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**Site Safety Analysis Report  
for Exelon Generation Company, LLC  
Early Site Permit**



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# Introduction and Description of Proposed Facility

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Exelon Generation Company, LLC (EGC), hereinafter referred to as the Applicant, has developed this comprehensive Site Safety Analysis Report (SSAR) to address the safety issues associated with its Early Site Permit (ESP) application in compliance with the applicable portions of Title 10 of the Code of Federal Regulations (CFR) Part 52 ([10 CFR 52](#)), Subpart A - Early Site Permits.

The Applicant has selected a vacant parcel of land on the Clinton Power Station (CPS) Site (hereinafter generally referred to as the EGC ESP Site) located approximately 700 ft south of the existing CPS Facility as the location for a possible future facility (hereinafter generally referred to as the EGC ESP Facility). The CPS Facility is located in Harp Township, DeWitt County approximately 6 mi east of the city of Clinton, in central Illinois. It is a single unit nuclear generating facility licensed to operate at 3,473 MWt (approximately 1,138.5 MWe gross). The Boiling Water Reactor (BWR) designed by General Electric (GE) has been producing electricity for customers since 1987. The specific reactor type has not been identified for the EGC ESP Facility. Technical information from various designs has been used to develop and envelope the facility characterization necessary to evaluate the suitability of the site for the construction and operation of a nuclear power plant.

This co-location strategy proves beneficial because this existing nuclear site is already developed and dedicated to nuclear use. Considerable site data exists and has been submitted to and reviewed by the United States Nuclear Regulatory Commission (USNRC) for the present CPS Facility. Where applicable, data from the CPS Updated Safety Analysis Report (USAR) ([CPS, 2002](#)), CPS Environmental Report (ER) ([CPS, 1982](#)), and other CPS licensing basis documents have been utilized in the development of the Site Safety Analysis Report (SSAR).

The SSAR complies with the applicable portions of [10 CFR 52.17\(a\)\(1\)](#), and consists of a general description of the proposed facility, and a description of the site characteristics.

The following briefly describes the sections of the SSAR:

[Chapter 1](#), Introduction and Description of Proposed Facility - includes a general site description, overview of reactor types, and the Plant Parameters Envelope (PPE) approach to characterize the proposed development.

[Chapter 2](#), Site Characteristics - includes geography and demography, nearby industrial, transportation, and military facilities, meteorology, hydrology, and geologic and seismic characteristics of the site.

[Chapter 3](#), Site Safety Assessment - includes radiological effluents, thermal discharges, major accident doses, and conformance with [10 CFR 100](#) - Reactor Site Criteria requirements. This section provides the anticipated maximum levels of radiological and thermal effluents the proposed facility will produce. This data are used to verify that plant

effluents will meet applicable regulatory standards and serve as input for the development of the environmental impacts analyses presented in the ER.

# 1.1 Organization of Contents

## 1.1.1 Subdivisions

The SSAR is organized into three chapters each of which consists of a number of sections that are numerically identified by numerals separated by a decimal (for example, Section 2.3 is the third section of Chapter 2). The format and content of Regulatory Guide 1.70 (Revision 3) was used for Chapters 1 and 2 as appropriate for those sections applicable to an ESP application.

## 1.1.2 References

References to other sections in the SSAR are made by chapter or section number. References to another document are indicated by citation (e.g. USGS, 1964). A reference section is located at the end of each chapter and is paginated sequentially. Reference pagination begins with the chapter number, followed by a decimal, then a capital letter "R," followed by a hyphen, and then the page number. Therefore, page one of chapter one references reads 1.R-1, page two of chapter one references reads 1.R-2, and so on.

A list of the acronyms and abbreviations used in this report can be found in [Appendix A](#) of the Administrative Information.

## 1.1.3 Tables and Figures

Tabulations of data are designated as "tables." They are identified by the section number, followed by a number typically indicating their order of mention in the section (for example, Table 2.3-4 is the fourth table of Section 2.3). Tables are located at the end of the applicable chapter following the text. Drawings, sketches, curves, graphs, and engineering diagrams are identified as "figures" and are typically numbered according to the order of mention in the section for example, Figure 1.2-3 is the third figure of Section 1.2). Figures are located at the end of the applicable chapter following the tables.

