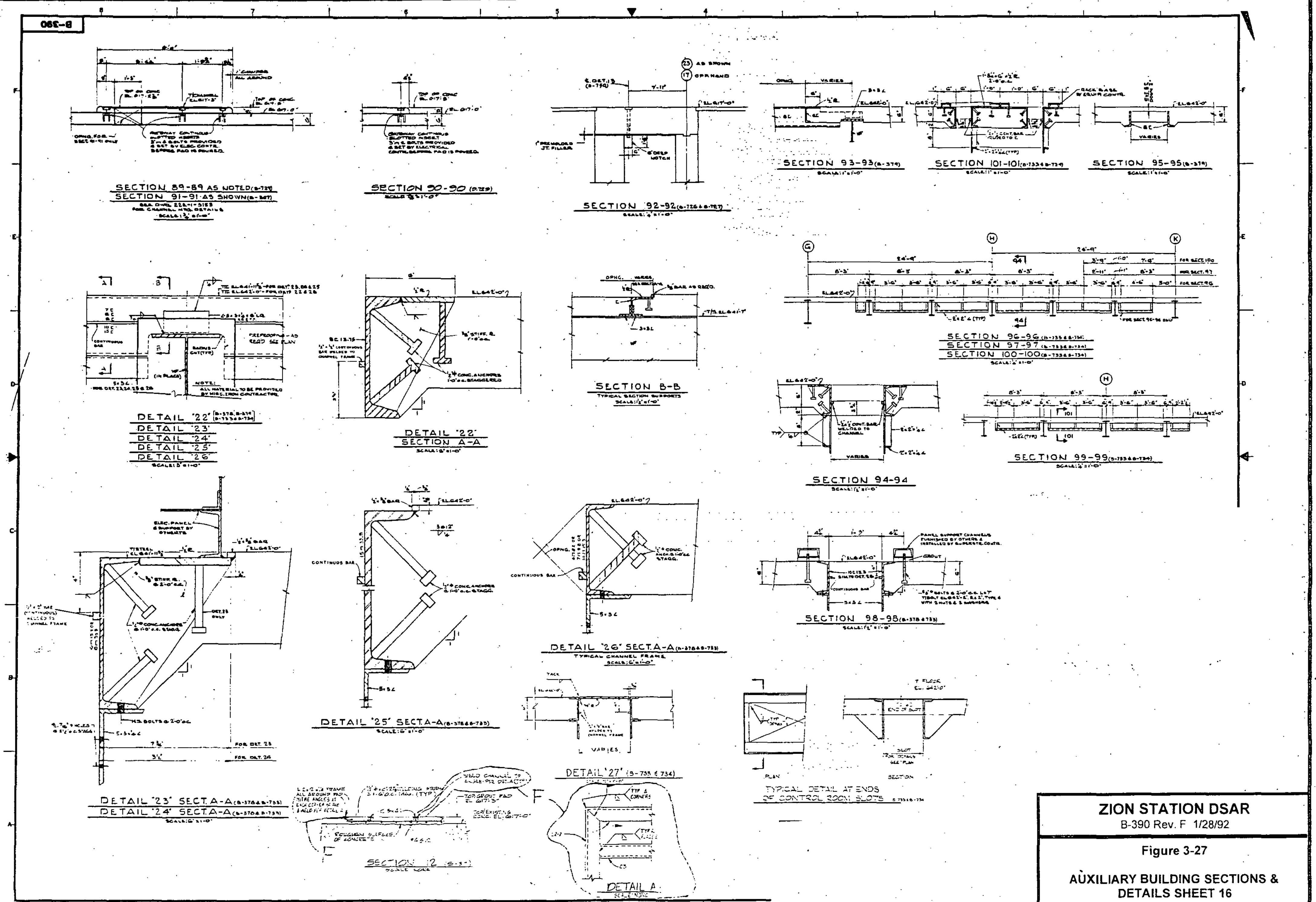
B-421 Rev. A 10/31/69

Figure 3-26

FUEL HANDLING BUILDING WALL PLAN
EL. 617'-0" EAST AREA

AUGUST 1998



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B-390 Rev. F 1/28/92

Figure 3-27

AUXILIARY BUILDING SECTIONS & DETAILS SHEET 16

AUGUST 1998

B-172

AUXILIARY BUILDING BEAM SCHEDULE

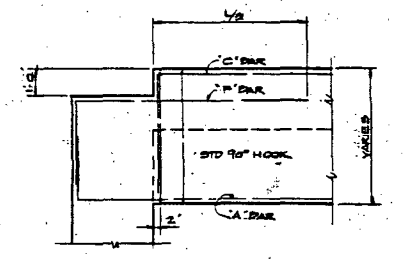
BEAM NO.	SIZE B	SIZE D	BOTTOM BARS A-BARS	BOTTOM BARS B-BARS	TOP BARS C-BARS	TOP BARS D-BARS	TOP BARS E-BARS	STIRRUPS SIZE	STIRRUPS TYPE	STIRRUPS SPACING	REMARKS
2B1	24"	48"	4-#11	—	6-#11	—	—	#5	□	12" CONT.	
2B2	36"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B3	30"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B4	36"	48"	5-#11	—	5-#11.	—	—	#5	□	12" CONT	
2B5	36"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B6	24"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B7	24"	24"	5-#11	—	3-#11	—	—	#4	□	9" CONT.	
2B8	24"	48"	5-#9	5-#9	5-#9	—	5-#9	#5	□	12" CONT.	
2B9	24"	48"	5-#9	5-#9	8-#9	—	5-#9	#5	□	12" CONT.	
2B10	24"	24"	3-#11	—	3-#11	—	—	#4	□	9" CONT.	
2B11	24"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B12	24"	54"	6-#11	5-#11	5-#11	2-#11	5-#11	#4	□	12" CONT.	
2B13	24"	48"	6-#11	—	5-#11	2-#11	2-#11	#5	□	12" CONT.	
2B14	36"	48"	6-#11	—	6-#11	2-#11	2-#11	#5	□	9" CONT.	
2B15	24"	48"	5-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B16	24"	48"	4-#11	—	6-#11	2-#11	—	#5	□	12" CONT.	
2B17	24"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B18	24"	30"	5-#11	—	3-#11	—	—	#4	□	12" CONT.	
2B19	24"	48"	7-#11	—	6-#11	3-#11	2-#11	#5	□	10@6" EACH END BAL.@12"	
2B20	24"	54"	7-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B21	24"	48"	4-#11	—	5-#11	2-#11	—	#6	□	12" CONT.	
2B22	24"	48"	6-#11	—	7-#11	2-#11	—	#5	□	6@6 EACH END BAL.@12"	
2B23	24"	48"	6-#11	—	4-#11.	3-#11	—	#5	□	12" CONT.	
2B24	24"	54"	6-#11	—	5-#11	2-#11	2-#11	#5	□	12" CONT.	
2B25	24"	48"	6-#11	—	5-#11	2-#11	2-#11	#5	□	12" CONT.	
2B26	24"	48"	6-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B27	24"	48"	4-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B28	24"	48"	4-#11	—	5-#11	2-#11	2-#11	#5	□	12" CONT.	
2B29	21"	24"	4-#11	—	4-#11	—	—	#4	□	9" CONT.	
2B30	24"	54"	6-#11	—	5-#11	2-#11	2-#11	#5	□	9" CONT.	
2B31	18"	40"	4-#11	—	4-#11	—	—	#5	□	12" CONT.	
2B32	24"	54"	6-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B33	24"	54"	6-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B34	30"	48"	6-#11	—	5-#11	4-#11	—	#5	□	4@6" EACH END BAL.@12"	
2B35	30"	48"	6-#11	—	7-#11	3-#11	—	#5	□	8@6 EACH END BAL.@12"	
2B36	36"	48"	11-#11	—	6-#11	3-#11	2-#11	#5	□	12" CONT.	
2B37	24"	48"	5-#11	5-#11	5-#11	2-#11	3-#11	#6	□	9" CONT.	2 BEAMS REQ'D.
2B38	24"	54"	6-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B39	24"	54"	6-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
2B40	24"	54"	7-#11	—	4-#11	3-#11	4-#11	#5	□	9" CONT.	
2B41	24"	54"	6-#11	4-#11	4-#11	3-#11	3-#11	#5	□	6" CONT.	
2B42	24"	48"	5-#11	—	5-#11	2-#11	—	#5	□	12" CONT.	
2B43	24"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B44	24"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
2B45	24"	48"	5-#11	—	5-#11	—	—	#5	□	12" CONT.	
3B1	24"	48"	5-#11	—	4-#11	2-#11	2-#11	#5	□	16@6 EACH END BAL.@12"	
3B2	24"	48"	6-#11	—	4-#11	2-#11	2-#11	#5	□	6" CONT.	
3B3	24"	48"	6-#11	—	4-#11	2-#11	2-#11	#5	□	6" CONT.	
3B4	18"	28"	5-#11	—	3-#11		—	#4	□	12" CONT.	
3B5	24"	48"	4-#11	—	4-#11		—	#5	□	12" CONT.	
3B6	24"	96"	6-#11	—	4-#11	2-#11	—	#5	□	12" CONT.	
3B7	24"	48"	6-#11	—	3-#11	3-#11	—	#5	□	12" CONT.	
3B8	18"	48"	4-#11	—	4-#11		2-#11	#5	□	12" CONT.	
3B9	24"	48"	6-#11	—	4-#11	2-#11	—	#5	□	12" CONT.	
3B10	36"	48"	5-#11	—	5-#11			#5	□	12" CONT.	
3B12	30"	48"	5-#11	—	5-#11			#5	□	12" CONT.	
3B13	21"	28"	3-#11	—	3-#11	—	—	#4	□	9" CONT.	
3B14	24"	48"	3-#11	—	3-#11	2-#11	2-#11	#5	□	12" CONT.	
3B15	24"	48"	5-#11	—	4-#11	2-#11	2-#11	#5	□	9" CONT.	
3B16	24"	48"	5-#11	—	4-#11	2-#11	2-#11	#5	□	9" CONT.	
3B18	24"	48"	6-#11		4-#11	2-#11		#5	□	12" CONT.	
3B19	24"	46"	6-#11	—	5-#11	3-#11	4-#11	#5	□	3@6" SOUTH END BAL.@12"	
3B21	36"	36"	6-#11		6-#11	4-#11		#5	□	6" CONT.	
3B22	24"	48"	5-#11	—	5-#11	2-#11	5-#11	#5	□	9" CONT.	"E" BARS @ WEST END ONLY
3B23	36"	48"	9-#11		9-#11		4-#11	#5	□	9@6" EA. END, BAL.@12"	
3B24	36"	48"	9-#11		9-#11		4-#11	#5	□	9@6" EA. END, BAL.@12"	
3B25	36"	36"	6-#11		6-#11	4-#11	4-#11	#5	□	9" CONT.	"E" BARS @ EAST END ONLY
3B26	36"	36"	4-#11		3-#9	2-#9	5-#9	#6	□	9" CONT.	"E" BARS @ WEST END ONLY
3B27	24"	48"	4-#11		4-#11			#5	□	12" CONT.	
3B29	36"	24"	5-#8		5-#8			#5	□	12" CONT.	4 BEAMS REQ'D.
3B30	36"	18"	5-#8		5-#8			#5	□	12" CONT.	2 BEAMS REQ'D.
3B34	36"	54"	9-#11	—	9-#11	2-#11	3-#11	#5	□	18@6" WEST END BAL.@12"	
3B35	36"	48"	6-#11	—	3-#11	3-#11	—	#5	□	12" CONT.	
3B37	24"	48"	5-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
3B38	24"	42	5-#11	—	3-#11	3-#11	—	#5	□	9" CONT.	
3B39	24"	48"	6-#11		4-#11	2-#11	—	#5	□	12" CONT.	

AUXILIARY BUILDING BEAM SCHEDULE

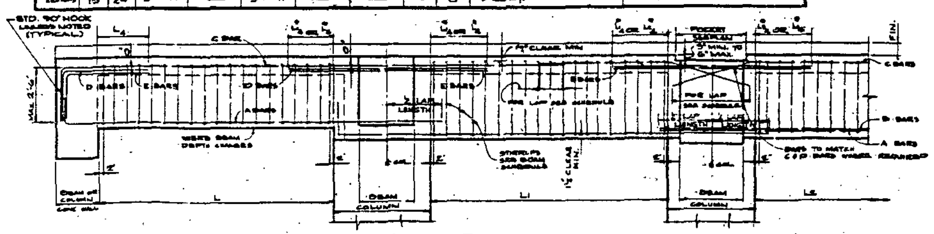
BEAM NO.	SIZE B	SIZE D	BOTTOM BARS A-BARS	BOTTOM BARS B-BARS	TOP BARS C-BARS	TOP BARS D-BARS	TOP BARS E-BARS	STIRRUPS SIZE	STIRRUPS TYPE	STIRRUPS SPACING	REMARKS
3B40	24"	48"	5-#11	—	3-#11	2-#11	—	#5	□	12" CONT.	
3B41	30"	48"	4-#11	—	3-#11	2-#11	2-#11	#5	□	12" CONT.	
3B42	36"	66"	8-#11	4-#11	10-#11			#5	□	18@6" WEST END BAL.@12"	"C" BARS IN 2 ROWS
3B43	36"	48"	7-#11		4-#11	3-#11		#5	□	12" CONT.	
3B44	36"	48"	7-#11	—	4-#11	4-#11	—	#5	□	12" CONT.	
3B45	36"	52"	9-#11		9-#11	2-#11	3-#11	#5	□	18@6" WEST END BAL.@12"	
3B46	36"	48"	9-#11		3-#11			#5	□	12" CONT.	2-BEAMS REQ'D.
3B47	24"	48"	5-#11	—	4-#11	3-#11	—	#5	□	12" CONT.	
3B48	24"	36"	4-#11	—	4-#11	2-#11	—	#5	□	9" CONT.	
3B49	24"	34"	3-#11	—	3-#11	3-#11	—	#5	□	12" CONT.	
3B50	30"	94"	4-#11		4-#11		3-#11	#6	□	12" CONT.	"E" BARS REQ.@ EXT. WALL SUPPORT
3B51	24"	48"	6-#11	—	4-#11	2-#11		#5	□	9" CONT.	
3B52	24"	48"	6-#11	—	5-#11	2-#11	5-#11	#5	□	12" CONT.	"E" BARS @ WEST END ONLY
3B55	30"	48"	6-#11	—	4-#11	3-#11	3-#11	#5	□	12" CONT.	"E" BARS @ EAST END ONLY
3B56	30"	48"	6-#11		4-#11	3-#11	4-#11	#5	□	6" CONT	"E" BARS @ WEST END ONLY
3B58	30"	48"	6-#11	—	7-#11	—	6-#11	#5	□	12@6" EA. END BAL.@12"	"E" BARS @ EAST END ONLY
3B59	30"	48"	6-#11	—	7-#11	—	—	#5	□	12@6" EA. END BAL.@12"	
3B60	24"	48"	5-#11	—	5-#11	2-#11	—	#5	□	9" CONT.	
3B72	24"	48"	7-#11	2-#11	5-#11	2-#11	4-#11	#5	□	9" CONT.	"E" BARS @ SOUTH END ONLY
3B74	30"	78"	6-#11	—	5-#11	3-#11	—	#5	□	6" CONT.	
3B75	24"	48"	8-#11	—	8-#11	3-#11	—	#5	□	6" CONT.	
3B76	30"	78"	6-#11	—	5-#11	3-#11	—	#5	□	6" CONT.	"D" BARS @ NORTH END ONLY
2B46	18"	24"	3-#11	—	3-#11	—	—	#4	□	9" CONT.	
2B47	24"	48"	4-#11	—	6-#11	2-#11	—	#5	□	12" CONT.	2 BEAMS REQ'D.
2B48	24"	48"	5-#11	—	6-#11	—	—	#5	□	12" CONT.	
2B49	15"	24"	3-#11	—	3-#11	—	—	#4	□	9" CONT.	

REINFORCING LAP SPLICE LENGTH SCHEDULE

BAR SIZE	TOP BARS	OTHER BARS
#3	17"	17"
#4	22"	22"
#5	27"	27"
#6	33"	33"
#7	38"	38"
#8	47"	44"
#9	59"	49"
#10	75"	55"
#11	92"	65"
A432 REINF. WITH 4000 #/□" CONCRETE		

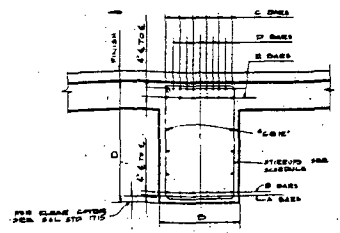


TYPICAL COLUMN POCKET DETAIL



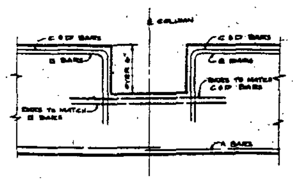
TYPICAL BEAM REINFORCING

FOR SIZE AND NUMBER OF BARS SEE BEAM SCHEDULE
& WHICHEVER IS GREATER
NO SCALE



TYPICAL BEAM SECTION

NO SCALE



TYPICAL BEAM REINFORCING AT DEEP POCKET

NO SCALE

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Figure 3-28

AUXILIARY BUILDING CONCRETE BEAM SCHEDULE

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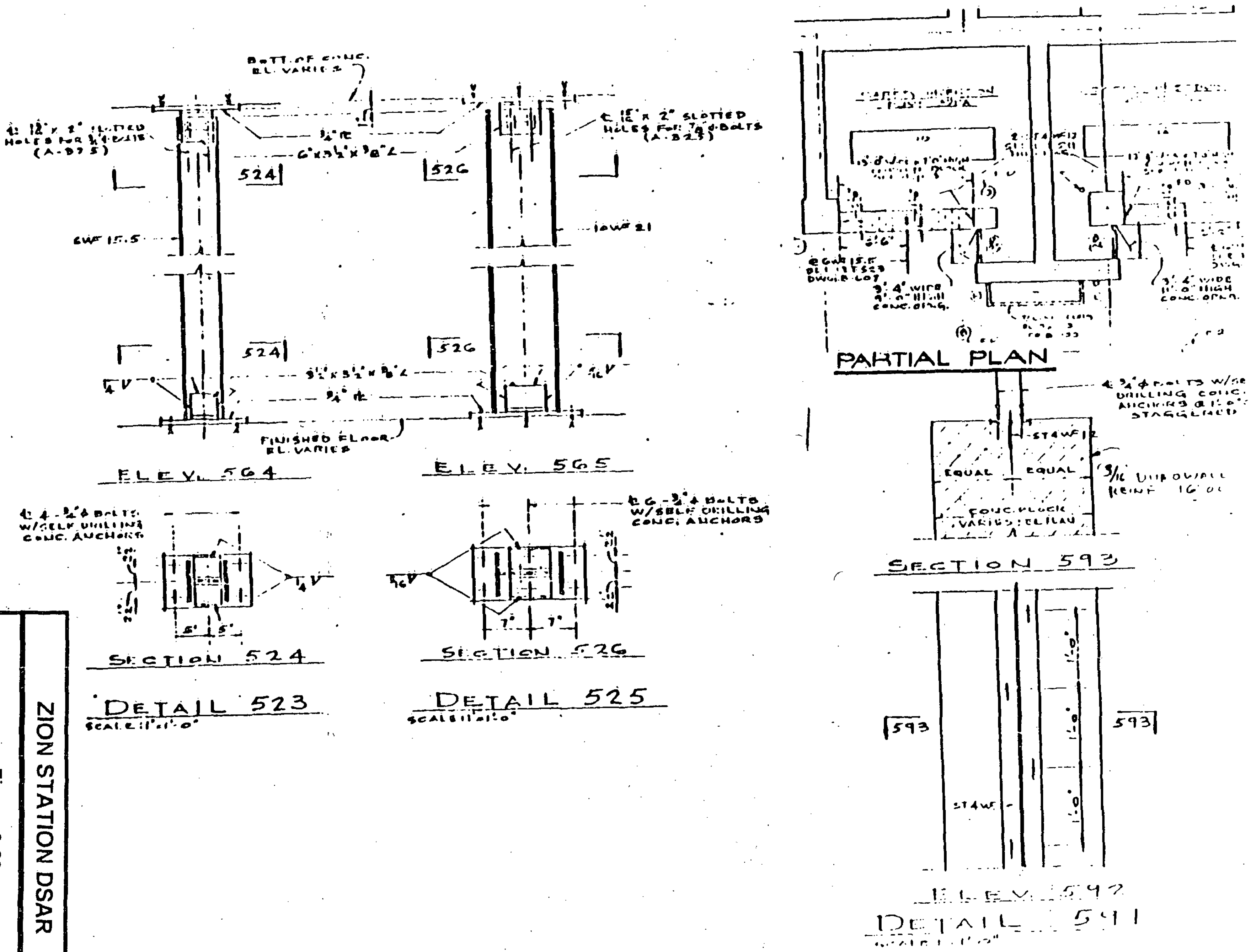

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Figure 3-29

CONCRETE BLOCK SHIELD WALL – TIE DOWN DETAILS

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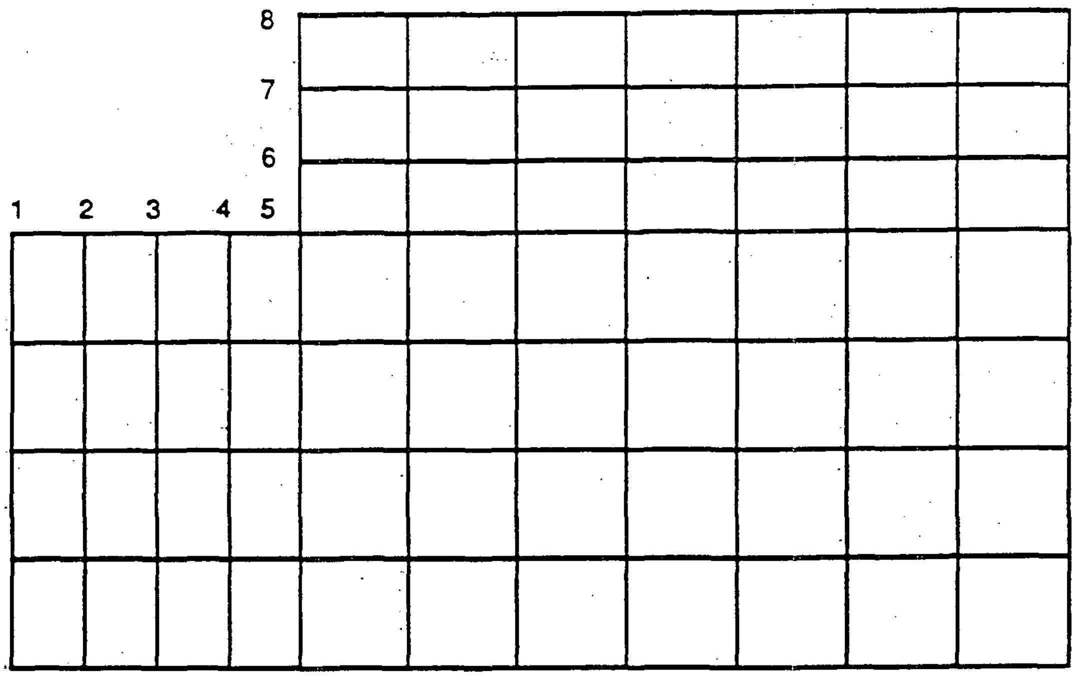

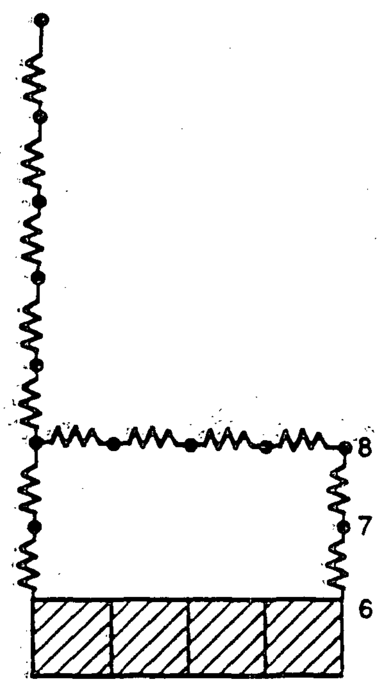

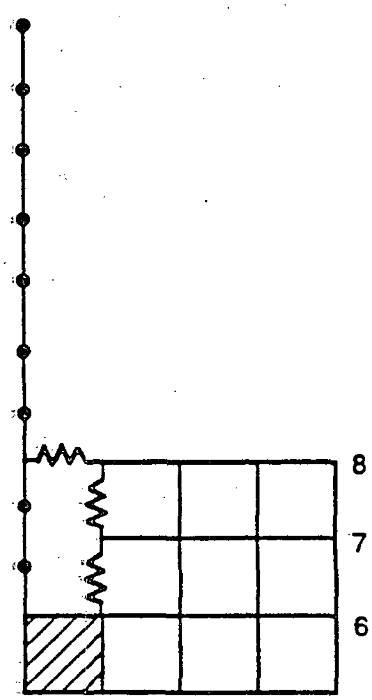

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Figure 3-30

COMBINED INTERACTION MODEL FOR REACTOR AND AUXILIARY BUILDINGS

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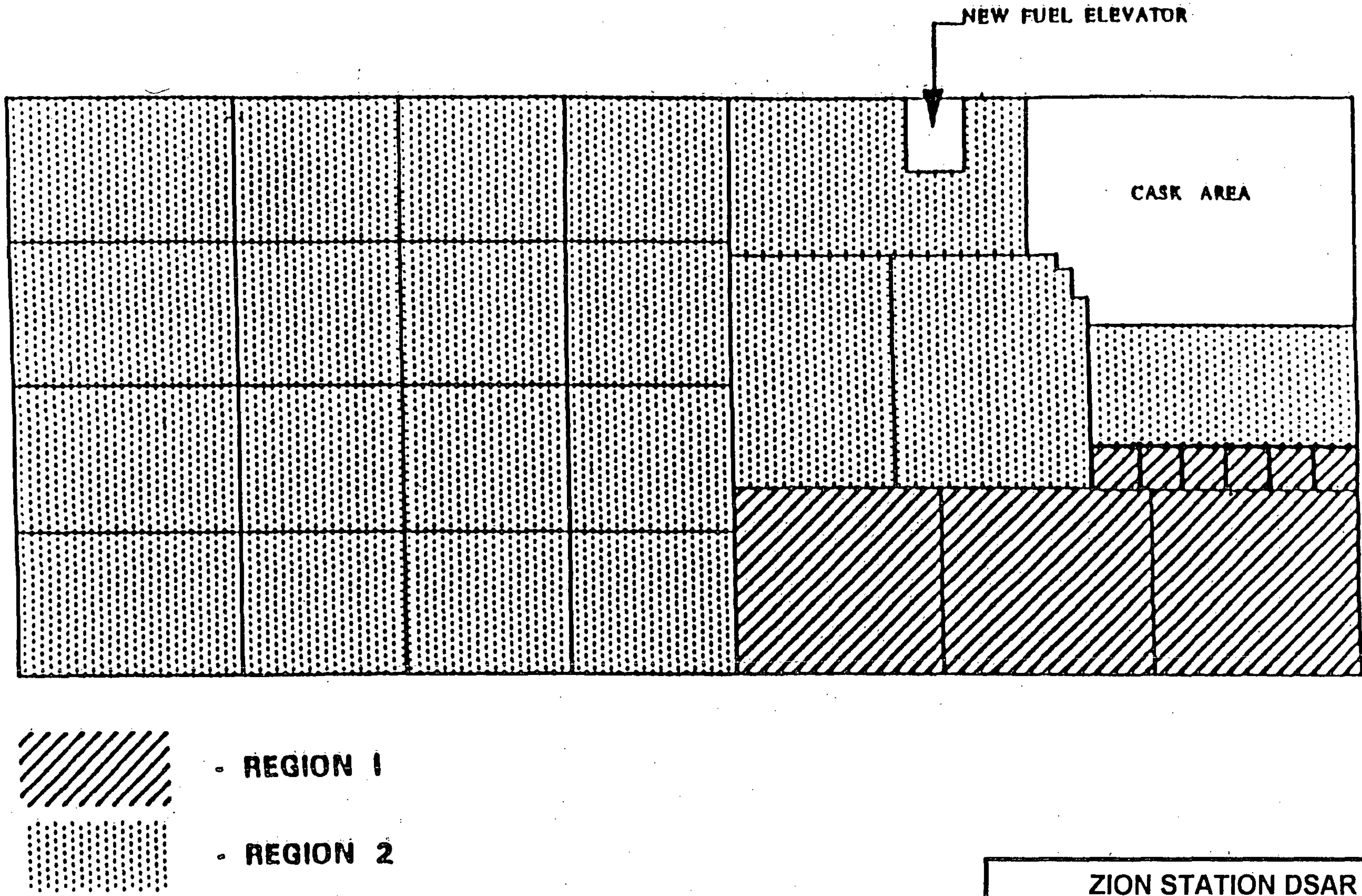

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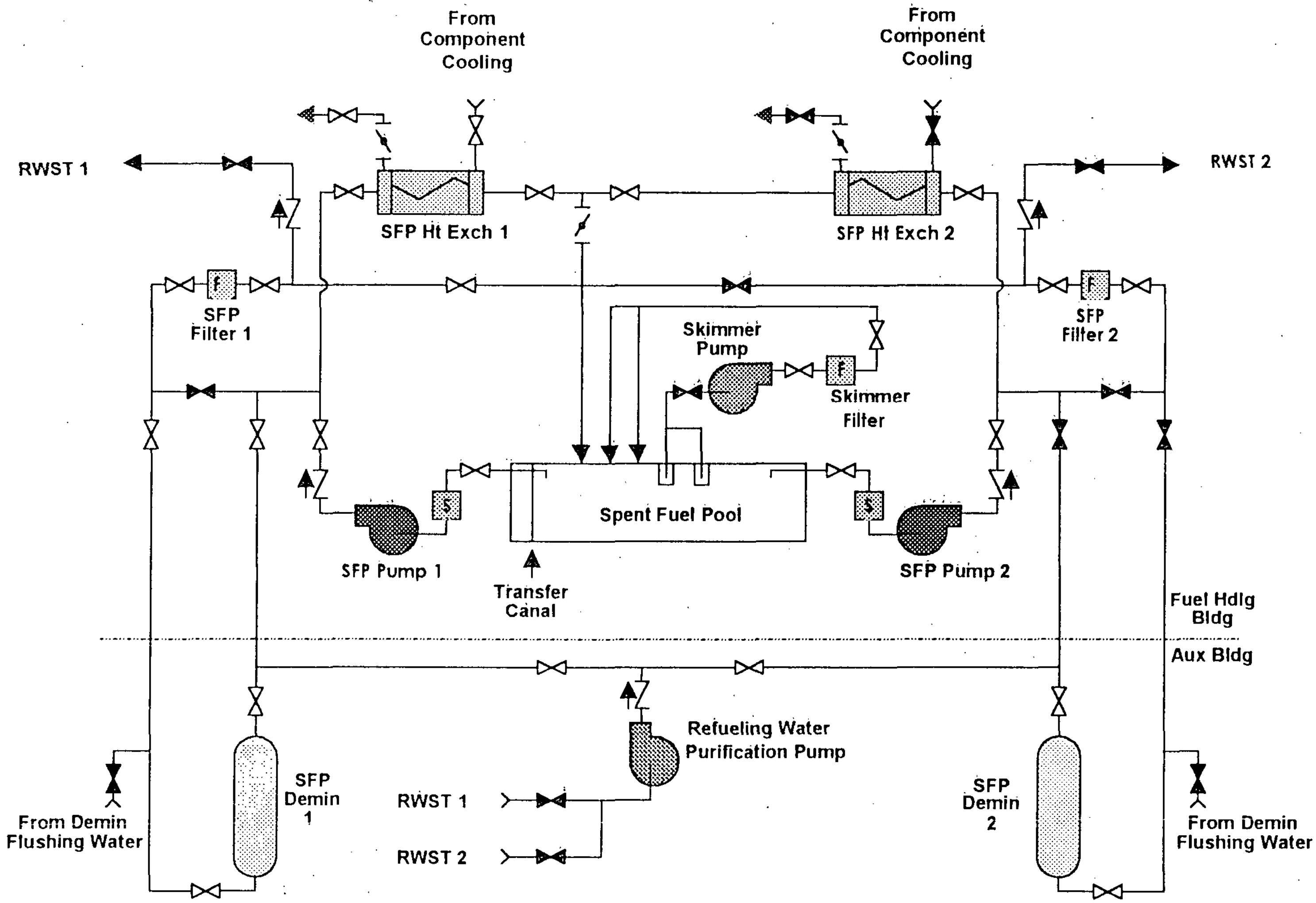
Figure 3-31

SPENT FUEL STORAGE POOL

AUGUST 1998



ZION STATION DSAR

Figure 3-32

SPENT FUEL POOL COOLING AND CLEANUP SYSTEM (SIMPLIFIED)

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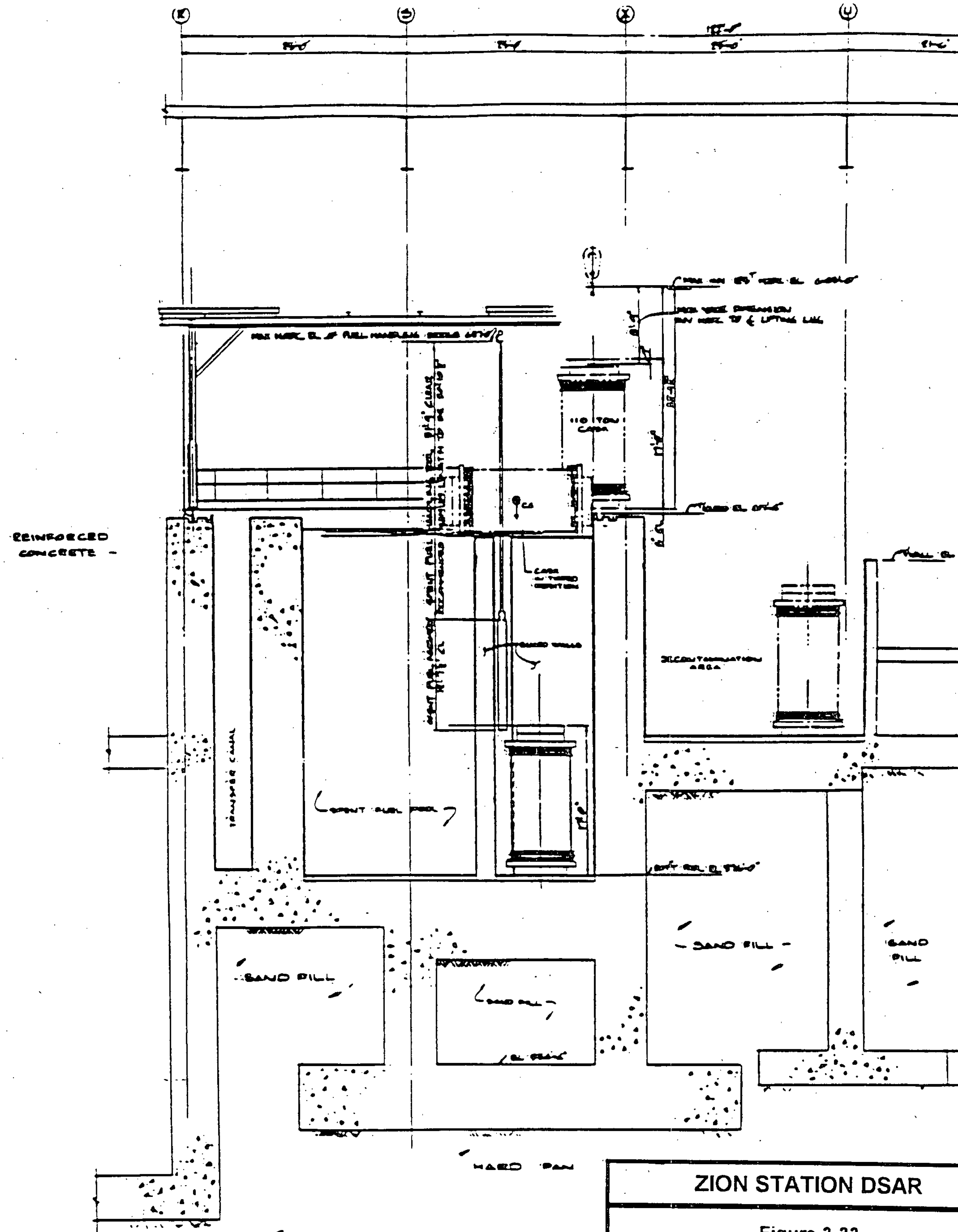