## 1.1.4 Page Numbering

Pages are numbered sequentially within each section. Two numerals separated by a decimal correspond to the chapter and section number and are followed by a hyphen and a number representing the page within the section (for example, the fifth page in Section 2.3 of Chapter 2 is numbered 2.3-5). When it becomes necessary during the revision of the SSAR to insert a page(s) within a section, letters may be used. For example, to insert two pages between 2.3-5 and 2.3-6, the following page sequence would appear: 2.3-5, 2.3-5a, 2.3-5b, 2.3-6.

The table of contents, introduction, the main body of the text, and references are printed double-sided. Page numbers appear on the right-hand side for odd pages and on the left-hand side for even pages. The control number (namely, DEL-096-REV0) is located on the left-hand side for odd pages and on the right-hand side for even pages. Tables and figures are printed single-sided.

### 1.1.5 Revisions

The following instructions will be used for revisions:

- When a change is made to the SSAR text, those pages affected will be marked with the revision number and date in the footer opposite the page number. The changed or revised portion on each page will be highlighted by a “change indicator” mark consisting of a bold vertical line drawn in the outside margin next to the material affected. Further revising of previously revised pages will delete the original vertical change bar.
- Tables and figures will be revised by indicating the revision number and date in the footer.
- Figures will be revised by indicating the revision number and date in the title block.
- Changes to text, tables, and figures in the SSAR will be itemized and explained in the revision transmittal letter or attachment.

## 1.2 General Site Description

### 1.2.1 Location and Use

The EGC ESP Facility will be co-located on the property of the existing CPS Facility. The CPS Site with its associated 4,895 acres (ac), man-made cooling reservoir (Clinton Lake) is an irregular U-shaped site in DeWitt County in east-central Illinois about 6 mi east of the city of Clinton. The site is located between the cities of Bloomington and Decatur to the north and south, respectively, and Lincoln and Champaign-Urbana to the west and east, respectively, as shown on [Figure 2.1-1](#).

The total area of the existing CPS Site is about 13,730 ac. The site includes an area that extends approximately 14 mi along Salt Creek and 8 mi along the North Fork of Salt Creek. The site is about 3 mi northeast of the confluence of Salt Creek and the North Fork of Salt Creek. The site location is shown on [Figure 1.2-1](#) and is discussed in more detail in [Section 2.1](#).

### 1.2.2 Existing Development

CPS Unit 1 is a BWR-6 with a rated core thermal power level of 3,473 MWt and a gross electrical output of 1,138.5 MWe.

Initially, two identical units were planned for CPS. The CPS Preliminary Safety Analysis Report, which was submitted in 1973, described both Units 1 and 2 ([CPS, 1973](#)).

Construction Permits were issued for both units on February 24, 1976. Construction on CPS Unit 2 was canceled in 1983.

The operating license for CPS Unit 1 was issued in September 1986 and commercial operation commenced in April 1987. The initial licensed power level was 2,894 MWt. An application to increase the power level approximately 20 percent (to 3,473 MWt) was submitted on June 18, 2001. This application was approved on April 4, 2002.

[Figure 1.2-2](#) is an aerial view of the EGC ESP Site showing the existing development.

### 1.2.3 Proposed Development

The specific reactor type for the EGC ESP Site has not been selected, however, sufficient information from a range of possible facilities is available to characterize the proposed development to support the application for an ESP.

The EGC ESP Facility will be located approximately 700 ft south of the existing CPS Facility on the existing CPS property. [Figure 1.2-3](#) shows the location of the EGC ESP Site footprint and the distance by sector from the outside boundary of the footprint to the CPS property line. Depending on the reactor type selected, the EGC ESP Facility could have a total core thermal power rating between approximately 2,400 and 6,800 MWt. The EGC ESP Facility may consist of a single reactor or multiple reactors (or modules) of the same reactor type. An overview of the reactor designs considered in developing the information necessary to support this application is provided in [Section 1.3](#). The EGC ESP Facility may be any of the reactor designs described or a new design that falls within the range of the information developed to characterize the facility (Plant Parameters Envelope).

The EGC ESP Facility will be constructed as a large industrial facility similar in general appearance to the existing CPS Facility. However, unlike the existing plant that uses the Clinton Lake for normal cooling processes, cooling tower(s) will be used for the EGC ESP Facility. The Clinton Lake will be used as the source of make up for the EGC ESP Facility cooling water systems.

Raw water for cooling tower makeup and other plant services will be provided from a new intake structure located on Clinton Lake adjacent to the existing CPS Unit 1 intake structure. Cooling tower blowdown and other plant discharges will use the existing CPS Unit 1 discharge flume as a discharge path to Clinton Lake. The additional discharge flow from the EGC ESP Facility is insignificant relative to the capacity of the existing discharge flume.