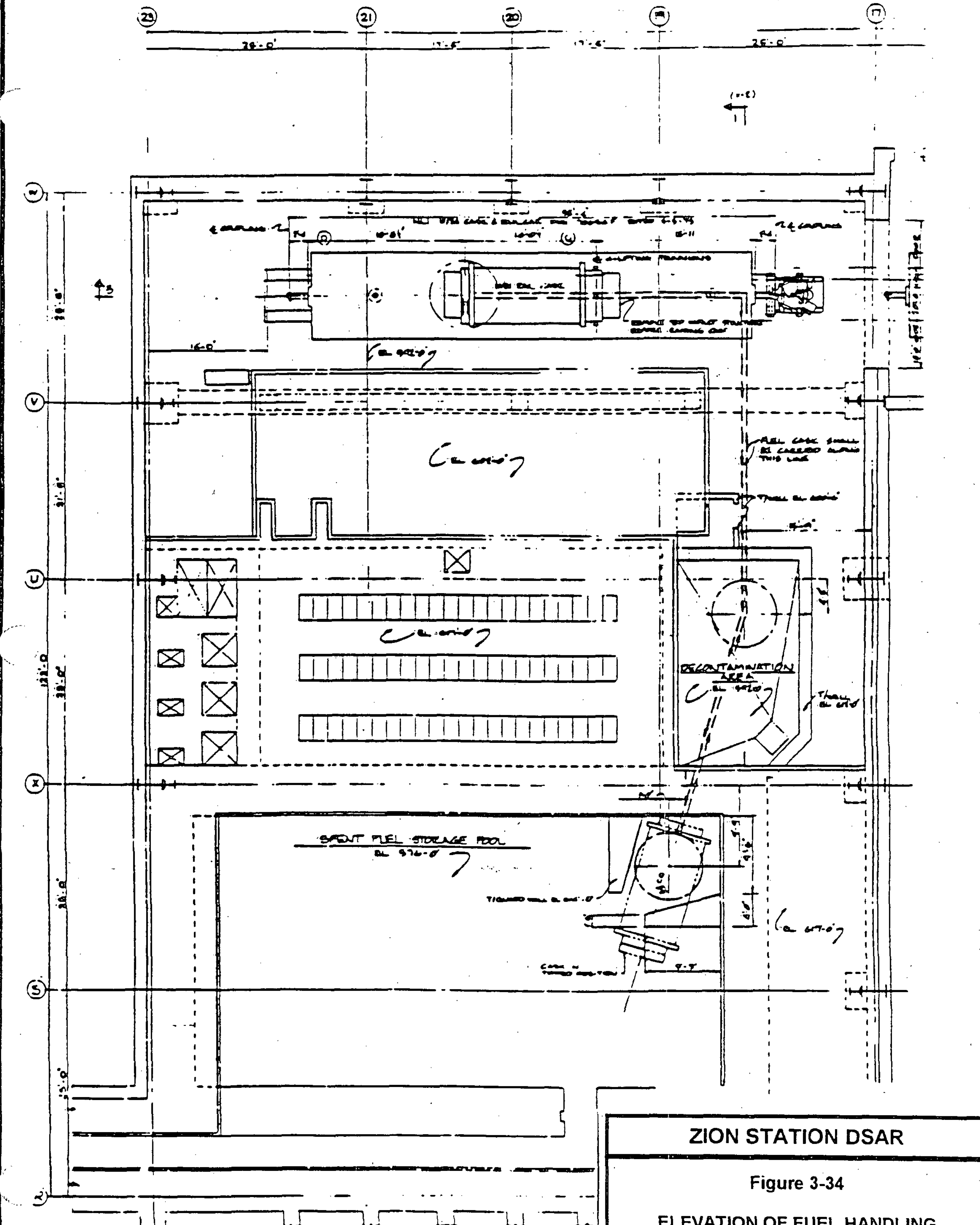
SECTION 1

ZION STATION DSAR

Figure 3-33

SPENT FUEL CASK MOVEMENT PATH IN FUEL HANDLING BUILDING

AUGUST 1998

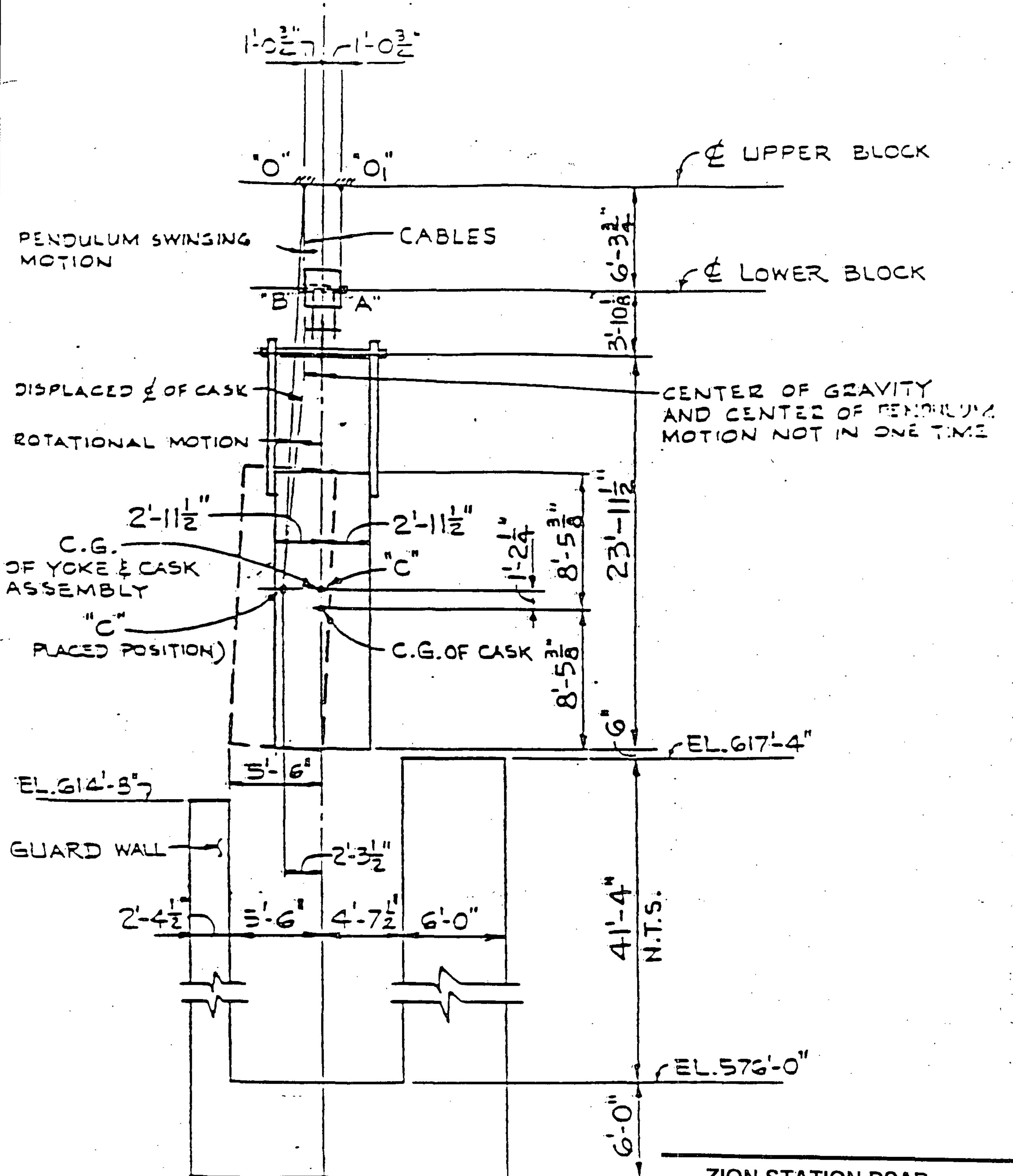


ZION STATION DSAR

Figure 3-34

ELEVATION OF FUEL HANDLING BUILDING

AUGUST 1998

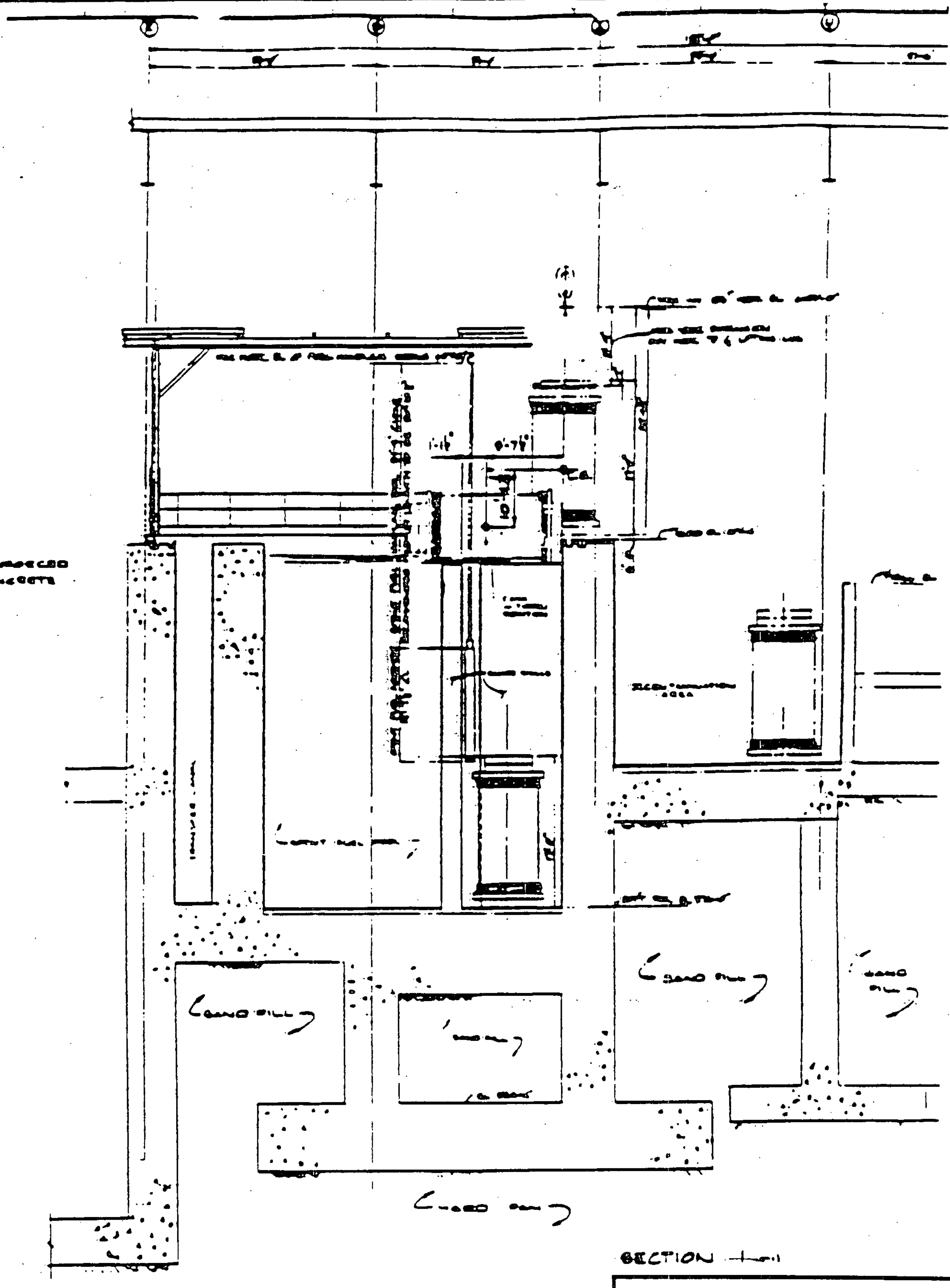


ZION STATION DSAR

Figure 3-35

CASK OVER STORAGE AREA – LOOKING SOUTH

AUGUST 1998

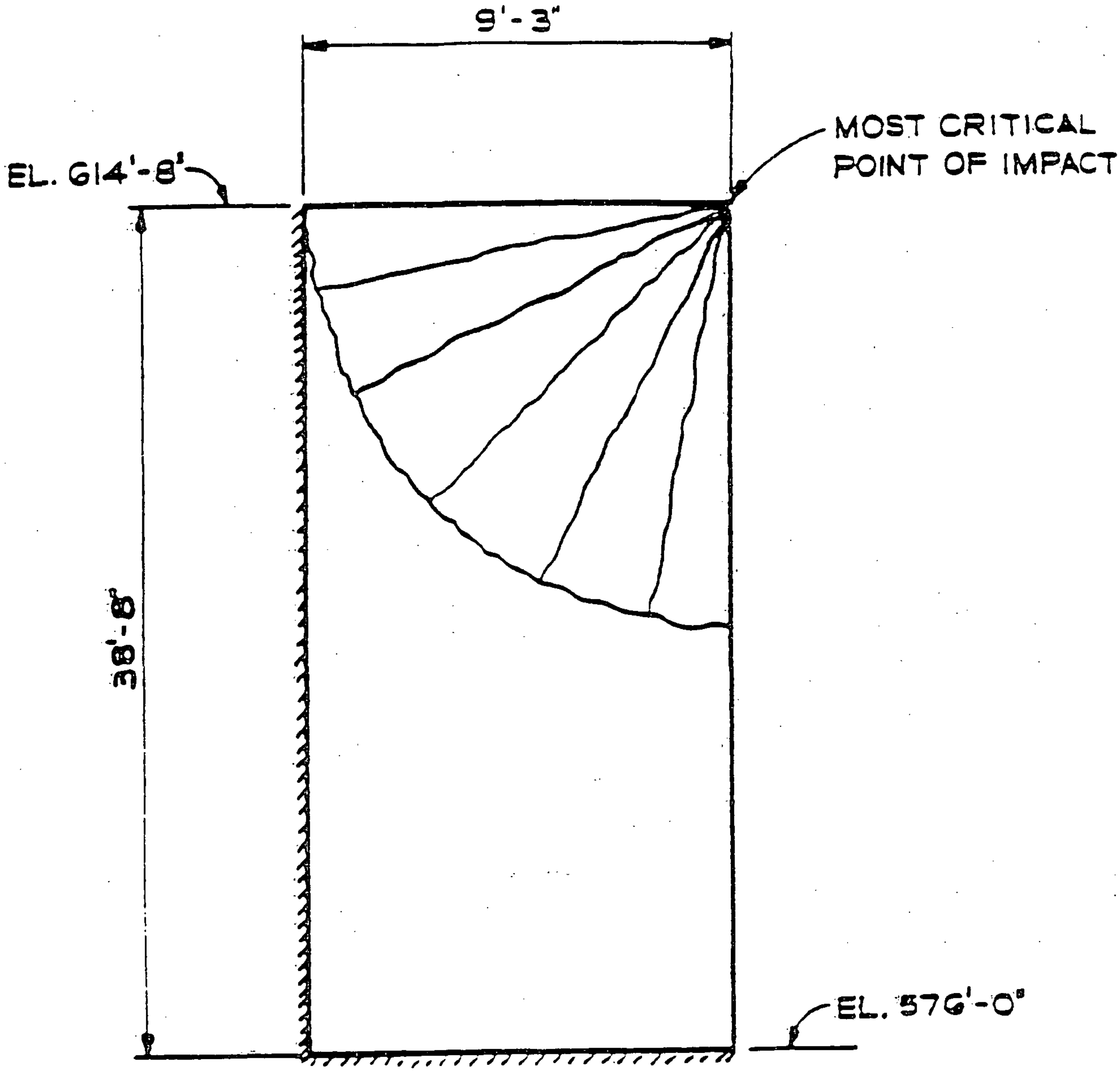


ZION STATION DSAR

Figure 3-36

ELEVATION OF FUEL HANDLING BUILDING – LOOKING SOUTH

AUGUST 1998

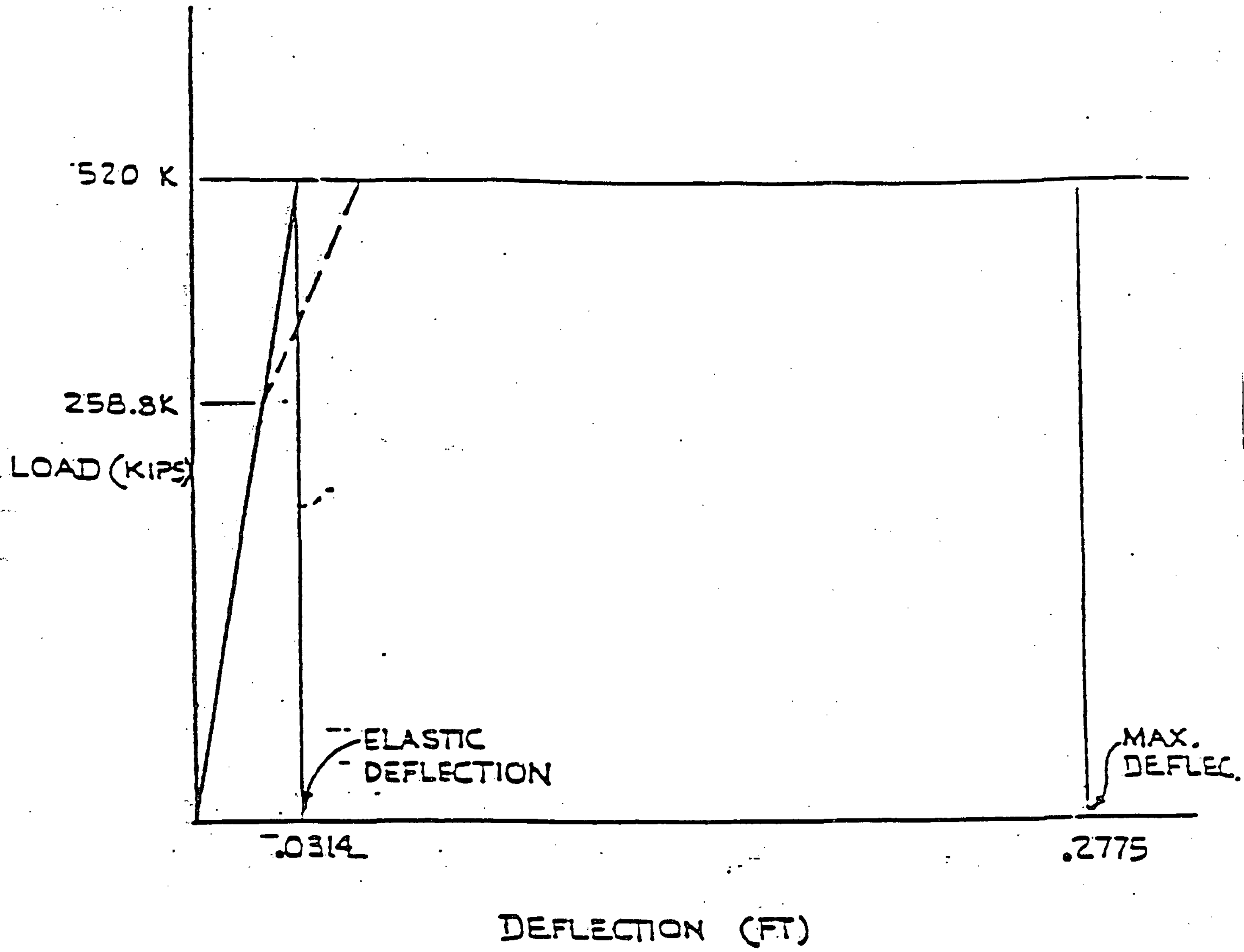


ZION STATION DSAR

Figure 3-37

YEILD LINE PATTERN FOR FLEXURAL FAILURE IN GUARD WALL

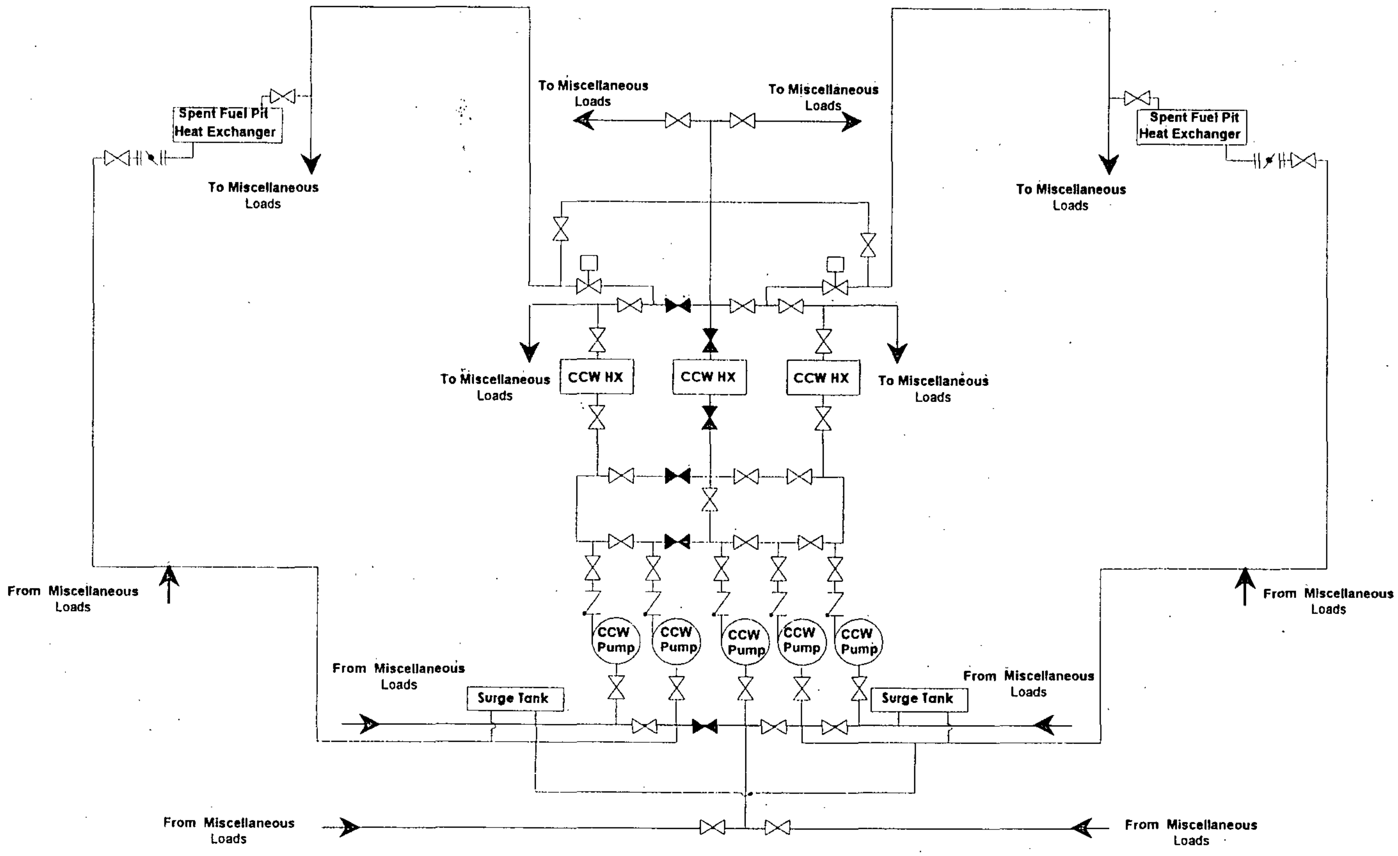
AUGUST 1998



ZION STATION DSAR

Figure 3-38
LOAD VS. DEFLECTION CURVE FOR GUARD WALL (FOR MOST CRITICAL POSITION)

AUGUST 1998



ZION STATION DSAR

Figure 3-39

COMPONENT COOLING WATER SYSTEM (SIMPLIFIED)

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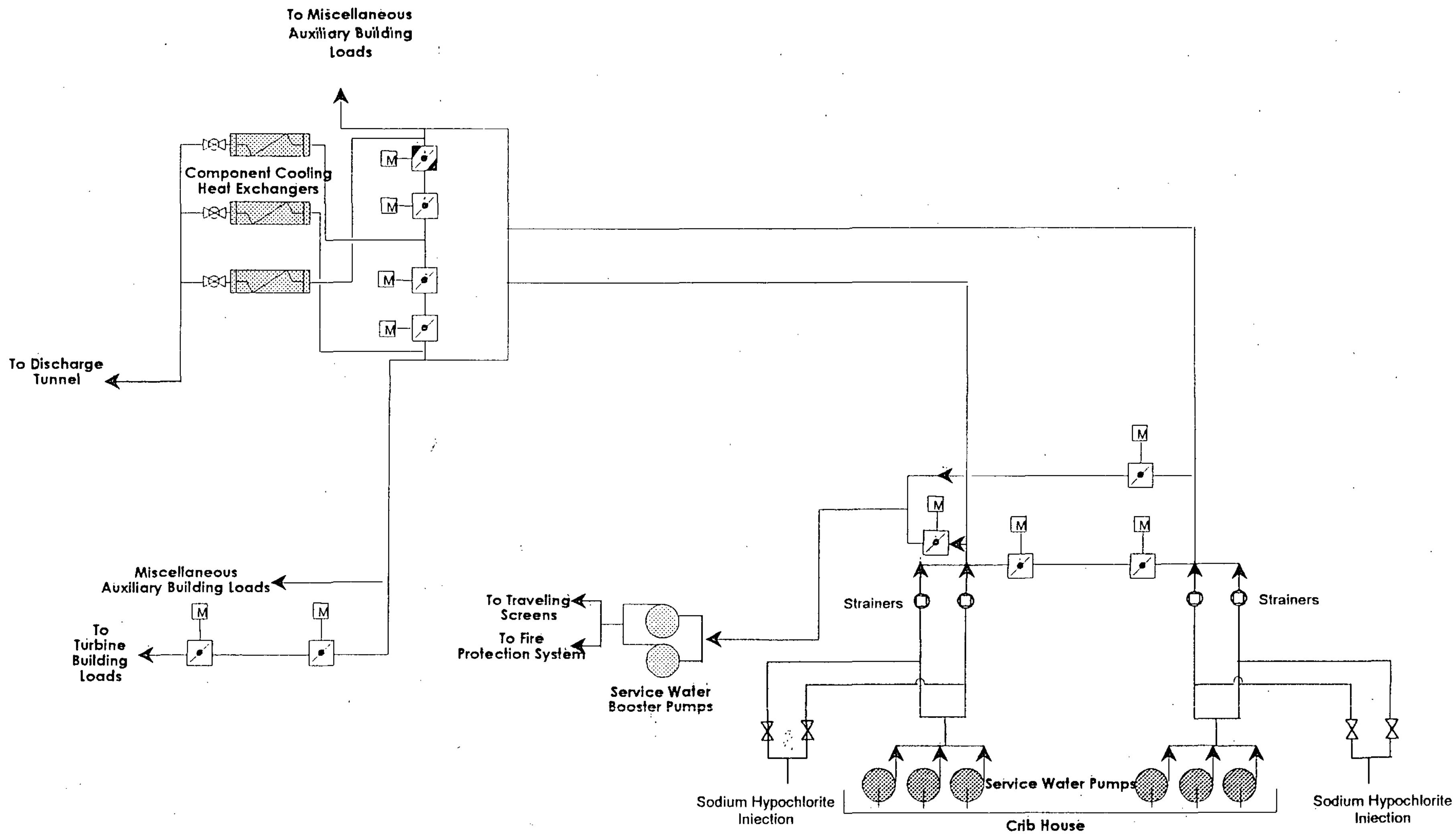

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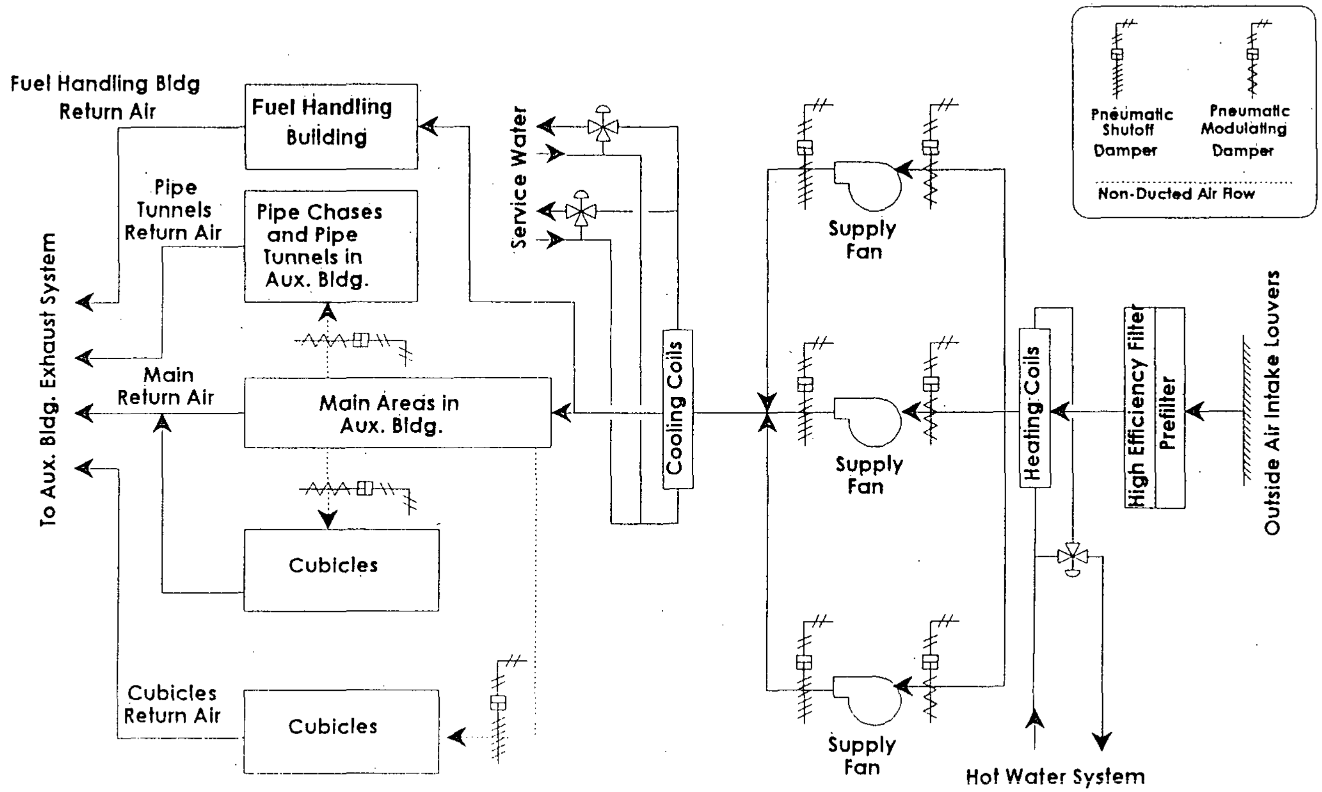
Figure 3-40

SERVICE WATER SYSTEM (SIMPLIFIED)

AUGUST 1998

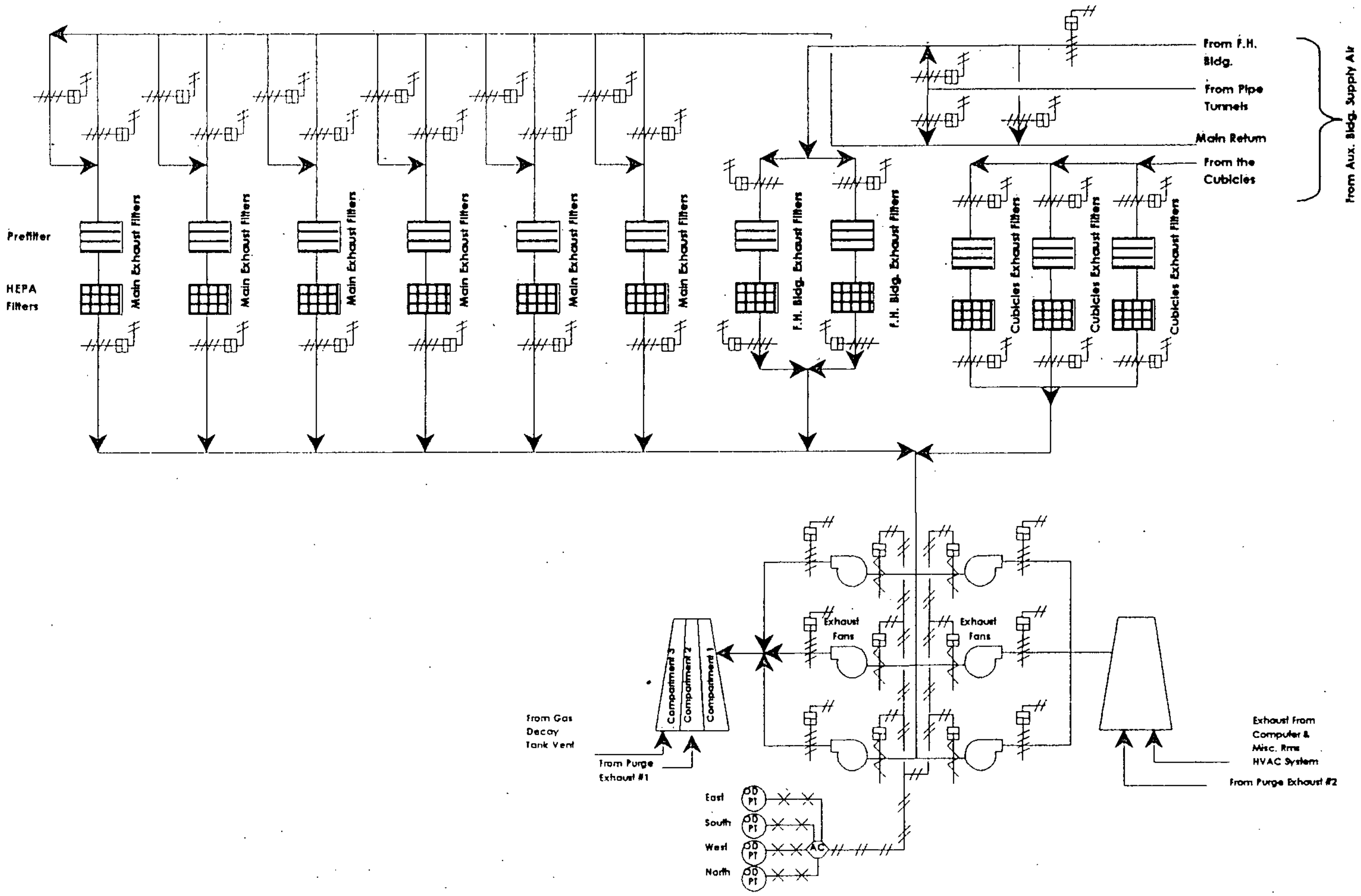


ZION STATION DSAR

Figure 3-41

AUXILIARY BUILDING VENTILATION SUPPLY SYSTEM (SIMPLIFIED)

AUGUST 1998

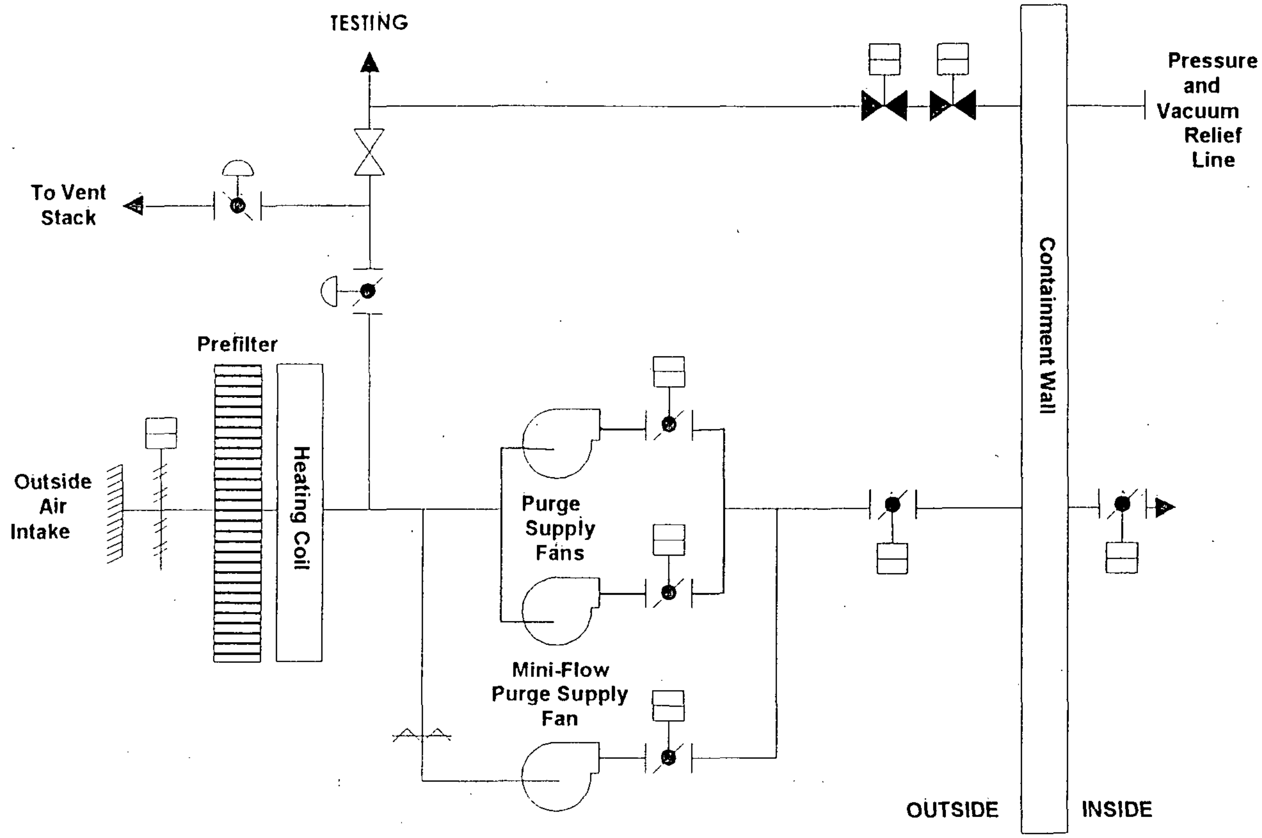


ZION STATION DSAR

Figure 3-42

AUXILIARY BUILDING VENTILATION EXHAUST SYSTEM (SIMPLIFIED)

AUGUST 1998

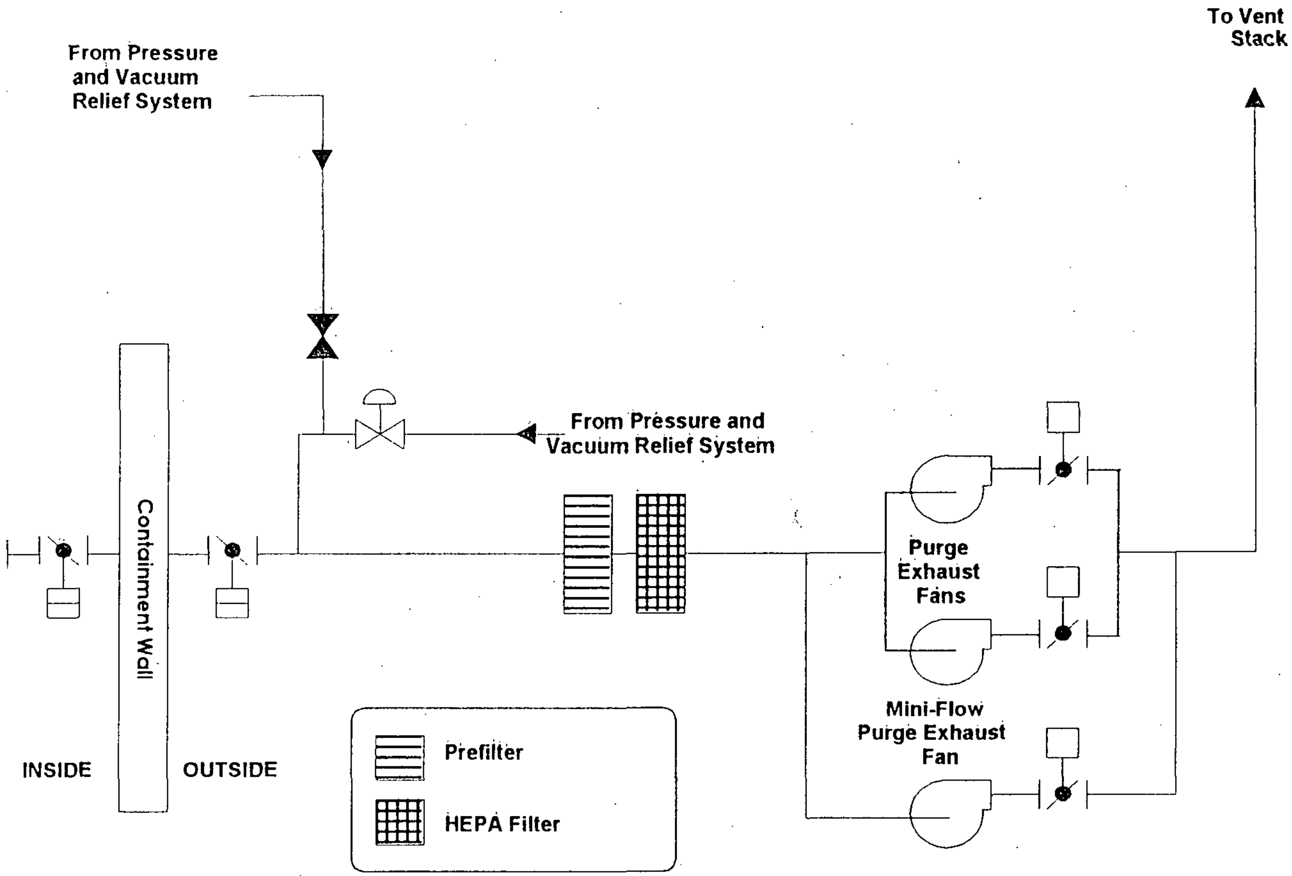


ZION STATION DSAR

Figure 3-43

CONTAINMENT PURGE SUPPLY SYSTEM (SIMPLIFIED)

AUGUST 1998

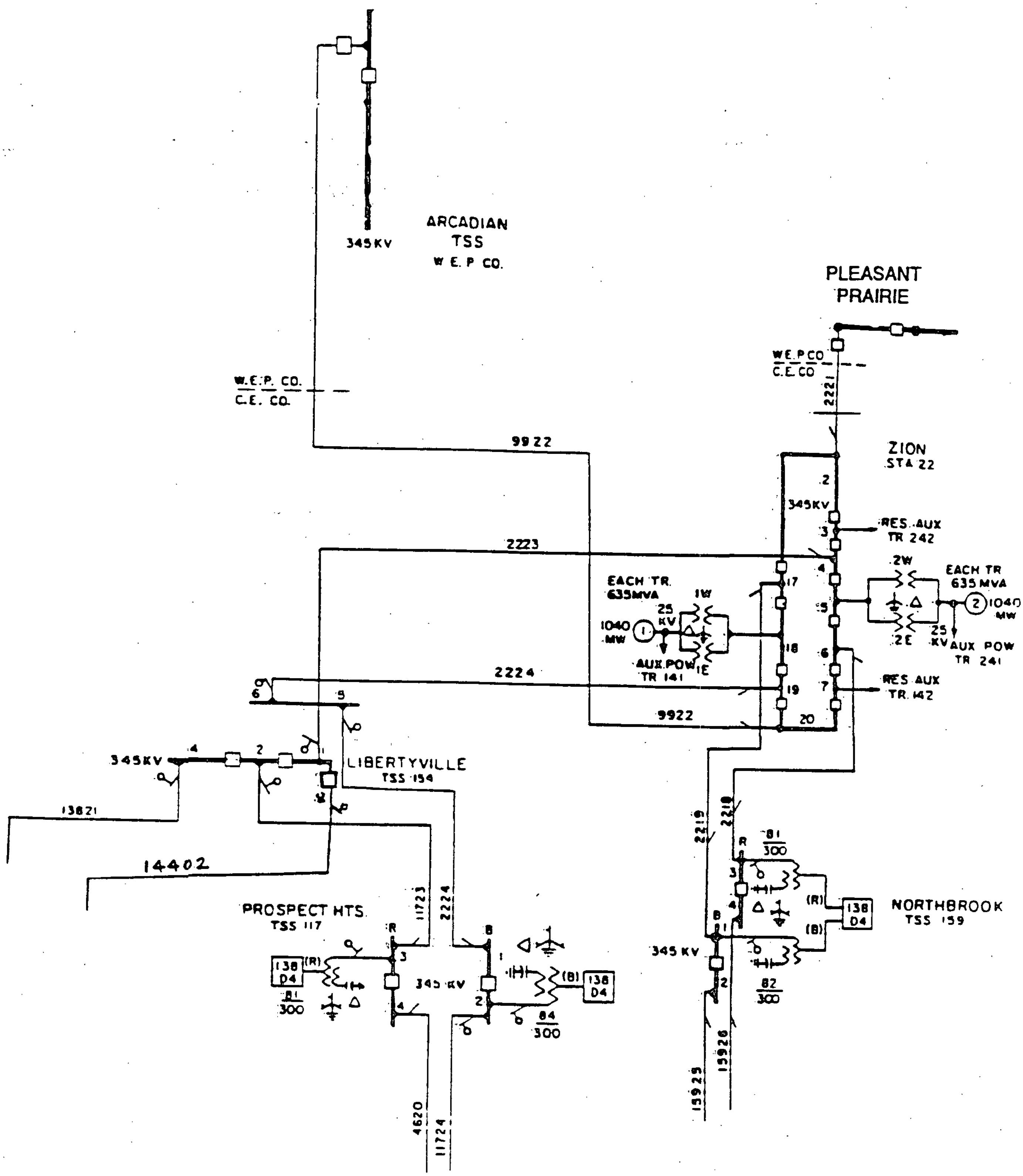


ZION STATION DSAR

Figure 3-44

CONTAINMENT PURGE EXHAUST SYSTEM (SIMPLIFIED)

AUGUST 1998

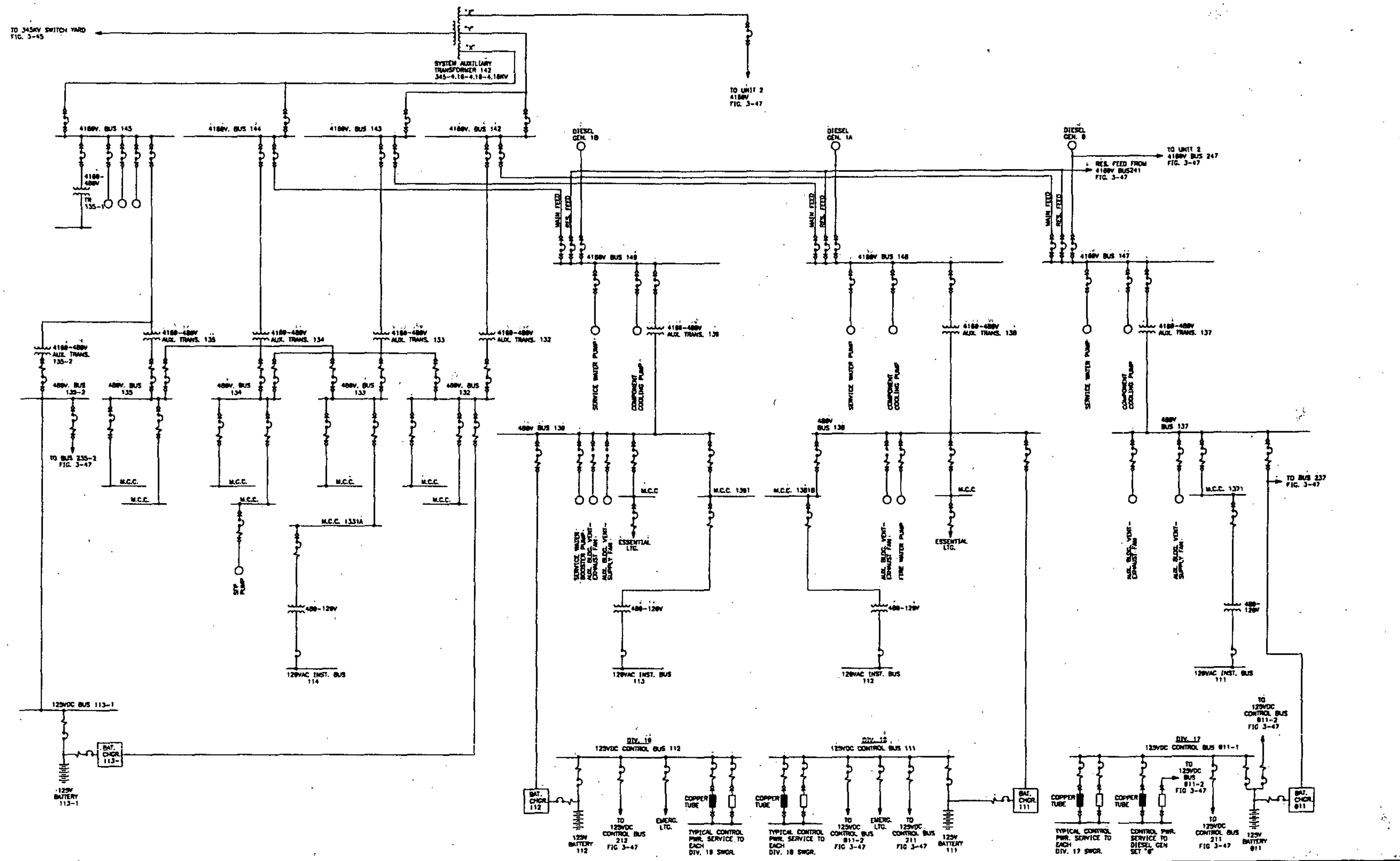


ZION STATION DSAR

Figure 3-45

345Kv INTERCONNECTION WITH TRANSMISSION SYSTEM

AUGUST 1998

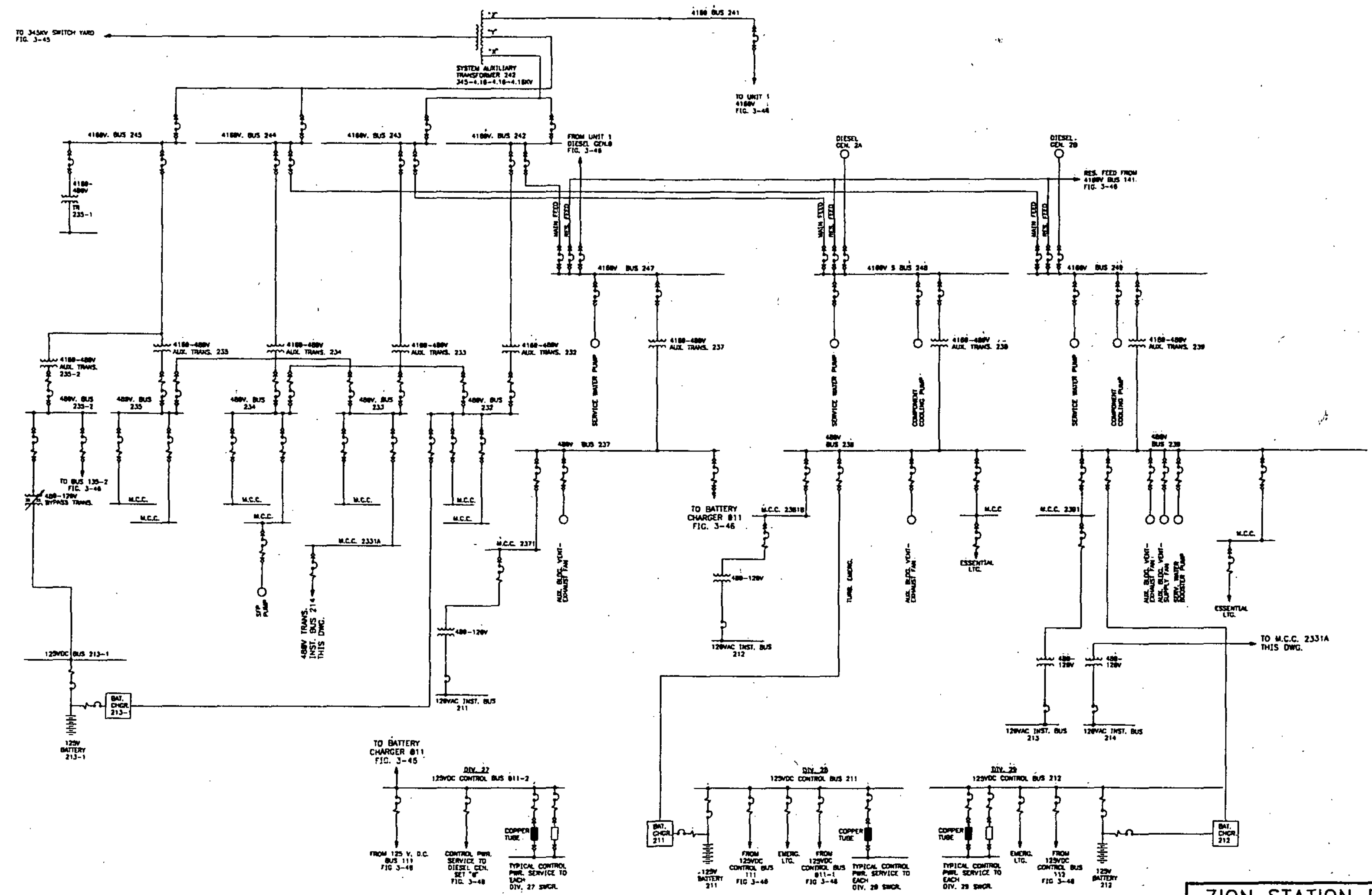


ZION STATION DSAR.