The CPS Facility's safety related systems and equipment will not be shared or cross-connected with the EGC ESP Facility. However the EGC ESP Facility will use the existing CPS Ultimate Heat Sink (UHS) as a source of makeup water for the EGC ESP Facility UHS.

Some structures, such as warehouse and training buildings and parking lots, may be shared. Some support facilities, such as domestic water supply and sewage treatment, may also be shared. The existing switchyard will be expanded to accommodate the output of the new facility and to provide the necessary off-site power. The switchyard area intended for the canceled CPS Unit 2 will be utilized for this purpose. Existing transmission right of way will be used.

The location of the EGC ESP Facility new structures relative to the existing CPS facilities is shown on [Figure 1.2-4](#).

## 1.3 Overview of Reactor Types

Information from several reactor plant designs either currently commercially available or anticipated to be commercially available within the term of the ESP was used to aid in developing input for the SSAR (and ER). The EGC ESP Facility may be any one of these reactor designs or an alternative design whose design parameters fall within the range of the information developed to characterize the ESP Facility. The reactor designs considered include light water reactors, gas-cooled reactors, and a heavy water moderated, light water cooled reactor. A brief overview of each of these reactor types is provided below for background understanding.

The approach underpinning this application is that these advanced reactor designs formed the basis of a surrogate plant design referred to as the PPE or Plant Parameters Envelope (see [Section 1.4](#)). Under this approach, any future design that is demonstrated to be bounded by the PPE, is suitable for the site, and the terms of the ESP granted pursuant to this Application remain valid and final. EGC therefore, is not seeking an ESP that concludes that the site is suitable and impacts acceptable for these designs. Rather EGC seeks an ESP that renders this conclusion for the surrogate plant.

### 1.3.1 Advanced Boiling Water Reactor

The Advanced Boiling Water Reactor (ABWR) is a commercially available advanced reactor designed by GE and certified by the USNRC. ABWRs have been built and are in operation in Japan and more are under construction in Taiwan and Japan. The ABWR standard design was reviewed and certified by the USNRC in 1997 ([10 CFR 52](#), Appendix A).

The ABWR is a single-cycle, forced-circulation, 3,926 MWt boiling water reactor. The ABWR incorporates design features proven in years of worldwide boiling water reactor experience, along with advanced features such as vessel-mounted reactor recirculation pumps; fine motion control rod drives; and digital, multiplexed, fiber-optic control, and instrumentation.

The site related parameters for the ABWR used in developing the SSAR and ER are based on one ABWR unit.

### 1.3.2 AP1000 Reactor

The AP1000 reactor is designed by Westinghouse Electric Company. It is a larger version of the AP600 design. The AP600 design was reviewed and certified by the USNRC in 1999 ([10 CFR 52](#), Appendix C). Westinghouse submitted an application to the USNRC on March 28, 2002 for certification of the AP1000. Certification of the design is anticipated within the next several years.

The AP1000 is a 3,400 MWt pressurized water reactor. The core, reactor vessel, internals, and fuel are essentially the same design as for present operating Westinghouse pressurized water reactors (PWRs). Fuel power density has been decreased to provide more thermal margin and canned rotor primary pumps have been adopted to improve reliability. The innovative aspect of the design is its reliance on passive features for emergency cooling of

the reactor and containment. The AP1000 is of the same design as the AP600, but up-rated in power to achieve economy of scale.

The site related parameters for the AP1000 used in developing the SSAR and ER are based on two AP1000 units (6,800 MWt).

### **1.3.3 Pebble Bed Modular Reactor**

The Pebble Bed Modular Reactor (PBMR) is being developed in South Africa by PBMR (Pty) LTD for deployment worldwide. Exelon has participated in the development of the PBMR.

The PBMR is a graphite-moderated, helium-cooled reactor. Heat generated by nuclear fission in the reactor is transferred to the helium and converted into electrical energy in a gas turbo generator via a Brayton direct cycle. The PBMR core is based on high temperature, gas-cooled technology. The PBMR fuel elements are spherical fuel kernels consisting of stoichiometric uranium dioxide surrounded by four layers or coatings. Proceeding outward from the fuel kernel there is a buffer layer, a inner pyrocarbon layer, a silicon carbide layer and a outer pyrocarbon layer. The 400 MWt PBMR module is the basic (and standard) stand-alone module of the PBMR electric power generation system. A commercial PBMR power plant may have one or more identical modules.

The site related parameters for the PBMR used in developing the SSAR and ER are based on a power plant consisting of eight modules (3,200 MWt).

### **1.3.4 Gas Turbine Modular Helium Reactor**

The Gas Turbine Modular Helium Reactor (GT-MHR) is under development by General Atomics Corporation (GA). GA submitted a pre-application licensing plan for the GT-MHR to the USNRC on February 18, 2002.

The GT-MHR is a graphite-moderated, helium-cooled reactor. Heat generated by nuclear fission in the reactor is transferred to the helium and converted into electrical energy in a gas turbo generator via a Brayton direct cycle. The fuel consists of spherical fuel particles; each encapsulated in multiple coating layers, formed into cylindrical fuel compacts, and loaded into fuel channels in graphite blocks. The 600 MWt GT-MHR is the basic stand-alone module of the GT-MHR. Up to four modules (2,400 MWt) comprise a complete plant.

The site related parameters for the GT-MHR used in developing the SSAR and ER are based on a power plant consisting of four modules.

### **1.3.5 Advanced CANDU Reactor**

The Advanced Canada Deuterium Uranium (CANDU) Reactor (ACR-700) is under development by Atomic Energy of Canada, Ltd. (AECL).

The ACR-700 is a 1,983 MWt light water-cooled, heavy water moderated reactor. This evolution of the CANDU design is based on the current CANDU-6 reactor design.

The reactor is a stainless steel horizontal cylinder (referred to as the calandria), closed at each end by end shields, which support the horizontal fuel channels that span the calandria. The calandria is housed in and supported by a light water filled, steel lined concrete structure that provides thermal shielding. The calandria contains a heavy water (D<sub>2</sub>O)

moderator at low temperature and pressure, reactivity control mechanisms, and several hundred fuel channels.

The heat transport system circulates pressurized light water coolant through the reactor fuel channels to remove heat produced by fission in the uranium fuel. The heat is conveyed by the reactor coolant to the steam generators where it is used to produce steam for the turbine cycle.

The site related parameters for the ACR-700 used in developing the SSAR and ER are based on two ACR-700 units (3,966 MWt).

### 1.3.6 IRIS Reactor

The International Reactor Innovative and Secure (IRIS) is a medium power, pressurized, light water-cooled reactor being designed by Westinghouse Electric Company.

IRIS is an innovative design, but it does not require new technology development, since it relies on the proven light water reactor technology. IRIS features a 1,000 MWt thermal core with standard commercial fuel assemblies (using uranium oxide fuel) that can operate over a four-year long straight burn fuel cycle.

The IRIS design features an integral reactor vessel that contains the reactor coolant system components, including the pressurizer, steam generators, and reactor coolant pumps, as well as reactor vessel radiation shields. This integral reactor vessel configuration allows the use of a small, high design pressure, spherical steel containment, resulting in a high level of safety. The IRIS reactor development has employed a "safety by design" approach that has eliminated or reduced the consequences of most serious event sequences.

The site related parameters for the IRIS used in developing the SSAR and ER are based on three IRIS units (3,000 MWt).

### 1.3.7 ESBWR

The Economic Simplified Boiling Water Reactor (ESBWR) is a new boiling water reactor designed by General Electric. The design is based on the 2000 MWt Simplified Boiling Water Reactor (SBWR), which was reviewed by the NRC as part of a design certification application in the early 1990's. As a first step toward design certification of the ESBWR, GE submitted an application to the NRC in April 2002 for review and closure of the technology issues related to the passive safety systems of the ESBWR. Following the completion of this review, a formal application for design certification of the ESBWR is planned for submittal in early 2004. The ESBWR is a 4000 MWt boiling water reactor that relies on the use of natural circulation and passive safety features to enhance the plant performance and simplify the design.

The ESBWR has achieved a major plant simplification by elimination of the recirculation pumps and significantly reducing the number of control rods and control rod drives. Natural circulation in the ESBWR is established due to the density differences between the water in the reactor vessel annulus (outside the shroud and chimney) and the steam/water mixture inside the shroud and chimney. The chimney is an open-ended stainless steel cylinder installed above the core at the flow outlet side that forms the inboard boundary of the downcomer annulus. The chimney adds vertical length to the upward flow path for two

phase (steam-water) coolant leaving the core and to the downward flow path for the single phase (liquid) recirculation flow returning to the core lower plenum, thus augmenting the natural circulation driving head.