Figure 3-46

SINGLE LINE DIAGRAM
UNIT 1

AUG 1998

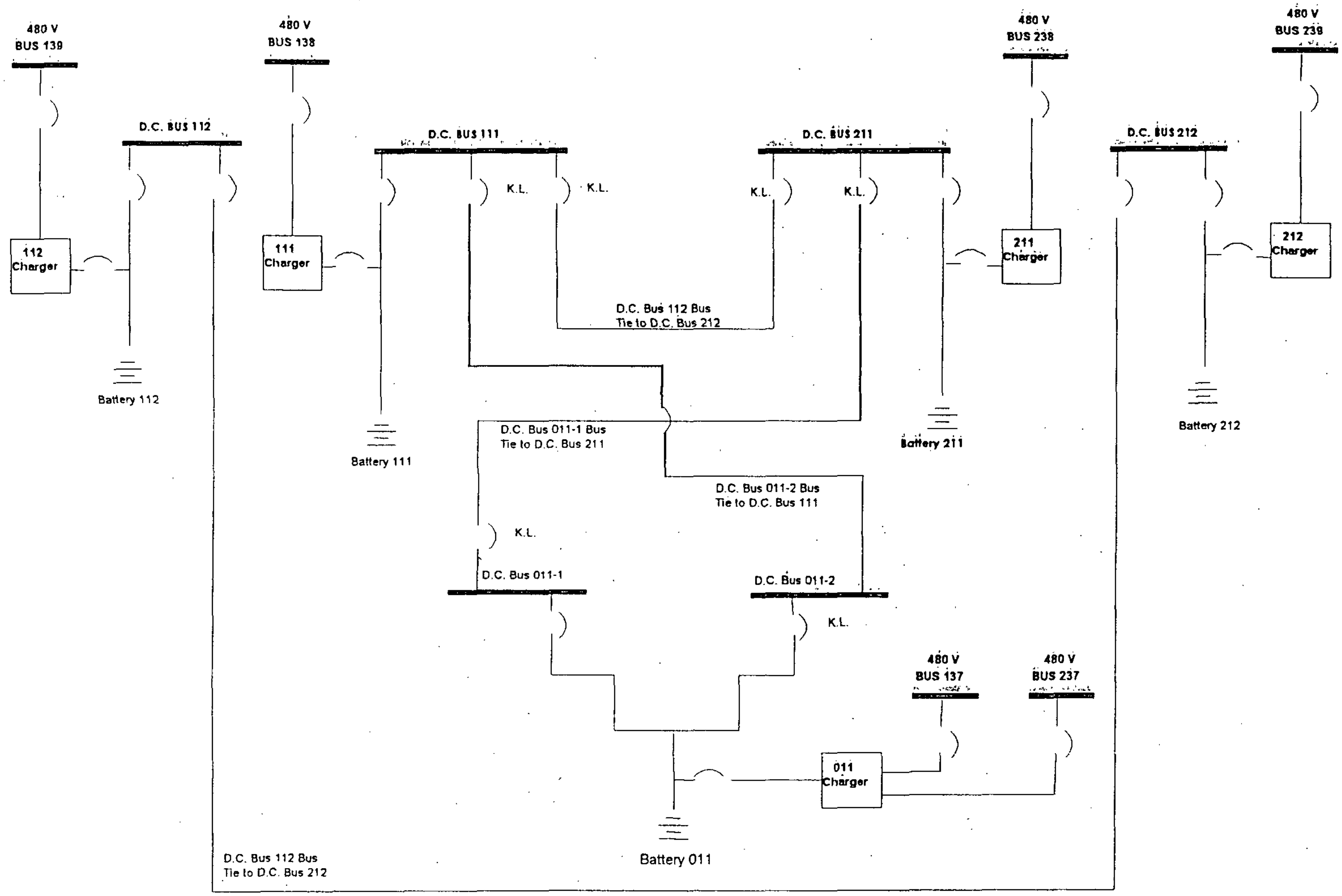


ZION STATION DSAR

Figure 3-47

SINGLE LINE DIAGRAM
UNIT 2

AUG 1998



ZION STATION DSAR

Figure 3-48

125V DC DISTRIBUTION SYSTEM

AUGUST 1998

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4. RADIATION PROTECTION

4.1 Ensuring That Occupational Radiation Exposures are As Low As Reasonably Achievable (ALARA)

Consistent with station modification, maintenance, operational requirements, and economic and social considerations, the policy of the Commonwealth Edison Company is to:

1. Maintain the occupational dose equivalent to the individual As Low as is Reasonably Achievable (ALARA);

2. Maintain the sum of occupational dose equivalents received by all exposed workers ALARA; and

3. Limit the number of workers authorized to receive exposure to radiation.

Regulatory Guide 8.8, Revision 3, Sections C.1, C.3, and C.4 is used as a basis for developing the ALARA and radiation protection programs.

Station management's commitment to this policy is reflected in radiological procedures and programs. The Radiation Protection staff provides the radiological conditions and protective requirements necessary to complete work safely. Each individual's responsibility to adhere to these requirements and the procedures governing their work is key to the success of the program.

4.2 Radiation Sources

The source terms used in the design and evaluation of Zion Station consists of the types and quantities of radionuclides that are produced in the fuel, primary coolant, and structural materials of the reactor coolant system, and the rate of transfer of these nuclides into other systems for an operating plant. In a permanently defueled plant, the number and magnitude of potential radiation sources have been reduced substantially from the original design bases source terms. The source terms in the defueled condition are bounded by the source terms existing during normal plant operations and relate to stored spent fuel, residual post operational radioactive material, structure and component activation, and new radioactive material generated during plant decontamination. The source terms used in the original plant design are historical information and are not discussed here since they are not applicable for a permanently defueled plant. The radiation protection program will continue to monitor appropriate areas to ensure proper confinement of existing radioactive material.

4.3 Radiation Protection Design Features

4.3.1 Shielding

The nuclear radiation shielding has been designed to prevent persons from being exposed to radiation in excess of that allowed by 10CFR20 and 10CFR100.

The source terms used in the design of plant shielding are based on full power operations, reactor shutdown, and design basis accidents. In the defueled condition, the source term of prime importance is from the spent fuel assemblies that are stored in the spent fuel pool. In addition, and to a lesser extent, filters and resins used in the processing of radioactive liquids also provide a source of radiation which require shielding for personnel protection. The source term values used in the original design of plant shielding conservatively bound the design requirements for the permanently defueled condition.

The following administrative procedures will be used to supplement the protection afforded by shielding:

1. Control of access to radiation areas,
2. Wearing of protective clothing and equipment,
3. Use of portable, stationary, personnel radiation monitors, and
4. Recording of personnel exposures.

4.3.1.1 Shielding Description

4.3.1.1.1 Auxiliary Building

Shielding protecting general access areas in the Auxiliary Building is designed to reduce radiation levels to an acceptably low level. General access areas are entered through access control stations and access is controlled through the Radiation Protection Program.

Concrete shielding is provided in the following major Auxiliary Building areas:

Mixed Bed Demineralizer Cubicles
Reactor Coolant Filter Cubicles
Radwaste Drum Fill and Storage Areas
Spent Resin Storage Tank Cubicle

A shielded drum is used to remove a spent cartridge filter and transport the filter by means of a dolly to the Radwaste Facility as necessary.

4.3.1.1.2 Fuel Handling Building

The Fuel Handling Building houses the spent fuel pool and associated pumping, cooling, and filtering equipment. The spent fuel pool provides water shielding of approximately 25 feet over the stored spent fuel. The minimum wall thickness of the pool is 6 feet 0 inches of ordinary concrete.

Concrete shielding is provided for the following spent fuel pool service equipment:

Heat Exchangers
Pumps
Skimmer Filter
Demineralizer After Filter

4.4 Health Physics Program

4.4.1 Equipment, Instrumentation, and Facilities

4.4.1.1 Personnel Monitoring

All personnel entering radiologically posted areas onsite are required to wear personnel monitoring devices, except for visitors. The minimum requirements include an electronic dosimeter (or its equivalent) and a thermoluminescent dosimeter (TLD) badge. Additional dosimeters such as finger rings, electronic dosimeter, high range pocket dosimeter, neutron dosimeter, etc. are required when radiological conditions warrant their use. Visitors to the station who enter radiologically posted areas are required to either wear the minimum dosimetry described above, or they are provided with an escort who will wear an extra TLD badge to collectively monitor their dose. As a minimum, each visitor will wear an electronic dosimeter (or its equivalent) inside posted areas.

As a general rule, the TLD badge will provide the official record of personnel exposure. If this device is lost or fails to respond properly, the official record will be determined by a health physicist after evaluating electronic dosimeters, radiation surveys, radiation timekeeping records, etc. The electronic dosimeter readings (or equivalent) and applicable timekeeping results are normally recorded daily. These records are routinely reviewed by radiation protection management and, if applicable, by management in the individual's work group. The TLD badges are changed at regular intervals. Badge results are reviewed by Health Physics Management and are entered in the Commonwealth Edison Company computerized dose records system. These official and permanent records provide the exposure data for the administrative control of radiation exposure. Required exposure reports are made by radiation protection management utilizing the dose records system.

A portal personnel radiation monitor is provided at the plant exit for monitoring of surface and internal activity of people leaving the plant. The portal monitor provides for complete head-to-foot coverage. The portal console monitor located on the portal frame includes status lights including a contamination alarm. The contamination signal from the console alerts personnel to the contamination condition so that the proper action can be taken.

4.4.1.2 Protective Clothing

The nature of the work to be done and the radiological conditions are the governing factors in the selection of protective clothing to be worn. Examples of the protective apparel available are shoe covers, rubber overshoes, head covers, beanies, gloves (cotton liners and rubber gloves), and coveralls or lab coats. Additional items of specialized apparel such as plastic or rubber suits, face shields, and respirators are available for operations involving high level contamination and airborne radioactivity areas. In all cases, radiation protection personnel shall evaluate the radiological conditions and specify the required items of protective clothing.

Controlled areas are posted as radiation areas, high radiation areas, radioactive materials areas, airborne radioactivity areas, or combinations thereof. Access to controlled areas for all work is authorized in accordance with the Radiation Protection Program and Procedures. An uncontrolled area is that area within the Station security fencing that is not part of a controlled area.

4.4.1.3 Physical Barriers for Access to High Radiation Areas

Areas in which the radiation levels could result in a whole body radiation exposure of greater than 1000 mrem in one hour at 30 cm from the source are equipped with locked doors or appropriate barriers to prohibit unauthorized entry. A key control procedure is implemented to ensure positive control of each entry to locked high radiation areas.

4.4.1.4 Monitoring and Change Room Facilities

The general arrangement of the plant is designed to provide adequate personnel decontamination and change areas. Local change areas are provided for control of radioactive contamination at the job site. Clothing racks, hampers, and step-off pads, are provided in these areas. A radiation monitor (frisker) is provided as practicable at the exit from contaminated areas. Personnel are instructed to check themselves for contamination before leaving. Use of personnel monitoring devices, such as portal monitors, friskers, etc., are required before leaving the Auxiliary Building. A portal monitor, as described earlier in this section, is located in the Gate House. Each person leaving the plant is required to pass and check through this monitor.

4.4.1.5 Records

Logs are kept in the Control Room or other appropriate locations to record the various unit operations and conditions. Each shift records sequentially in these logs such items as status of unit equipment, malfunctions, trips (including the reasons therefore), changes in operating conditions, tests and measurements performed by the operators, and other information of a significant nature. In addition to the logs, separate log sheets are also maintained for significant routine data and special tests or measurements.

Records of personnel radiation exposure histories and radioactivity discharged to the environment (at or prior to the point of such discharge) are maintained by the Radiation Protection Department.

Records of principal maintenance operations involving substitution or replacement of equipment or components and the reasons therefore are maintained in the Records, Retention, and Retrieval System.

4.4.2 Procedures

The Radiation Protection Program and Procedures are designed to provide protection of personnel against exposure to radiation and radioactive materials in a manner consistent with applicable regulations. The policy of Commonwealth Edison Company is to maintain personnel radiation exposure As Low as is Reasonably Achievable (ALARA). Therefore, each individual is trained to minimize his exposure consistent with discharging his duties. Each individual is responsible for observing rules adopted for his safety and that of others.

Radiation protection personnel evaluate radiological conditions of operations and establish the procedures to be followed by all personnel. They ensure that all applicable regulations are complied with and that the required radiation protection records are adequately maintained.

Training of operators, maintenance, and technical personnel in radiation protection principles and procedures took place before initial unit operation. New employees, contractors, and other supporting personnel are given initial training at the beginning of their work assignments and annual retraining thereafter.

Procedures are in place which require performance of ALARA reviews, as necessary, of proposed plant design changes and modifications.

4.5 Radioactive Waste Management

4.5.1 General

Radioactive waste management is maintained through the use of the Liquid and Solid Waste Systems. These systems collect, process, monitor, and regulate the discharge of all potentially radioactive wastes from both units. Storage of radioactive gaseous waste for decay is not anticipated in the defueled condition. The contents of the six gas decay tanks have been sampled and determined to have negligible activity. As such, the Gaseous Waste System is not important to the defueled condition of the station and is not discussed as part of Radioactive Waste Management. The design of the waste systems is in accordance with USNRC Regulatory Guide 1.143.

Normally, all waste systems are operated remotely so as to minimize the radiation exposure of plant personnel. Waste processing is a batch-type operation which allows a determination of the activity to be discharged before any action is undertaken to make the actual release. Monitoring equipment is provided to maintain surveillance over the release operations and to halt these operations on indication of radioactivity concentrations above established limits.

The design of the waste systems was based on 1% of the fuel rods releasing fission products into the coolant by diffusion out of the pellets through defects in the cladding. In the defueled condition, the normal sources of radioactive wastes are activated corrosion products and fission products generated during power operations, liquid wastes generated while maintaining spent fuel pool water chemistry, liquid wastes generated during decommissioning activities, ground water in-leakage through contaminated areas in the auxiliary building, and solid wastes in the form of spent demineralizer resins, filters and sludge. Since neither of the Zion Station reactor cores operated with 1% failed fuel, the design of the Radioactive Waste Systems in the defueled condition is bounded by the original design of the system.

4.5.2 Liquid Waste Management System

4.5.2.1 Design Basis

The Liquid Waste Systems are designed to collect, store, process, monitor, and dispose of liquid radioactive waste from the station. The principle design criteria for the Liquid Waste Systems are as follows:

1. Ensure that the quantities of radioactive waste discharged from the plant during normal operation are as low as practicable and, in any event, well within the allowable concentration limits; and

2. Limit the inadvertent release of radioactive material from the plant so that the resulting radiation exposure to the public is as low as practicable and, in any event, well within the allowable concentration limits.

The allowable concentration limits described above are defined as 10 times 10CFR20 limits for batch releases from the Lake Discharge Tanks.

4.5.2.2 System Description

Liquid waste is processed on a batch basis using filtration and/or demineralization. The method of processing that is utilized is dependent on the type of waste.

Processed waste to be released is discharged from one of two lake discharge tanks into the circulating water discharge canal for dilution before entering the lake and, in the case of turbine building wastes and other low level secondary wastes, they may be sent to the Wastewater Treatment Facility (WWTF) which discharges to the intake fore-bay.

Surveillance requirements for radioactive liquid releases are stipulated in the Offsite Dose Calculation Manual, Section 12.3. Liquid waste, low enough in activity level to be released, is discharged on a batch basis from one of two 30,000-gallon lake discharge tanks. The tank containing the batch to be discharged is isolated so that no additional waste can be added to it. The batch of liquid waste is mixed by recirculation to assure uniformity and is then sampled. The sample drawn from the lake discharge tank is analyzed for gross alpha, gross beta, radio-isotopic profile, and tritium activity. Based upon this analysis, a discharge rate is determined so that when the batch is released and diluted by the plant circulating water and/or service water, the individual radio-isotopic concentrations in the discharge leaving the plant site is less than the allowable concentration limits. Normally, the waste discharge is a small percentage of allowable concentration limits. At no time during waste discharge is the water leaving the plant and entering the lake above the allowable concentration limits.

Before liquid waste can be released from a lake discharge tank, a locked closed valve must be opened. The key for this valve is retained by the operations department personnel, and the analysis of the sample must be approved by the shift supervisor or his designated alternate. As a further backup, a radiation detector monitors the radioactive system discharge line that feeds the circulating water discharge line. Upon detecting an abnormal level, a valve closes and an alarm signal is actuated. As a final check, the circulating water discharge is sampled and analyzed per the Radiological Effluent Monitoring Program as described in ODCM Section 12.5. Detailed records are maintained of all radioactive waste discharged to the environs. A simplified sketch of the Liquid Waste System is provided as Figure 4-1. Specific tank details are listed in Table 4-1.

4.5.2.3 Design Features Important to the Defueled Condition

The Liquid Waste Management System, as described in section 4.5.2.2, is considered Important to the Defueled Condition.

4.5.2.4 Wastewater Treatment Facility

The Wastewater Treatment Facility (WWTF) is designed to treat nonradioactive and low level radioactive liquid from many facility sources including building roof runoff and the turbine building fire sump, which receives input from the turbine building equipment and floor drains. The Steam Generators may also be drained to the turbine building fire sump in the future. To prevent excessive contamination of the WWTF, the fire sump discharge is monitored for radioactivity and sampled and analyzed per the ODCM. Should high radioactivity be detected, piping connections are in place to divert sump fluids for radwaste processing. The critical treatment units in the WWTF are provided in duplicate to provide operational reliability and maintenance capability.

The WWTF is designed to remove suspended solids and oil to the level acceptable to the Illinois Environmental Protection Agency and to ensure compliance with the facility National Pollutant Discharge Elimination System (NPDES) permit. Since the wastewater discharge rates are variable, an equalization tank is provided to maintain a more nearly uniform flow to the treatment facilities. The WWTF also includes other equipment such as: mixing tanks, mixers, oil skimmers, flocculators, oil coalescers, clarifiers, sludge drying beds, filters, etc.

Discharge from the WWTF is by gravity to the Intake forebay.

4.5.2.5 Oil Separator System

The Oil Separator System is designed to treat turbine building equipment and floor drains for release. The oil separator consists of an oil separator tank, which provides for oil coalescing, oil skimming, and oil baffling. Discharge from the oil separator tank is pumped by feed pumps to the fire sump and eventually to the WWTF.

4.5.2.6 Design Features Important to the Defueled Condition

The Wastewater Treatment Facility, as described in section 4.5.2.4 above, is considered Important to the Defueled Condition in order to meet Illinois Environmental Protection Agency requirements and compliance with the NPDES permit.

4.5.3 Solid Waste Management System

4.5.3.1 Design Basis

The principal design criteria for the Solid Waste System are as follows:

1. Package radioactive solid wastes for offsite shipment and burial in accordance with applicable regulations; and

2. Minimize the release of radioactive materials to the environs so as to keep the overall exposure to the public as low as practicable and, in any event, within the limits of 10CFR20.

Solid waste is divided into two categories – wet waste and dry active waste (DAW).

Wet waste consists of spent demineralizer resins, miscellaneous tank and sump solids, and contaminated oil.

DAW is the descriptive term applied to radioactively contaminated dry industrial trash generated at nuclear power facilities. DAW may further be distinguished between compactible and noncompactible components. Compactible DAW can be composed of protective clothing, plastic, paper, rubber, and similar materials. Non-compactible DAW can be composed of cartridge filter elements, wood, glass, concrete, and metals. Compactible DAW is generally compressed to reduce its volume by various volume reduction techniques such as pre-compaction, super-compaction, and, potentially, incineration.

4.5.3.2 System Description

4.5.3.2.1 Processing of Spent Demineralizer Resins

Spent demineralizer resins are transferred either into the spent resin storage tank or directly into a shipping container in the Radwaste Annex Building.

Specifications for the spent resin storage tank are as follows:

Number	1
Location	Auxiliary Building, El 617'
Capacity	5000 gallons
Materials	Type 304 Stainless Steel
Design Pressure	100 psig
Design Temperature	150°F
Code	ASME Section III, Class C

The water level in the spent resin storage tank is always maintained above the actual level of the spent resins. The volume of resin in the tank is determined prior to processing of resin to ensure available capacity. A level indicator allows the operator to establish a liquid level in the tank at a volume greater than that occupied by the resin. Primary makeup water is added if necessary. After the level is established, the tank is isolated by closing all valves. The tank is equipped with piping and a pump for recirculation. Piping is installed between the spent resin storage tank and the Radwaste Annex Building for transfer of spent resins.

Packaging of spent resins involves transfer to containers located in the Radwaste Annex Building. The resins are then solidified or dewatered in accordance with approved vendor Process Control Programs under 10CFR61.

4.5.3.2.1.1 Design Features Important to the Defueled Condition

The Resin Removal System, as described above, is considered Important to the Defueled Condition.

4.5.3.2.2 Processing of Miscellaneous Tank and Sump Solids

Miscellaneous tank and sump solids are simply dewatered or solidified in accordance with approved Process Control Programs.

4.5.3.2.3 Processing of Contaminated Oil

Contaminated oil is collected for batch processing. Methods that may be used for processing contaminated oil are:

1. solidify all of the collected oil.
2. perform a separation process that separates contaminated from uncontaminated oil (on-site or off-site). The separation process produces: A) uncontaminated oil which can be free released, B) solid waste, and C) contaminated oil which is then solidified.
3. Off-site incineration.

4.5.3.2.4 Processing of Dry Active Waste

All DAW is segregated for waste type.

Compressible wastes may be compacted to reduce volume. A hydraulic drum compactor is located adjacent to the decontamination pad at the north end of the Auxiliary Building, El 592'. The compactor is operated locally and exhaust air is vented through HEPA filters, or containers are shipped offsite for further volume reduction and then burial. Some containers may be sent directly to burial.

Non-compressible wastes are packaged in shipping containers. Containers are visually inspected for structural integrity prior to packaging for shipment. Because of the low activity, DAW can be stored until enough is accumulated to permit: 1) economical transportation to an offsite burial ground for final disposal, or 2) transportation to an offsite facility for further volume reduction.

4.5.3.2.5 Waste Storage

Storage of all containers of waste in final form is either in the Drumming or Shipping Rooms, El 592'. Liners and packaged radwaste material may be stored in the Interim Radwaste Storage Facility (IRSF). Additional storage for DAW is provided outside and in the DAW Storage Buildings.

4.6 Radiation Monitoring Systems

4.6.1 Design Bases

The Radiation Monitoring System is designed to detect, compute, indicate, annunciate and record the radiation levels at selected locations in the plant. The system is divided into the following subsystems:

1. The process radiation monitoring system, which includes the effluent monitors, is designed to provide early warning of increasing radiation activity due to a malfunction of plant equipment, and to monitor radioactive discharges to the environment to ensure concentrations do not exceed specified limits.

2. The area radiation monitoring system is designed to alert personnel of increasing radiation activity that might result in a radiation health hazard.

In the defueled condition, radioactive material exists in the form of particulates and noble gases. Radioactive isotopes of iodine present during normal plant operations are no longer present. As such, the instrument channels in the radiation monitoring system monitor either particulates or gases.

None of the radiation monitors are relied upon to initiate an accident mitigation function for the events described in Chapter 5.0. In the event of an accident releasing radionuclides, the process radiation monitoring system and area radiation monitoring system will provide information on the dispersion and concentration of radioactivity throughout the plant. This will enable personnel to evaluate the severity of the event and respond accordingly.

4.6.2 Process and Effluent Radiological Monitoring and Sampling Systems

4.6.2.1 System Description

The Process Radiation Monitoring System consists of channels which primarily give early warning of an equipment or system malfunction and also warn personnel of increasing radiation which might result in a radiation health hazard.

All radiation monitoring channels employ instrument failure alarms at the radiation monitoring cabinets, at local indicators (where provided), and on the Radiation Monitoring Display System (RMDS) in the Main Control Room. Instrument failure alarms are initiated upon failure of the radiation monitor, loss of detector signal, loss of power, or, for offline detectors, loss of sample flow. Control interlocks fail in the high radiation position upon instrument failure and must be manually reset.

Radiation monitor trip points are established in accordance with the Offsite Dose Calculation Manual (ODCM) to ensure "an as low as practicable" site boundary dose is obtained which is consistent with the design characteristics of the monitoring equipment, and acceptable operating considerations.

The Process Radiation Monitoring System consists of numerous channels with detectors located throughout the plant at the measurement location. The computing and readout equipment is located in cabinets in the Control Room and in consoles located in the Main Control Board area.

4.6.2.1.1 SPING Radiation Monitors

The SPING (System Particulate, Iodine, and Noble Gas) monitors are a self-contained microprocessor-based radiation detection system used to detect particulates, iodines, and noble gases in the atmosphere. The system is controlled by an onboard microcomputer. The microcomputer performs the tasks of data acquisition, history file management, operational status check, and alarm determination. Each unit's microcomputer links to a central console in the Control Room. All processes can be controlled by the operator from the central control console.

Decay has eliminated the radiological hazards associated with radioiodines, therefore the iodine channels do not provide a useful function in the defueled condition. Therefore the iodine channels are no longer addressed or considered part of the Process Radiation System.

The particulate monitor consists of a beta scintillation detector monitoring a filter paper collecting particulate. Counts from the beta detector measure the amount of beta-emitting isotopes on the filter. The alpha detector measures the radon/thorium levels in the sample. A factored amount of the alpha measurement can be subtracted from the beta measurement. This provides a means of nullifying the effects of fluctuating radon/thorium levels in the beta particulate measurement.

The noble gas measurement is performed by three detectors viewing a sample volume. The low and medium range detectors view the same sample assembly. The high-range noble gas detector is an option installed on the auxiliary building vent stack and containment SPING monitors. Low-range noble gas activity is monitored by a beta scintillation detector. Mid- and high-range noble gas activities are each monitored by one energy-compensated Geiger-Mueller detector.

4.6.2.1.1.1 Containment SPING Air Monitor

The containment SPING air monitor is designed to supply the operator with information on the beta particulate activity in the containment air during purging operations. A high radioactivity alarm from the containment SPING air monitor will automatically institute containment ventilation isolation by closing the pressure and vacuum relief isolation valves and the containment purge isolation valves.

The monitor draws its sample from the containment atmosphere by a sample line located at El 617' of Containment near the containment wall approximately midway between the purge valves and the personnel hatch. The sampled air is analyzed in a closed system outside of the containment, and then returned to the containment. Moisture removal equipment is installed to remove condensate from the air sample. The sample is passed through a filter paper which collects particulate matter and is viewed by a beta scintillation detector. The air sample is then monitored before being returned to the containment at El 604'.

The detector output is transmitted to the SPING system control terminal console in the Control Room and displayed on the RMDS when the appropriate screen is selected. The radioactivity level is output on the console at the request of the operator. High radioactivity indications are displayed by an alarm and automatic data output at the control console. The system can detect, quantify, and identify alpha and beta particulate. The monitors are located in the Fuel Building and alarm locally.

Isolation valves are installed on the inlet and discharge sample lines to the monitors to allow for maintenance and calibration.

4.6.2.1.1.2 Auxiliary Building Vent Stack SPING Air Monitor

This vent stack SPING continuously monitors the vent stack effluent for beta and alpha particulate and noble gas. The monitor outputs data and alarms to the SPING central control console.

This monitor outputs low flow and flow irregularity alarms to the control console.

This SPING monitor is different from others in that it has no self-contained pump to induce a sample flow through the SPING. The sample is fed to the SPING by the Isokinetic Sampling System at a flow rate of up to approximately 2 cfm. The purpose of this system is to regulate the sample flow to accurately duplicate stack gas velocity and pressure to the vent stack SPING monitor. This allows a valid indication of the radiological content of the vent stack effluent.

4.6.2.1.2 Liquid Radiation Monitors

The liquid radiation monitors are a set of self-contained monitors used to measure radioactivity levels in liquid process and effluent streams. Table 4-3 provides a list of these monitors and identifies their tag numbers and sensitivities.

Detector outputs are transmitted to the Radiation Monitoring System cabinets in the Control Room. The radioactivity levels are indicated by the module meters and RMDS displays and recorded on paper. High radioactivity-alarm indications are displayed on the RMDS in addition to the Radiation Monitoring System cabinets.

4.6.2.1.2.1 Component Cooling Loop Liquid Monitor

This channel continuously monitors the component coolant loop for activity indicative of a leak in the Spent Fuel Pool Cooling System heat exchanger tube. A scintillation counter inserted in an inline well is used as the detector. No automatic trip functions are employed.

4.6.2.1.2.2 Waste Disposal System Liquid Effluent Monitor

This channel continuously monitors all Liquid Waste System releases from the lake discharge tanks. A scintillation detector in a shielded assembly monitors all effluent discharges. Automatic valve closure action is initiated by the waste disposal system liquid effluent monitor to prevent further release after a high radioactivity condition is indicated or alarmed. The valve is located over 250 feet downstream of the monitor to allow closure prior to any radioactive release to the lake.

The accuracy of these monitors will be maintained to provide a highly reliable backup to the multiple sample analyses prior to discharge. A single monitor is provided on each discharge line and is considered adequate since the tank sample analyses are the primary method for determination of allowable discharge volume and flow. The release of liquid waste is performed under administrative control and these channels provide continuous monitoring during the release.

4.6.2.1.2.3 Fire Sump Discharge Liquid Monitor

The fire sump discharge liquid monitor is installed on the discharge of the fire sump pumps. A liquid proportional composite sampler is also installed on this discharge line. Upon actuation of the high radiation alarm from the fire sump discharge liquid monitor, the permanently installed fire sump pumps are automatically tripped to terminate release of radioactivity to the lake.

4.6.2.2 Calibration and Testing

Each channel employs an isotopic check source for channel testing. For many of these channels, the check source test is initiated at the Radiation Monitoring System cabinets or RMDS console. Check source testing of selected monitors requires local operation. Westinghouse supplied monitors can be tested online, without actuating interlocks, by increasing the interlock setpoint above the check source activity level.

All radiation monitors are calibrated by exposing the detectors to an isotope(s) of known activity. By changing the distance or placing filters between detector and the standard isotope, the field intensity is varied thereby allowing for a multi-point calibration. Channels employing count rate meters may be electronically calibrated via a pulse generator input.

The waste disposal system liquid effluent monitors are calibrated by the use of two (2) isotopic standards of different intermediate activity levels. The standards are monitored during calibration in a configuration similar to that of the monitored sample during normal operation. This method allows for an accurate isotopic calibration without contamination of the system.

The method of calibration of laboratory radiation counting instrumentation is in accordance with the vendor's manual. Complete documentation of calibration checks is maintained.

4.6.2.3 Effluent Monitoring and Sampling

The methods used in quantifying routine effluent releases to the environment consist of continuous Radiation Monitoring Systems and the laboratory analyses. Laboratory analyses are conducted on either grab samples or composite samples.

All liquid and gaseous effluents are scanned and logged in the Rad Monitor Display System (RMDS) computer thereby providing a complete history of abnormal occurrences for evaluation; high radiation levels alarm in the Control Room.

The high radiation alarm setpoints are based upon a value of activity which is sufficiently low to be in conformance with the concentration limit requirements.

Laboratory instrumentation used for radiation analysis of effluent grab samples are as described in the Offsite Dose Calculation Manual (ODCM). The calibration of counting equipment will be maintained by the use of sources certified against the National Institute of Standards and Technology (NIST) certificates.

Effluent monitors will be calibrated at frequencies established in the ODCM. The multi-channel gamma analyzer will be performance checked daily when in use. Sources are used to verify against known energy lines and activity. Geometry factors will be checked yearly. The liquid scintillation counter will be checked weekly.

Complete documentation of all calibration checks will be maintained.

Effluent discharge line waste monitors will be checked against laboratory analyzed or established known portable sources.

4.6.2.4 Design Features Important to the Defueled Condition

The Process Radiation Monitoring System Components, as described in section 4.6.2.1, and as shown in Table 4-3, are considered Important to the Defueled Condition.

4.6.3 Area Radiation Monitoring Instrumentation

4.6.3.1 System Description

The Area Radiation Monitoring System consists of channels which primarily monitor and indicate radiation levels in various areas of the plant.

Table 4-2 identifies the radiation monitors that are important to the defueled condition, including their location and a summary of the important features of each monitor. The detector output is amplified and the log count-rate is determined by the integral amplifier at the detector. The radiation level is typically shown at the detector and is transmitted to the radiation monitoring system cabinets in the Control Room where it is indicated on a meter and the Radiation Monitor Display System (RMDS) and recorded. Most area radiation alarms are displayed locally and on RMDS in the Control Room.

The Fuel Building overhead crane radiation monitor utilizes a gamma scintillation type detector with an integral amplifier at the detector. Since this type unit is a current integrating device rather than a pulse system, it is not affected by stray electro-static or electro-magnetic fields. In addition, this detector will not saturate in high radiation fields. When the level exceeds the range of the instrument, it merely reads full scale until such time as the level recedes to a point within the instrument's range. This radiation monitor, which is mounted in the cab of the crane, is interlocked with the crane hoists such that a high radiation level will stop upward motion of the main and auxiliary hoists.

4.6.3.2 Design Features Important to the Defueled Condition

The Area Radiation Monitoring System Components, as described above, are considered Important to the Defueled Condition.

4.7 Sealed Sources

Departmental procedures detail methods of leak testing sealed sources and receipt, handling and storage of radioactive sources. Approved calibration procedures outline specific techniques for the safe handling of calibration sources.

Accountability of sources is maintained in inventory records that are routinely updated. Source accessibility control is achieved through storage areas that are maintained locked to unauthorized personnel. While in use, sources are kept under the control of an authorized individual.

Radioactive sealed sources shall be leak tested for contamination. Any licensed sealed source is exempt from such leak tests if the source contains 100 microcuries or less of beta and/or gamma emitting material or 5 microcuries or less alpha emitting material.

Test for leakage and/or contamination shall be performed by the licensee or by other persons specifically authorized by the NRC or an Agreement State as follows:

1. Each sealed source (excluding startup sources and fission detectors previously subjected to core flux) containing radioactive materials in the form of gas or with a half-life of greater than 30 days (excluding H 3) shall be tested for leakage and/or contamination at intervals not to exceed 6 months.

2. The periodic leak test does not apply to sealed sources and fission detectors that are stored and not being used. The sources and fission detectors exempted by this test shall be tested for leakage prior to any use or transfer to another licensee unless they have been leak tested within the previous six months. Sealed sources and Fission detectors transferred without a certificate indicating the last test date shall be tested prior to being placed in use. Sealed sources contained in shielded devices such as rad monitors are considered to be stored unless they are removed from the shielded mechanism.

3. The leakage test shall be capable of detecting the presence of .005 microcurie of radioactive material on the test sample. If the test reveals the presence of 0.005 microcurie or more of removable contamination. It shall be immediately withdrawn from use, decontaminated, and repaired or disposed of in accordance with Commission regulations.

   A report shall be prepared and submitted to the Commission on an annual bases if sealed source leakage tests reveal greater than or equal to 0.005 microcurie of removable contamination, if the contamination could have resulted from source leakage.

TABLE 4-1
LIQUID RADWASTE SYSTEM TANKS

Tank Room	Number	Location	Capacity (gallons)	Material	Design Pressure	Design Temperature (degrees F)
Waste Evaporator Monitor Tanks	2	Auxiliary Building, El 614'	8000 each	Type 304 Stainless Steel	Atmospheric	200
Blowdown Monitor Tanks	3	Auxiliary Building, El 542'	20,000 each	Type 304 Stainless Steel	Atmospheric	150
Lake Discharge Tanks	2	Auxiliary Building, El 542'	30,000 each	Type 304 Stainless Steel	Atmospheric	150
Boric Acid Evaporator Monitor Tanks	4	Auxiliary Building, El 592'	21,600 each	Type 304 Stainless Steel	Atmospheric	150

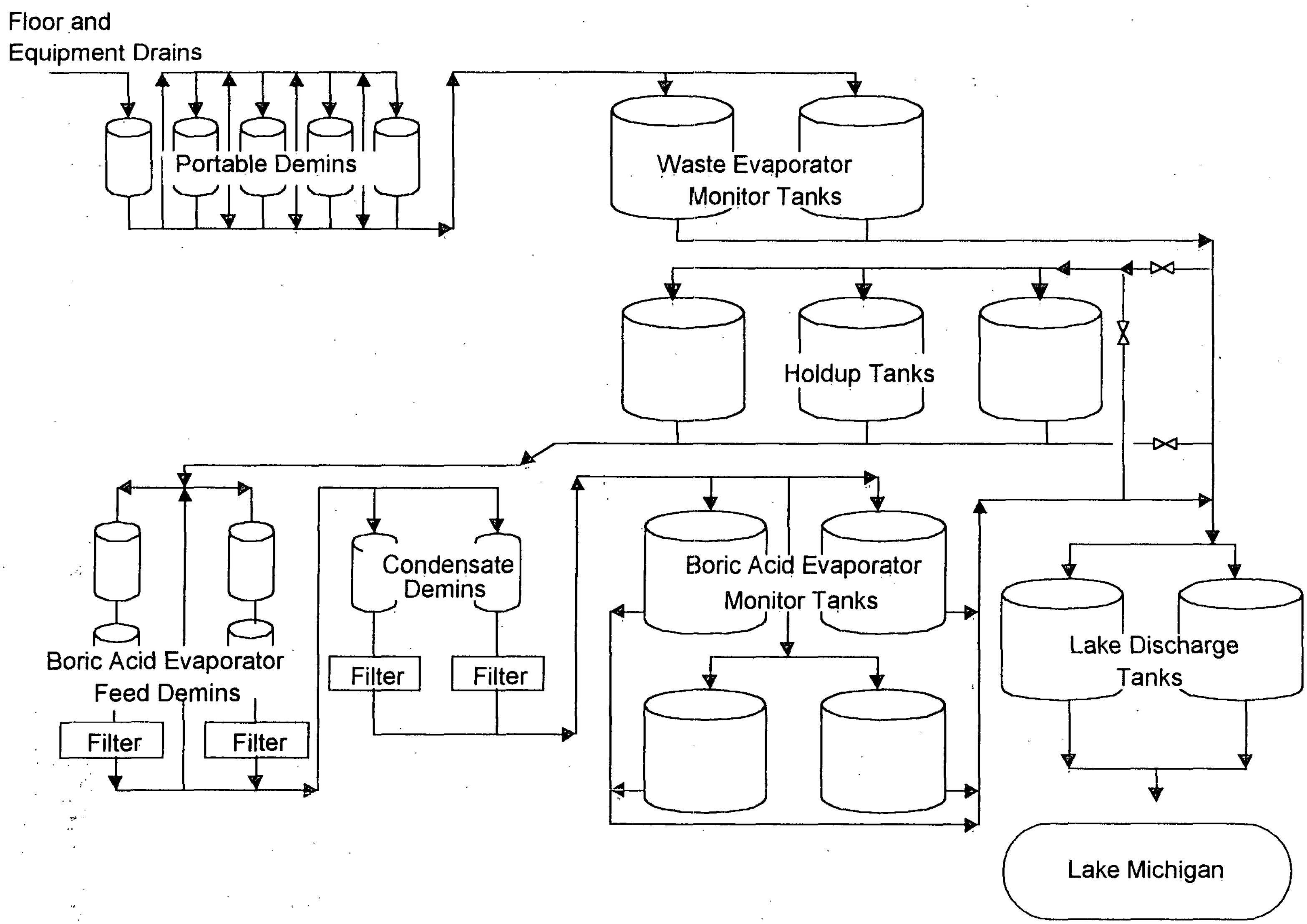
TABLE 4-2
AREA RADIATION MONITORS

Location	Monitor	Type	Range	Type of Readout	
				Control Room	Local
Fuel Handling Building, Decontamination Area	0RE-0005	Geiger-Mueller	0.1 mR/hr – 10 R/hr	Log Meter / Recorder	Log Meter
Fuel Handling Building, Pool Area	0RT-AR03	Geiger Mueller	0.1 mR/hr – 1 R/hr	Log Meter / Recorder	Log Meter
Fuel Building Overhead Crane	0RT-AR13	Gamma Scintillation	0.1 mR/hr – 1 R/hr	None	Log Meter

TABLE 4-3
PROCESS RADIATION MONITORS

SERVICE	MONITOR NO.	INSTRUMENT CHANNEL	DETECTOR TYPE	SENSITIVITY	ISOTOPE (1)
Containment Air	1RIA-PR40 2RIA-PR40	Particulate	Beta Scintillation	1.09 E 5 cpm/μCi	Sr-90/Y-90
Auxiliary Building Vent Stack	1RIA-PR49 2RIA-PR49	Particulate	Beta Scintillation	1.09 E 5 cpm/μCi	Sr-90/Y-90
		Low Range Noble Gas	Beta Scintillation	5.0 E-7 to 1.0 E-2 μCi/cc	Kr-85
		Mid Range Noble Gas	G-M	1.0 E-2 to 1.0 E 4 μCi/cc	Kr-85
		High Range Noble Gas	G-M	1.0 to 5.0 E 5 μCi/cc	Kr-85
Component Cooling Loop	1RE-017 2RE-017		Scintillation	1.0 E-6 to 1.0 E-1 μCi/cc	Cs-137
Fire Sump Discharge	0RT-PR25		Scintillation	9.0 E-7 to 8.0 E-2 μCi/ml	Cs-137
Waste Disposal System Lake Discharge Effluent	0RT-PR04 0RT-PR05		Scintillation	1.0 E-7 to 5.0 E-3 μCi/ml	Cs-137

(1) Sensitivity Ranges are based on these isotope



ZION STATION DSAR

Figure 4-1

Zion Station Liquid Processing Flowchart

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5. SAFETY ANALYSES

5.0 GENERAL

This chapter of the DSAR addresses those classification of accidents and events related to the movement and storage of irradiated fuel in the spent fuel pool, and the accidental airborne release of radioactive material due to a radioactive waste handling event. This chapter, therefore, presents an evaluation of the safety aspects of the plant and demonstrates that the plant can be safely maintained in a SAFSTOR condition even if highly unlikely events are postulated. It also shows that radiation exposures resulting from occurrences of these highly unlikely accidents do not exceed the guidelines of 10CFR100, or the Environmental Protection Agency (EPA) Protective Action Guidelines (PAGs).

Specifically, these events are:

- Spent Fuel Pool Events/Operational Occurrences
- Fuel Handling Accident in the Fuel Handling Building, and
- Radioactive Waste Handling Accident.

5.1 Spent Fuel Pool Events

The design of the spent fuel pool and its associated storage racks is to store up to 3012 spent fuel assemblies in a subcritical array during all credible storage conditions. This is accomplished, in part, by maintaining the fuel assemblies submerged in borated water. The design of the Spent Fuel Pool Cooling and Cleanup System is to remove the heat generated from the spent fuel pool by the stored fuel assemblies. In the defueled condition, the primary objective with respect to cooling, is to assure adequate decay heat removal capability exists such that boiling in the spent fuel pool is precluded to the extent that the spent fuel assemblies remain covered. The spent fuel pool contains a level instrument which annunciates on the main control board when the water level falls below the 614'-4" elevation. Additional design information for the spent fuel pool and its associated cooling system are provided in Section 3.

Potential events associated with the spent fuel pool while in the defueled condition are limited to those related to the loss of pool cooling or the loss of pool water inventory.

A loss of level in the Spent Fuel Pool has two main effects. The first effect, which occurs immediately, is the decrease in shielding as the level falls. The Spent Fuel Pool is designed so that drainage through any connected piping cannot result in the uncovering of any stored irradiated fuel assemblies. Therefore, a loss of level in the Spent Fuel Pool, in itself, caused by a piping failure, will not result in the uncovering of irradiated fuel assemblies and possible radioactive releases. The second effect is the loss of decay heat removal capability if the level falls enough. Failure to remove an irradiated fuel assembly's decay heat may lead to fuel failure and radioactive contaminant release.