The site related parameters for the ESBWR used in developing the SSAR and ER are based on one ESBWR unit.

## 1.4 Plant Parameters Envelope

EGC has not made a firm decision of when to build a nuclear power facility at the EGC ESP Site nor has the reactor technology that might potentially be deployed been selected. In the absence of these determinations, the PPE concept is being used to serve as a surrogate for the actual facility information.

The PPE is a set of design parameters that are expected to bound the characteristics of a reactor or reactors that might later be deployed at a site.

In terms of safety reviews, this means that design characteristics of potential designs will be no more demanding from a site suitability perspective than the bounding design parameters listing in the PPE tabulation.

In terms of environmental reviews, this means that impacts of the selected design will not be significantly greater than impacts evaluated in the ESP using the bounding design parameters in the PPE.

The following sections describe how the PPE approach is developed and applied.

### 1.4.1 Plant Parameters Envelope Approach

The listing of plant parameters necessary to define the plant-site interface were developed based on previous industry and Department of Energy-sponsored work performed in the early 1990s as part of the ESP Demonstration Program and current reactor vendor design input data. As a result of earlier and current efforts, appropriate design parameters have been identified for inclusion in the PPE through a systematic review of regulatory criteria and guidance, ESP application content requirements, and experience with previous site suitability studies. The plant parameters are used to characterize (1) the functional or operational needs of the plant from the site's natural or environmental resources, (2) the plant's impact on the site and surrounding environs and, (3) the site imposed requirements on the plant. For example, water used for cooling may be from a natural site resource; plant heat rejection affects the site and environs; site wind conditions impose a force on plant structures.

Design parameters are the postulated features of the reactor or reactors that could be built and values are chosen to bound a range of possible future facilities. The PPE values are generally based on certified design information and the best available information for as yet uncertified designs. Some of the values have been modified to include margin.

Site characteristics, on the other hand, are the physical, environmental, and demographic features of a proposed facility location. Site characteristics are established through data collection and/or analysis and are developed in accordance with NRC requirements and guidance. Examples of site characteristics are maximum wind speed, maximum snow loading, and seismicity.

Site parameters are the postulated physical, environmental, and demographic features of an unspecified site. These are the site-related parameters that vendors have assumed in completing (certifying) a reactor design. They establish the physical, environmental, and

demographic characteristics that a site must possess if it is to be suitable for the vendor's reactors.

Design characteristics are the actual features of a reactor or reactors.

At COL application phase, design characteristics are assessed to verify they fall within the site characteristics and environmental impacts approved in the ESP. Certain design parameters in the PPE correspond to site characteristics, while other design parameters do not. For example, maximum snow loading is both a characteristic of the site that is quantified based on meteorological data and an important parameter in the design of plant structures. In contrast, building height is solely associated with the design and has no corresponding site characteristic.

A set of plant parameter values is developed considering the values provided by various reactor vendors and by applying appropriate conservatism where required to characterize the surrogate facility. As applicable, the most limiting (maximum or minimum) bounding value is selected. The complete set of plant parameter values describes, or envelopes, the site-facility interface. This type of facility characterization is considered sufficient to assess the future use of the site for a nuclear electric generating facility from both a safety and environmental viewpoint.

## 1.4.2 Applicable Plant Parameters Envelope

Tables 1.4-1 through 1.4-8 present the listing of parameters used, the PPE values selected or the site characteristic values used in assessing the safety and environmental impact of constructing and operating the EGC ESP Facility. Table 1.4-9 provides a description or definition and bases for the plant parameters utilized in evaluating the safety and or environmental impact of locating the proposed nuclear generating capacity at the EGC ESP Site.

As indicated in Section 1.4.1, the listing of plant parameters necessary to define the plant-site interfaces was developed based on previous industry and Department of Energy sponsored work performed in the early 1990s. A preliminary version of this listing was issued as Appendix C to Revision A of NEI 01-02 and was updated by the Pilot ESP Applicants to reflect changes in parameter content, numbering and designations. This updated PPE listing will, when issued, present a comprehensive set of the possible plant parameters. Due to site-specific conditions many of the originally listed parameters are not applicable to, nor included in, the EGC ESP tabulation. Only those plant parameters and site characteristics utilized in EGC ESP SSAR, ER, EP or Redress Plan assessments are presented in Tables 1.4-1 through 1.4-9.

## 1.5 USNRC Regulatory Guides

Table 1.5-1 lists the applicable Division 1 USNRC Regulatory Guides considered in the development of the EGC ESP SSAR. Relevant portions of these guides were applied, as appropriate, as discussed in the conformance/comment column of the Table.