5.1.1 Loss of Spent Fuel Cooling

5.1.1.1 Event Description

This analysis assesses the time available to initiate compensatory measures in the event forced cooling to the spent fuel pool is lost, as well as the resultant radiological impact. The inability to remove the heat generated from the stored spent fuel by means of forced cooling will result in a temperature increase in the spent fuel pool water to the point that bulk boiling of the coolant volume occurs. Although boiling continues to provide a means for heat removal, if left unabated it would result in boiloff of the pool volume and the uncovering of stored irradiated fuel assemblies. No specific initiating mechanism is identified for this event. This analysis simply assumes the ability to cool the volume of water in the spent fuel pool has been lost. A failure in the Component Cooling Water System, Service Water System, or Electrical Power System may result in a loss of spent fuel pool cooling.

5.1.1.2 Method of Analysis

Decay heat calculations were performed using the methods described in Reference 5 to determine the heat load of the spent fuel pool. The results of these calculations are presented in Figure 5-1. The spent fuel pool heat load is used to calculate the time available before the volume of water in the pool reaches saturation; the time available before stored spent fuel assemblies are uncovered due to boiloff of the pool water; and the required rate of makeup water necessary to match pool boiloff.

Heat transfer from the pool at elevated temperatures occurs by conduction through the pool walls and surface, convection across the surface of the pool, and by boiloff or evaporation of water from the pool surface. However, for additional conservatism, the calculation to determine the time to reach saturation assumes that all energy released by decay goes into sensible heating of the water in the pool. Saturation conditions are assumed to be for water at standard pressure with no consideration given for hydrostatic pressure changes due to depth. The pool walls are assumed to be adiabatic and the metal in the pool does not store any energy. Energy losses through evaporation are also neglected. Other principle assumptions used in the determination of the time to reach saturation are the net mass of the spent fuel pool (4287266.6 lbm, or 520351.7 gal.) and an initial pool water temperature of 125 degrees F. The initial pool water temperature is based on the pool high temperature alarm setpoint. The time to saturation for various initial spent fuel pool water levels is provided in Figure 5-2.

As boiling of the spent fuel pool begins, the available water inventory to cool the spent fuel assemblies decreases due to vaporization. Figure 5-3 contains a profile of the level decrease in the spent fuel pool as a function of boiling time. As the level decreases, the radiological hazards in the Fuel Handling building increase due to the gamma radiation shine from the spent fuel assemblies. Table 5-5 contains the gamma radiation dose rates at the edge of the spent fuel pool as a function of the water level above the stored assemblies. To maintain an adequate inventory and thus assure cooling of the spent fuel assemblies, the water in the spent fuel pool must be replenished. Figure 5-4 shows the required makeup flow rate necessary to match the boiloff rate in the spent fuel pool as a function of time. The required makeup flow rate assumes that the water being added to the pool is at saturation temperature and therefore has no cooling effects on the pool.

The time to increase the spent fuel pool temperature to the point of bulk boiling, in addition to the time it takes to boiloff the water in the spent fuel pool to a level approximately three and one-half feet above the top of the fuel assemblies, represents the total time available to initiate compensatory cooling measures. Compensatory cooling measures involve the establishment of a source of makeup water to the spent fuel pool at a flow rate equal to or greater than the pool boiloff rate. Makeup water may be provided from onsite storage tanks using installed piping systems, or in the case of a total loss of electrical supply to the station, using alternative external supplies and temporary piping or hoses.

5.1.1.3 Results

With a spent fuel heat load that is assumed to exist in July 1998 (Figure 5-1), it can be shown from Figure 5-2 that, with loss of forced spent fuel pool cooling at an initial pool temperature of 125 degrees F and a minimum pool level at elevation 614' 4", approximately 39 hours are available before saturation of the pool water occurs. In addition, the time it takes to boiloff the coolant volume from an initial pool elevation of 614' 4" to the 594' elevation (the tops of stored fuel assemblies are at elevation 590' 1-1/10") is approximately 250 hours (figure 5-3). Thus, approximately 289 hours (12 days) are available to institute an alternative method of pool cooling from the time normal cooling is lost until the pool level decreases to a level approximately 3.9 feet above the stored fuel assemblies. The resultant radiological dose at the edge of the spent fuel pool at elevation 594' is 3.61 R/hr (Table 5-5). The required makeup flow rate to match the boiloff of the pool water is approximately 20.5 gpm (Figure 5-4).

Based on the above, it can be reasonably concluded that a loss of forced spent fuel pool cooling does not constitute an excessive risk for Zion Station. Due to the extremely slow rate of spent fuel pool water boiloff, adequate time is available to initiate corrective measures for restoration of malfunctioning components, or to institute an alternative method of cooling using onsite or offsite water supplies without significant radiological consequences for plant workers in the fuel handling building.

5.1.2. Loss of Spent Fuel Pool Inventory

5.1.2.1 Event Description

This analysis assesses the time available to initiate compensatory measures in the event of a loss of spent fuel pool inventory, as well as the radiological impact. The spent fuel pool is normally filled with borated water to approximately 615' elevation. Because the spent fuel pool is used for semi-permanent storage of irradiated fuel assemblies, it is designed without piping connections that could be used to drain it. However, two aspects of the pool design would allow the inventory to be significantly reduced in the event of a failure. These are,

1. a seal failure of a fuel transfer canal removable weir gate, and
2. a rupture of the spent fuel pool cooling water pump return line.

In the permanently defueled condition, the transfer tube gate valves are closed and their flanges installed. The Spent Fuel Pool removable weir gate, the bottom of which is approximately 2'-3" above the top of the stored fuel, is in place and its seal inflated (with instrument air or nitrogen bottle back-up). If the gate and/or its seal should have a catastrophic failure, and if the transfer canal is drained, the spent fuel pool would lose inventory to fill and equalize levels with the empty transfer canal. Assuming the water level in the spent fuel pool starts at its lowest normal level (El 614'4"), the level would remain above the 607' elevation. The fuel assemblies in the pool would remain covered by more than 17' of water, although a loss of forced cooling would result as the water level will be below the elevation that the spent fuel pumps take their suction (611'8").

The more limiting of the spent fuel pool inventory events is the rupture of the spent fuel pool cooling water pump return line. The spent fuel pumps suction is taken from strainers at elevation 611'8" and returned to the pool at elevation 598'; approximately eight feet above the top of the stored fuel assemblies. Rupture of any of this piping cannot cause the pool to be gravity drained to expose irradiated fuel assemblies. It does however, result in a condition with reduced pool inventory beyond that caused by a seal failure in the fuel transfer removable weir gate (assuming siphoning occurs at the return line and no credit is taken for the anti-siphon device), as well as a loss of forced pool cooling. Therefore, the remainder of this evaluation discusses the bounding rupture of the spent fuel pool cooling water pump return line.

5.1.2.2 Method of Analysis

This evaluation assume that, upon a rupture in the spent fuel pool cooling water return line, the water in the spent fuel pool immediately drains to the 598' elevation. Although some period of time would be available for the actual drain down to occur, this assumption provides additional conservatism with respect to the significance and resultant consequences of the event. This evaluation is similar to the evaluations performed for a Loss of Spent Fuel Pool Cooling in Section 5.1.1 in that spent fuel pool heat load is used to calculate the time available before the volume of water in the pool reaches saturation, the time available before stored spent fuel assemblies are uncovered due to boiloff of the pool water, and the required rate of makeup water necessary to match pool boiloff.

Assumptions related to energy releases from the stored fuel assemblies, energy losses from the pool water, mass of the spent fuel pool, and initial temperature of the pool are also consistent with Section 5.1.1.

The time to increase the spent fuel pool temperature to the point of bulk boiling, in addition to the time it takes to boiloff the water in the spent fuel pool to a level approximately three and one-half feet above the top of the fuel assemblies, represents the total time available to initiate compensatory cooling measures. Compensatory cooling measures involve the establishment of a source of makeup water to the spent fuel pool at a flow rate equal to or greater than the pool boiloff rate. Makeup water may be provided from onsite storage tanks using installed piping systems, or in the case of a total loss of electrical supply to the station, using alternative external supplies and temporary piping or hoses. Evaporative cooling of the spent fuel pool with subsequent makeup continues until the ruptured piping is repaired or isolated while maintaining the pool level above the tops of the seated fuel assemblies and below the 598' elevation. Once the necessary repairs or isolations are made, the pool level can be raised to its normal level. If available, forced cooling of the spent fuel pool can resume.

5.1.2.3 Results

With a spent fuel heat load that is assumed to exist in July 1998 (Figure 5-1), it can be shown from Figure 5-2 that, with a minimum pool level at elevation 598' with a concurrent loss of forced spent fuel pool cooling at an initial pool temperature of 125 degrees F, approximately 21 hours are available before saturation of the pool water occurs. In addition, the time its takes to boiloff the coolant volume from an initial pool elevation of 598' to the 594' elevation (the tops of stored fuel assemblies are at elevation 590' 1-1/10") is approximately 56 hours (Figure 5-3). Thus, approximately 77 hours (3.2 days) are available to institute an alternative method of pool cooling from the time a rupture occurs in the spent fuel pool cooling return line until the pool level decreases to a level approximately 3.9 feet above the stored fuel assemblies. The resultant radiological dose at the edge of the spent fuel pool at elevation 594' is 3.61 R/hr (Table 5-5). The required makeup flow rate to match the boiloff of the pool water is approximately 20.5 gpm (Figure 5-4).

Based on the above, it can be reasonably concluded that a rupture in the spent fuel pool cooling return line does not constitute an excessive risk for Zion Station. Due to the extremely slow rate of spent fuel pool water boiloff, adequate time is available to institute an alternative method of cooling using onsite or offsite water supplies without significant radiological consequences for plant workers in the fuel handling building.

5.2 Fuel Handling Accident in the Fuel Building

5.2.1 Accident Description

The accident is defined as dropping of a spent fuel assembly onto the spent fuel pool floor and breaking of all the fuel rods, despite the administrative controls and physical limitations imposed on fuel handling operations. All operations involving the movement of irradiated fuel are conducted in accordance with prescribed procedures under direct surveillance of a supervisor.

5.2.2 Method of Analysis

Two calculations were performed to determine the dose consequences resulting from a dropped spent fuel assembly in the spent fuel pool. One calculation determines the two hour integrated dose received by a receptor at the site Exclusion Area Boundary (EAB) (Reference 1), and the other calculation determines the two hour integrated dose received by personnel in the control room (Reference 2). Inputs and assumptions used in these calculations are provided in Table 5-1, Table 5-2, and Table 5-3. The methodology used in the fuel handling accident analysis does not credit the actuation or mitigation of any system, structure, or component (e.g., ventilation system filtration). Conservative values for atmospheric diffusion (X/Q) are assumed since the release is postulated to occur from undefined leakage pathways in the fuel handling building without the aid of ventilation systems. No credit is taken for iodine scrubbing by the water in the spent fuel pool.

5.2.3 Results

The radiological dose consequences for a fuel handling accident in the fuel handling building are presented in Table 5-4. For the site EAB evaluation, these results show that the projected doses are insignificant in comparison to the 10CFR100 guidelines, and less than the EPA PAGs. The projected dose at the Low Population Zone would be less than at the Exclusion Area Boundary and, since this accident involves an instantaneous release, is also within the 10CFR100 guidelines. For the control room evaluation, these results show that the projected dose to control room personnel are within the limits specified in 10CFR50, Appendix A, General Design Criteria 19.

5.3 Radioactive Waste Handling Accident

5.3.1 Accident Description

This accident postulates the failure of a High Integrity Container (HIC) containing dewatered radioactive demineralizer resin generated during decontamination activities to the extent that entire solid, non-combustible contents escape. Such a failure would consist of radioactive waste handling that is beyond the design, testing, and handling criteria in 10CFR71. All solid radioactive waste handling is conducted in accordance with the Process Control Program.

5.3.2 Method of Analysis

Calculations have been performed (Reference 9) to determine the dose at the Exclusion Area Boundary that would result from dropping a HIC in the Interim Radwaste Storage Facility (IRSF) such that its entire contents of radioactive, dewatered resin escape. A fraction of the escaped resin is non-mechanistically assumed to be released as airborne radioactivity and pass from the IRSF directly to the environment, resulting in off-site dose consequences. The solid-to-aerosol release fraction is assumed to be the worst case non-mechanistic, mechanically initiated release fraction. The whole body and inhalation dose at the closest point on the Exclusion Area Boundary from the IRSF are then calculated.

Inputs and assumptions used in this evaluation are provided in Table 5-6. The radioactivity assumed to be present in the HIC for this evaluation is 1000 curies. The amount of radioactivity that can be placed in a HIC is limited by handling and shipping requirements. The Process Control Program at Zion ensures that the radioactivity level placed in a HIC will be less than the assumed amount. The worst case mix of fission products that contribute to dose consequences is represented by 100% Co-60. The methodology used in this accident analysis does not credit the actuation or mitigation of any system, structure, or component (e.g., ventilation system filtration). Conservative values for atmospheric diffusion (X/Q) are assumed since the release is postulated to occur from undefined leakage pathways in the IRSF without the aid of any ventilation system.

5.3.3 Results

The radiological dose consequences for an accident involving the failure of a High Integrity Container are presented in Table 5-7. The results show that the projected doses are insignificant in comparison to the 10CFR100 guidelines, and are less than the EPA PAGs. The projected dose at the Low Population Zone would be less than at the Exclusion Area Boundary and, since this accident involves an instantaneous release, is also within the 10CFR100 guidelines.

It is anticipated that future station decontamination and dismantling activities (e.g., vacuum filter bag ruptures, or removal of major primary system components etc.) will not result in potential releases of radioactive material beyond the levels discussed here.

5.4 References, Section 5.0

1. Zion Station Calculation No. 22S-0-110X-0057, Rev. 1, "Fuel Handling Accident Offsite Dose Calculation with Extended Radioactive Decay and no AB Filtration,

2. Zion Station Calculation No. 22S-0-110X-0059, "Fuel Handling Accident Control Room Dose Calculation with Extended Radioactive Decay,

3. NRC Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors", March 23, 1972,

4. NRC Regulatory Guide 1.109 Rev. 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50 Appendix I", October, 1977,

5. Nuclear Regulatory Commission Branch Technical Position 9-2, "Residual Decay Energy for Light-Water Reactors for Long-Term Cooling", Rev. 2, July, 1981.

6. Zion Station Calculation No. 22S-0-107X-0002, "Spent Fuel Pool Dose Rates at Various Water Levels",

7. Zion Station Calculation No. 22N-0-110M-0058, "Zion Decommissioning Spent Fuel Pool Heat Load and Time to Saturation Calculation",

8. Zion Station Calculation No. 22S-0-110S-0060, "Evaluation of the Zion Spent Fuel Pool for an Accident Temperature of 212°F"

9. Zion Station Calculation No. 22N-0-119M-0001, Rev. 1, "Dose Effects of Radwaste Handling Accident Involving a HIC."

10. Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Ingestion." Washington, DC; U.S. Environmental Protection Agency, 1988.

TABLE 5-1

ASSUMPTIONS USED IN CALCULATING THE SOURCE TERM FOR A FUEL HANDLING ACCIDENT

Power Level (MWt)	3250
Lead Rod Burnup (MWD/MTU)	60,000
Number of Failed Fuel Rods	204 (1 assembly)
Number of Fuel Assemblies in the Core	193
Assembly Radial Peaking Factor	1.65
Fuel Rod Inventory Release to Gap, %	
Iodine – 131	12
Other Iodine	10
Krypton – 85	30
Other Noble Gases	10

TABLE 5-2

SOURCE TERM INFORMATION FOR THE FUEL HANDLING ACCIDENT IN THE FUEL BUILDING

ISOTOPE	TOTAL CURIES/ASSEMBLY (1 YEAR AFTER SHUTDOWN)	FRACTION IN FUEL-CLADDING GAP	E (MEV)
I-131	2.05×10^{-9}	0.12	0.589
I-132	0.0	0.10	2.907
I-133	0.0	0.10	1.177
Kr-85	3.49×10^{3}	0.30	0.274
Xe-133	$< 1.0 \times 10^{-10}$	0.10	0.264
Xe-133m	$< 1.0 \times 10^{-10}$	0.10	0.233

TABLE 5-3

ASSUMPTIONS USED IN CALCULATING THE DOSE CONSEQUENCES FOR A FUEL HANDLING ACCIDENT

Site EAB Evaluation

Parameter	Value
Minimum Fuel Decay Time From 2/21/97	8760 hours(1)
Breathing Rate	3.47×10^{-4}(m^3/sec)
Distance to Exclusion Area Boundary	377 meters
Atmospheric diffusion Factor (X/Q)	3.7×10^{-3} sec/m^3
Decontamination Factor for SFP and Ventilation Filtration	1
Activity in Fuel Clad Released	100%
Wind Speed	1 meter/sec.
Iodine Dose Conversion Factors	From Reference 3
Inhalation Dose Conversion Factors	From Reference 10, Table 2-1

Control Room Evaluation

Parameter	Value
Minimum Fuel Decay Time From 2/21/97	10104 hours(2)
Distance from SFP to Cont. Rm. Outside air intake	27.8 meters
Atmospheric diffusion Factor (X/Q)	0.168 sec/m^3
Decontamination Factor for SFP and Ventilation Filtration	1
Activity in Fuel Clad Released	100%
Total Body/Skin Dose Conversion Factors	From Reference 4

(1) Based on one year (365 days) decay time

(2) Based on 421 days decay time

TABLE 5-4

PROJECTED DOSE FOLLOWING A FUEL HANDLING ACCIDENT

	Whole Body Dose (Rem)	Thyroid Dose (Rem)	Skin Dose (Rem)
Site EAB	8.8×10^{-1}	3.9×10^{-9}	NA
CR Outside Air Intake	2.59×10^{-1}	NA	21.9
10 CFR 100 Guidelines	25	300	NA
GDC 19 Limits	5.0	30	30
EPA PAGs	1[(1)]	5	50

(1) The acceptance criteria is that the sum of the whole body dose and the inhalation dose is less than 1.0 rem. For this accident, the inhalation dose due to isotopes other than iodine is insignificant.

TABLE 5-5

ESTIMATED GAMMA RADIATION DOSE RATES AT THE EDGE OF THE SPENT FUEL POOL AS A FUNCTION OF POOL WATER LEVEL AFTER 1 YEAR OF RADIOACTIVE DECAY

Water Level (ft.)	Height Above Fuel (ft.)	Dose Rate (mrem/hr.)
614	23.91	1.57E-14
612	21.91	9.36E-13
610	19.91	5.53E-11
608	17.91	3.23E-09
606	15.91	1.87E-07
604	13.91	1.06E-05
603	12.91	7.95E-05
602	11.91	5.92E-04
601	10.91	4.37E-03
600	9.91	3.21E-02
599	8.91	2.33E-01
598	7.91	1.67E+00
597	6.91	1.18E+01
596	5.91	8.21E+01
595	4.91	5.55E+02
594	3.91	3.61E+03
593	2.91	2.22E+04
592	1.91	1.23E+05

TABLE 5-6

ASSUMPTIONS USED IN CALCULATING THE DOSE CONSEQUENCES FOR A RADIOACTIVE WASTE HANDLING ACCIDENT INVOLVING A HIGH INTEGRITY CONTAINER (HIC)

Parameter	Value
Radioactivity Level in HIC	1000 curies
Breathing Rate	3.47×10^{-4} (m^3/sec)
Distance to Exclusion Area Boundary	210 meters
Atmospheric diffusion Factor (X/Q)	1.2×10^{-2} sec/m^3
Fission Product Mix	100% Co-60
Wind Speed	1 meter/sec.
Inhalation Dose Conversion Factors	From Reference 10, Table 2.1

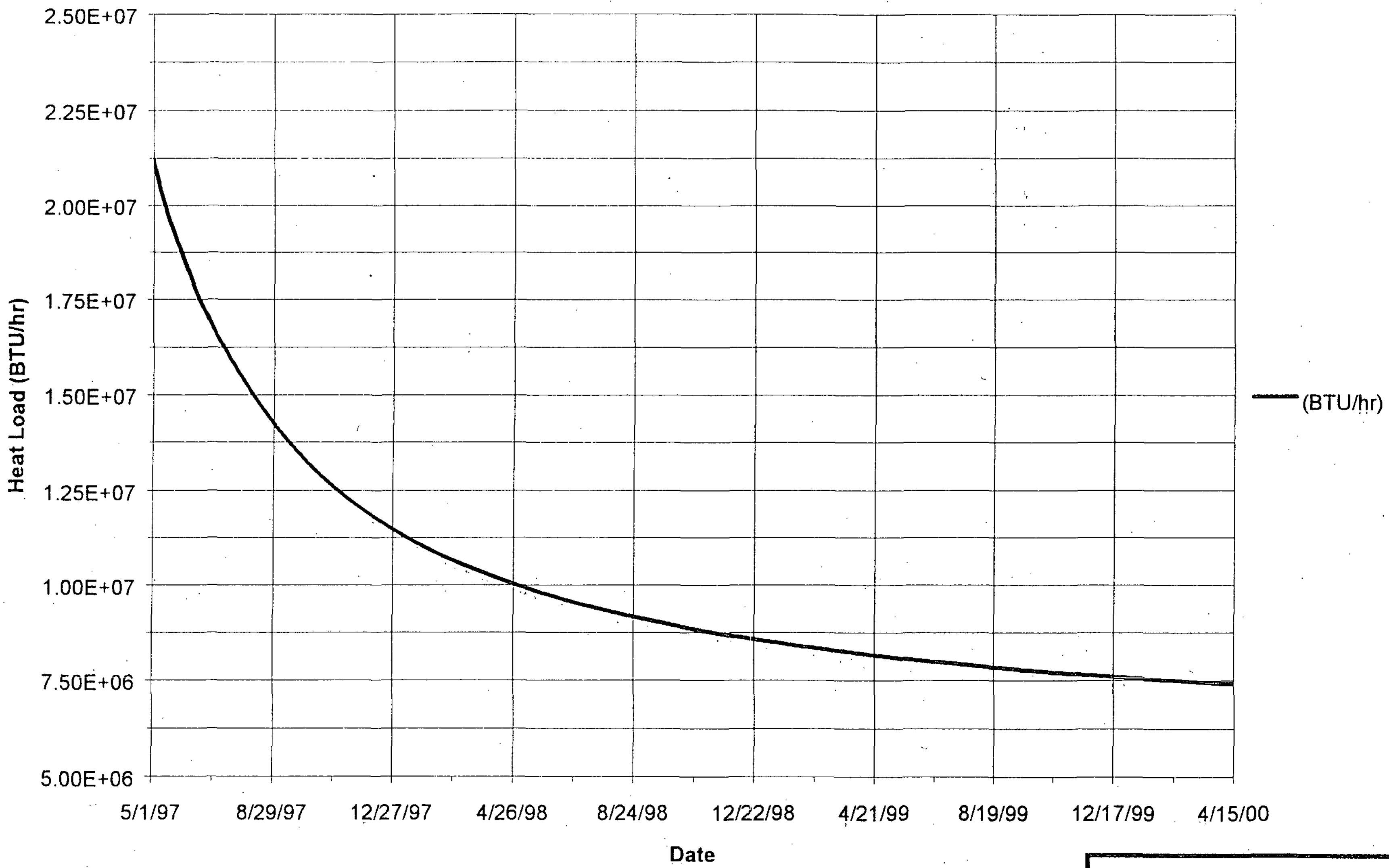
TABLE 5-7

PROJECTED DOSE FOLLOWING A
RADIOACTIVE WASTE HANDLING ACCIDENT

	Whole Body Dose (Rem)	Inhalation Dose (Rem)
Site EAB	7.9×10^{-3}	9.1×10^{-1}
10 CFR 100 Guidelines[(1)]	1	NA
EPA PAGs	Note 2	Note 2

(1) For conservatism, the probability of the accident occurring is the same as a radioactive gas tank rupture. The acceptance criteria is established as 1/50 of the 10CFR100 guidelines.

(2) The acceptance criteria is that the sum of the whole body dose and the inhalation dose is less than 1.0 rem.

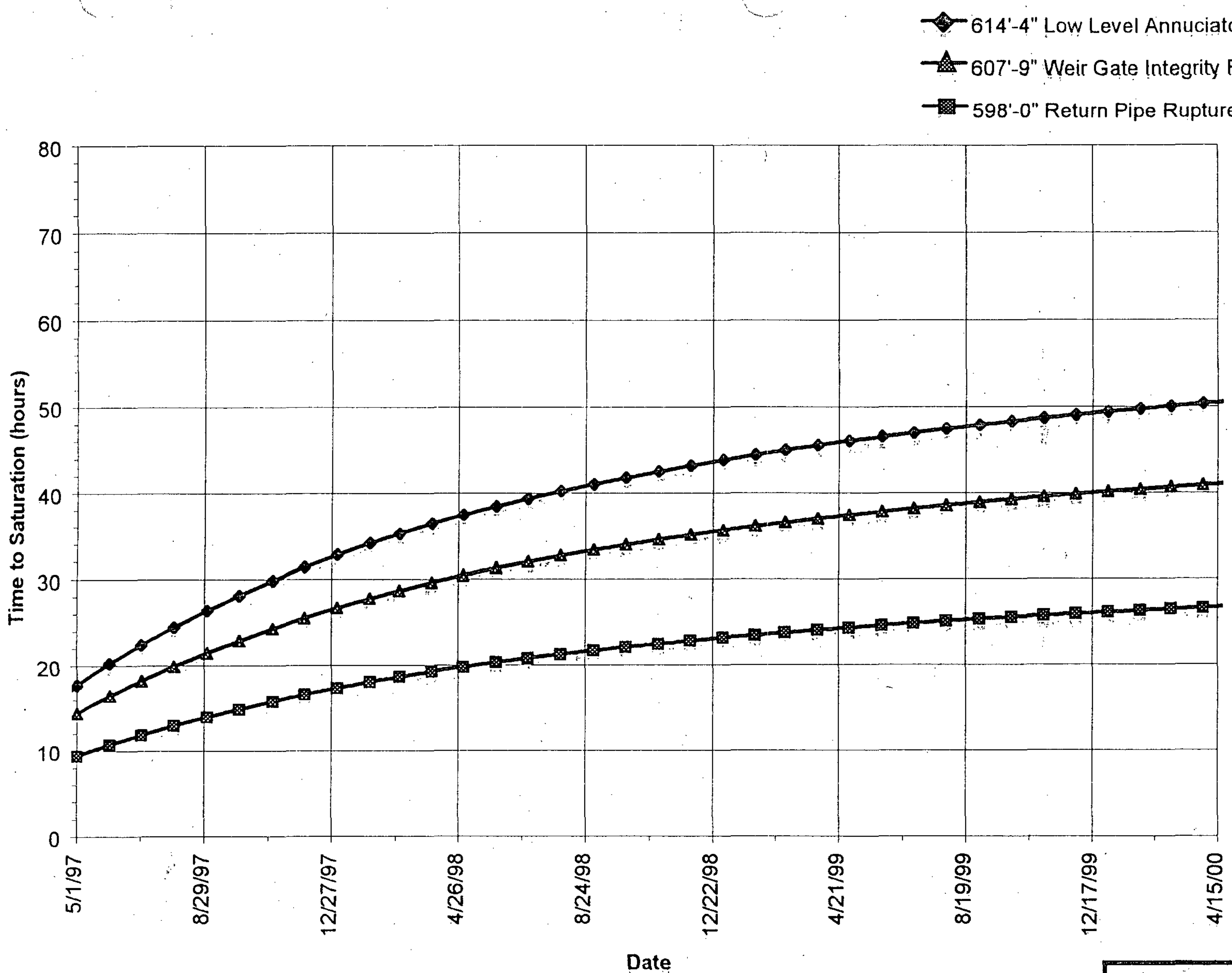


ZION STATION DSAR

Figure 5-1

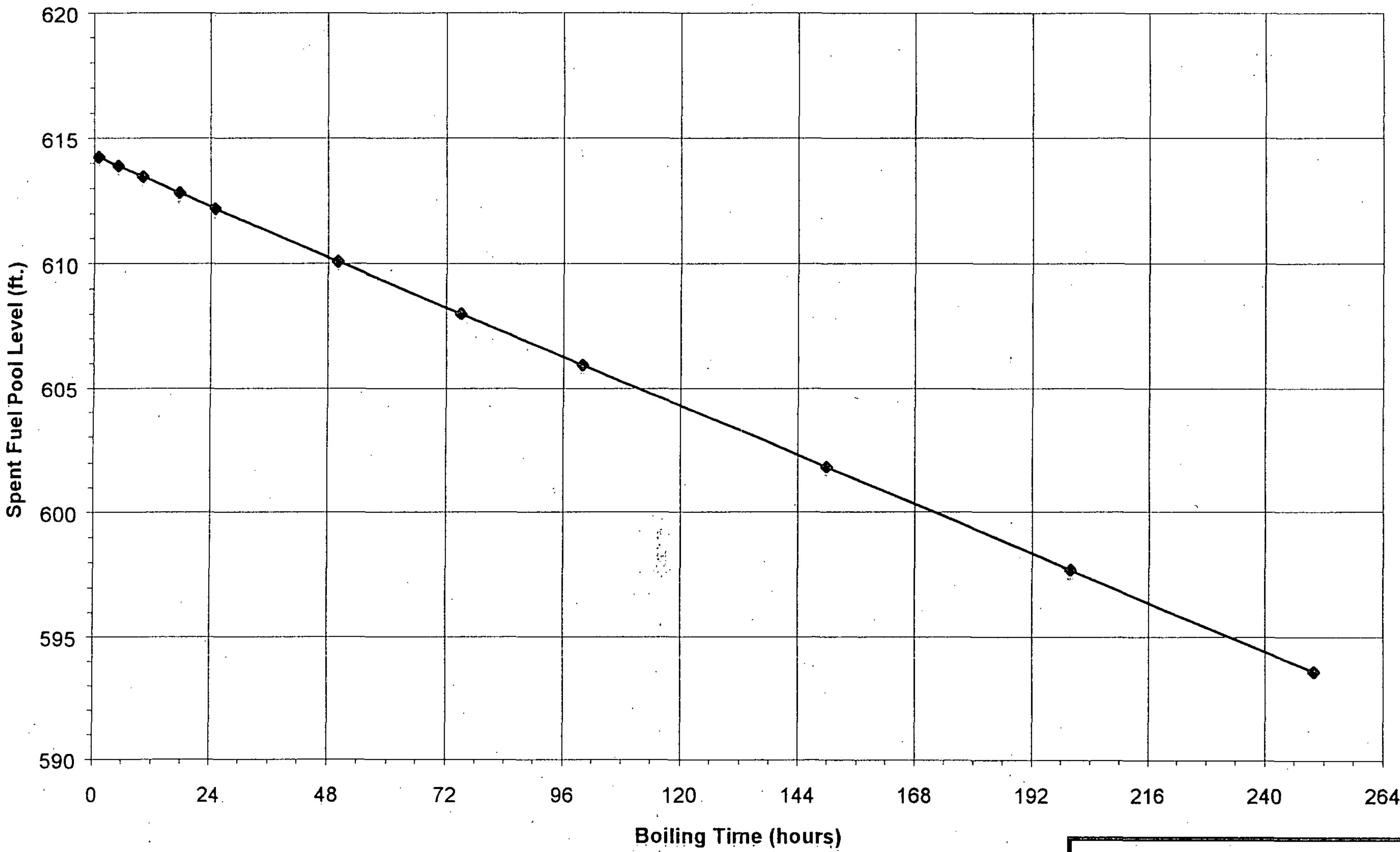
SPENT FUEL POOL HEAT LOAD VERSUS TIME

AUGUST 1998



ZION STATION DSAR

Figure 5-2
TIME TO SATURATION FOR VARIOUS INITIAL WATER LEVELS INITIAL WATER TEMPERATURE @ 125°F
AUGUST 1998

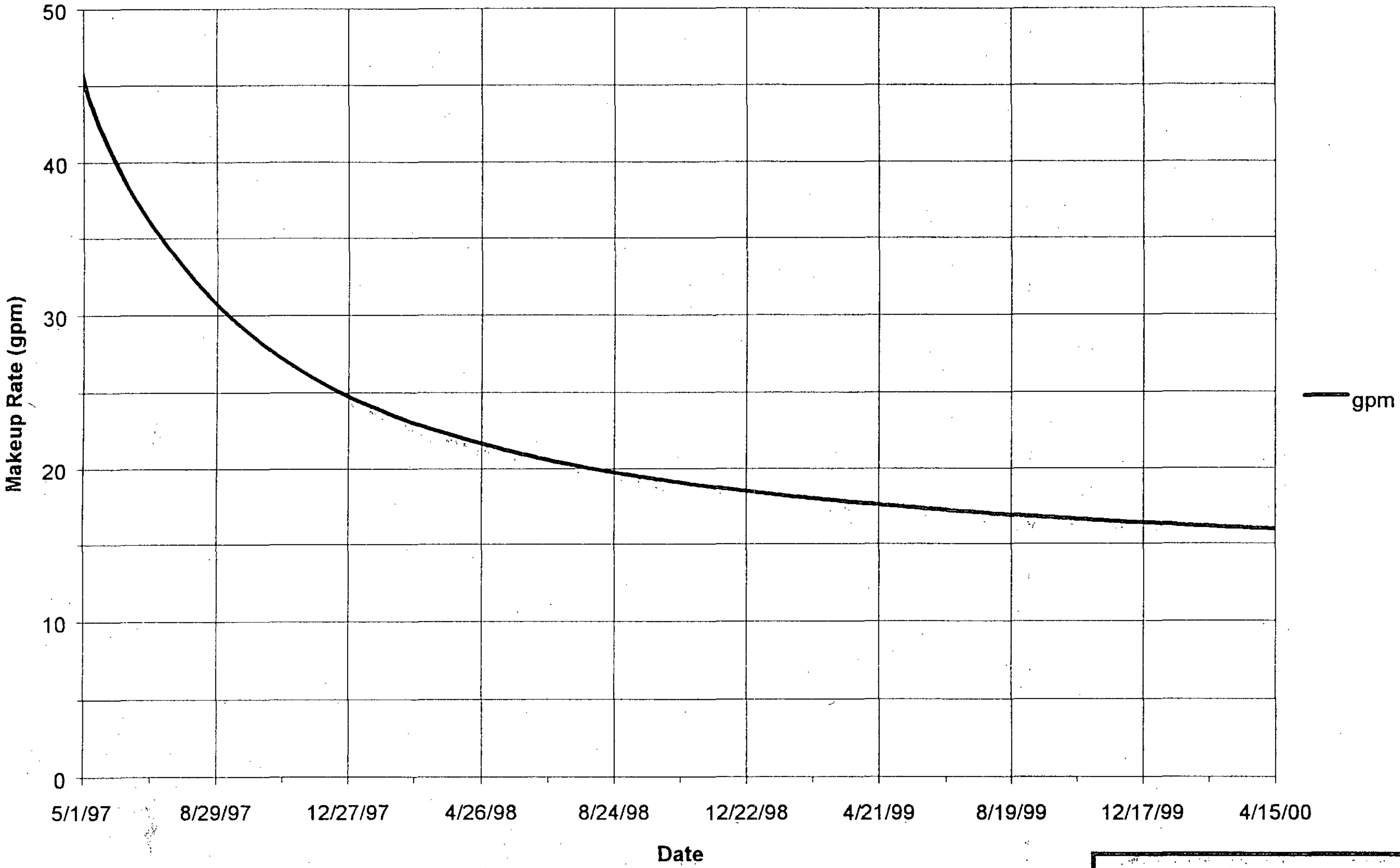


ZION STATION DSAR

Figure 5-3

LEVEL DECREASE VERSUS TIME UPON INITIATION OF BOILING

AUGUST 1998



ZION STATION DSAR

Figure 5-4

MAKEUP RATE MUR VERSUS TIME UPON INITIATION OF BOILING

AUGUST 1998

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6. CONDUCT OF OPERATIONS

6.1 RESPONSIBILITY AND ORGANIZATION

Onsite and offsite organizations are established for unit and corporate management, respectively. The onsite and offsite organizations include the positions for activities affecting the safety of the facility.

1. Lines of authority, responsibility, and communication are established and defined for the highest management levels through intermediate levels including all operating organization positions. These relationships are documented and updated, as appropriate, in the form of organization charts, functional descriptions of departmental responsibilities and relationships, and job descriptions for key personnel positions, or in equivalent form of documentation.

2. The Senior Vice President, Nuclear Services has corporate responsibility for decommissioning activities and the safe storage of spent nuclear fuel at the facility. The Manager of Decommissioning Projects is responsible for decommissioning project activities.

3. Zion Station is managed by the Decommissioning Plant Manager. The Decommissioning Plant Manager has day-to-day responsibility for the facility and has control of the onsite activities necessary for the safe operation and maintenance of structures and systems required for the safe storage of spent nuclear fuel.

4. The individuals who train the operating staff and those who carry out radiation protection and quality functions may report to an appropriate onsite manager; however, they have sufficient organizational freedom to ensure their independence from operating pressures.

6.1.1 On-Site Organization

6.1.1.1 Duties and Responsibilities of the Operating Staff Personnel

6.1.1.1.1 Decommissioning Operations Manager

The Decommissioning Operations Manager is responsible for the operation of dedicated systems for the facility. He directs and monitors the activities of decommissioning work groups to ensure that there is no adverse safety impact on the facility prior to execution. He is responsible for assuring that the facility technical specifications are met.

6.1.1.1.2 Shift Supervisor, Decommissioning

The Shift Supervisor is typically the qualified (Certified Fuel Handler) individual on site who has the responsibility for the day-to-day safe storage of spent nuclear fuel, fuel handling, and operational activities to support decommissioning. These responsibilities are fulfilled through a staff that includes Fuel Handlers and non-certified operators.

6.1.1.2 Duties and Responsibilities of the Support Staff

6.1.1.2.1 RP/Chemistry Manager, Decommissioning

The RP/Chemistry Manager is responsible for directing health physics and chemistry activities.

6.1.1.2.2 Maintenance Manager, Decommissioning

The Maintenance Manager manages the day-to-day work activities for mechanical equipment, electrical equipment, and instrumentation. He is also responsible for the installation of facility additions and modification and for managing decontamination and dismantlement services.

6.1.1.2.3 Regulatory Assurance Manager

The Regulatory Assurance Manager is responsible for monitoring compliance with regulatory requirements and commitments.

6.1.1.2.4 Engineering Manager, Decommissioning

The Engineering Manager has responsibility for design activities and plant configuration control.

6.1.1.2.5 Services Manager, Decommissioning

The Services Manager provides materials management, information services, office support, and training support to site organizations.

6.2 TECHNICAL SPECIFICATIONS

Zion Station is governed by the Technical Specifications provided as Appendix A to Operating License Nos. DPR-39 and DPR-48, Docket Nos. 50-295 and 50-304.

6.3 TRAINING

Programs are conducted to train plant personnel. Key technical and operating personnel receive on-site classroom or guided self-study and on-the-job training. The Certified Fuel Handler training program ensures the monitoring, handling, storage, and cooling of nuclear fuel is performed in a manner consistent with ensuring the health and safety of the public. Appropriate plant personnel receive instruction in emergency plan and radiation protection procedures. Specialized training in specific areas conducted by the equipment manufacturers or other vendors is utilized as necessary. Training on a continuing basis is used to maintain a high level of proficiency in the staff.

6.4 PROCEDURES

Written procedures/instructions, e.g. Nuclear Work Requests are required for maintenance or repair activities related to the structures, systems and components which are identified as Important To the Defueled Condition (ITDC) as defined in Section 3.2.

In addition, written procedures are required for operational activities related to the structures, systems, and components which are identified as Important to the Defueled Condition as defined in Section 3.2.

Written procedures shall be established, implemented and maintained as required by the Technical Specifications.

6.5 PROGRAMS

6.5.1 Emergency Plan

The Generating Stations Emergency Plan (GSEP) is a written emergency plan that establishes the concepts, evaluation and assessment criteria, and recommended protective actions necessary to limit and mitigate the consequences of potential or actual nuclear power plant emergencies. The GSEP provides the necessary pre-arrangements, directions, and organization to ensure nuclear emergencies can be effectively and efficiently resolved in order to safeguard station personnel, property, and the general public.

The GSEP identifies on-site and off-site facilities and equipment available for emergency assessment, communications, first aid and medical care, and damage control. The GSEP also includes notification requirements for classified events, including prompt and accurate notifications to Federal, State, and local governments.

Zion has developed Emergency Plan Implementing Procedures (EPIPs) which implement the GSEP appropriately. Training is conducted for all emergency response personnel to ensure their proficiency.

The GSEP manuals and Station Annexes are distributed on a controlled basis to all stations and emergency facilities requiring them, including appropriate Federal, State, and local agencies.

The GSEP has been submitted to and approved by the NRC. It is reviewed annually, and any changes or revisions that pertain to regulatory requirements are submitted to the NRC for approval.

6.5.2 Security Plan

A detailed Zion physical security plan, withheld from public disclosure pursuant to 2.790 of 10CFR2, has been made available to the NRC.

The Zion Station physical security plan conforms to the requirements of 10CFR73.55.

6.5.3 Fire Protection Program

The Zion Station Fire Protection Program describes how Zion Station complies with and meets the objectives of 10CFR50.48(f) and describes the fire detection and suppression systems. The Fire Protection Program includes provisions for periodic assessments to ensure that the Program is maintained and is appropriate throughout the various stages of facility decommissioning. A fire suppression water system consists of: a water source(s); pumps; and distribution piping with associated sectionalizing isolation valves. Such valves shall include yard hydrant valves, and the first valve upstream of the water flow alarm device on each sprinkler, hose standpipe or spray system riser.

6.5.4 Fitness for Duty

The ComEd Fitness for Duty (FFD) Program meets the requirements and standards of 10CFR26.

6.5.5 Offsite Dose Calculation Manual

The Zion Station Offsite Dose Calculation Manual (ODCM) is defined by Technical Specifications to contain the methodology and parameters used in the calculation of off-site doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints and in the conduct of the Environmental Radiological Monitoring Program. The ODCM shall also contain the Radioactive Effluent Control and Radiological Environmental Monitoring Programs and descriptions of the information that should be included in the Annual Radiological Environmental Operating and Annual Radioactive Effluent Release Reports.

6.5.6 Process Control Program

The Process Control Program (PCP) contains the current formulas, sampling analyses, tests, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10CFRParts 20, 61, and 71; state regulations; burial ground requirements; and other requirements governing the disposal of solid radioactive waste. Dry active waste (DAW) such as compacted trash and contaminated components are not included in the scope of the PCP. Written procedures are established, implemented, and maintained covering the key activities of the Process Control Program.

Changes to the PCP shall be documented and records of reviews performed shall be retained as required by Technical Specifications.

6.5.7 Maintenance Rule Program

A Maintenance Rule Program has been established, in accordance with 10CFR50.65, for monitoring the performance of structures, systems, and components associated with the storage, control, and maintenance of spent fuel in a safe condition. The Maintenance Rule Program has established performance criteria for these SSCs such that attainment of the criteria provides reasonable assurance that the SSCs are capable of fulfilling their intended functions.

6.6 REVIEW AND INVESTIGATIVE FUNCTION

The review and investigative functions are conducted in accordance with the plant Technical Specifications.

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7. QUALITY AND TECHNICAL REQUIREMENTS

7.1 Engineered/Quality Requirements for ITDC SSCs

A higher level of quality is maintained for ITDC components to assure that the capability exists to reliably meet the performance expectations and requirements. As discussed in Section 3.2.4, ITDC components are not safety-related components and are not required to satisfy 10CFR50, Appendix B requirements. Although not required by regulation, the following criteria is developed and applied, as appropriate, to ITDC SSCs to assure continued reliability:

a. Design Control

Measures will be invoked to assure applicable regulatory requirements, license basis, and design basis information is correctly translated into specifications, drawings, procedures and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Design changes, including field changes, will be subjected to engineering design control measures commensurate with the importance of the SSC.

b. Instructions, Procedures, and Drawings

Activities affecting ITDC SSCs will be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and will be accomplished in accordance with these instructions, procedures, and drawings. Instructions, procedures, and drawings will include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

c. Inspection

Inspection of activities affecting quality will be invoked and executed to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity.

d. Test Control

Surveillance testing will be established for ITDC SSCs to ensure that the SSCs perform satisfactorily commensurate with the importance of its intended safety function.

e. Measuring and Test Equipment

Appropriate controls will be invoked to assure that measuring and test devices used on ITDC SSCs are properly controlled, calibrated and adjusted at specified periods to maintain accuracy within necessary limits.

f. Corrective Action

Measures will be invoked to assure that conditions adverse to quality are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures will assure that the cause of the condition is determined and corrective action is taken to preclude repetition.

g. Quality Assurance Records

Sufficient records are maintained to furnish evidence of activities affecting the safe storage of nuclear fuel.