# References

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## Chapter Introduction

10 CFR 52. Code of Federal Regulations. "Early Site Permits; Standard Design Certification; and Combined Licenses for Nuclear Power Plants."

10 CFR 52. Subpart A. Code of Federal Regulations. "Early Site Permits."

10 CFR 100. Code of Federal Regulations. "Reactor Site Criteria."

Clinton Power Station (CPS). *Clinton Power Station Environmental Report Operating License Stage*. Supplement 3. April, 1982.

Clinton Power Station (CPS). *Clinton Power Station Updated Safety Analysis Report*. 2002.

## Section 1.1

U.S. Nuclear Regulatory Commission (USNRC). *Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants*. Regulatory Guide 1.70, Revision 3. November 1978.

## Section 1.2

Clinton Power Station (CPS). *Clinton Power Station Preliminary Safety Analysis Report*. 1973.

Illinois Department of Natural Resources (IDNR). Aerial Photography. USGS Digital Orthophoto Quadrangle for DeWitt County, 1998 and 1999.

U.S. Census Bureau, Census 2000 County and County Equivalent Areas of Illinois Generalized Boundary File. Available at:  
<http://www.census.gov/geo/www/cob/co2000.html>. June 26, 2002a.

U.S. Census Bureau, Census 2000 Incorporated/Census Designated Places of Illinois Generalized Boundary File. Available at:  
<http://www.census.gov/geo/www/cob/pl2000.html>. June 26, 2002b.

U.S. Census Bureau, Census 2000 TIGER/Line Files (machine-readable data files). Roads, Railroads and Water Features. Washington D.C. 2000.

## Section 1.3

10 CFR 52. Appendix A. Code of Federal Regulations. "Design Certification Rule for the U.S. Advanced Boiling Water Reactor."

10 CFR 52. Appendix C. Code of Federal Regulations. "Design Certification Rule for the AP600 Design."

## Section 1.4

American National Standards Institute, Inc. (ANSI). "Minimum Design Loads for Buildings and Other Structures". ANSI A58.1-1982. New York, New York. 1982

American National Standards Institute/ American Nuclear Society (ANSI/ ANS). ANSI/ANS-2.8-1983. "Determining Design Basis Flooding at Power Reactor Sites." American Nuclear Society. La Grange Park, Illinois. 1983.

McGuire, R.K., Silva, W.J., and C.J. Costantino "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines." NUREG/CR-6728. Washington, D.C., U.S. Nuclear Regulatory Commission. May 2001.

Nuclear Energy Institute, (NEI). *Industry Guideline for Preparing an Early Site Permit Application* - 10 CFR Part 52, Subpart A, NEI-01-02 [Revision A], September 2001.

U.S. Department of Commerce (USDOC) and U.S. Army Corp of Engineers (USACOE). E.M. Hansen, L.C. Schreiner and J.F. Miller. "Application of Probable Maximum Precipitation Estimates – United States East of the 105<sup>th</sup> Meridian." NOAA Hydrometeorological Report No. 52. August 1982.

U.S. Nuclear Regulatory Commission (USNRC). *Standard Review Plan for the Review of Safety Analysis Report for Nuclear Power Plants*. NUREG-0800. Office of Nuclear Regulatory Research. 1987.

## Section 1.5

U.S. Nuclear Regulatory Commission (USNRC). *Criteria for Emergency Planning in Early Site Permit Application*. Draft Report for Comment. NUREG-0654/FEMA-REP-1. Revision 1. Supplement 2. April 1996.

CHAPTER 1

# Tables

**TABLE 1.4-1**  
Plant Parameters Envelope (PPE) EGC ESP Facility

<b>PPE Section</b>	<b>PPE Value</b>	<b>Site Characteristic Value</b>	<b>Usage</b>
<b>1. Structure</b>			
<b>1.1 Building Characteristics</b>			
1.1.1 Height	234 ft above grade	Not Applicable	ER
1.1.2 Foundation Embedment	140 ft below grade	Not Applicable	ER
<b>1.2 Precipitation (for Roof Design)</b>			
1.2.1 Maximum Rainfall Rate	Note 1	13.5 in/hr (4.3 in/5 min)	SSAR
1.2.2 Snow Load	Note 1	35 lb/ft <sup>2</sup>	SSAR ER
<b>1.3 Safe Shutdown Earthquake (SSE)</b>			
1.3.1 Design Response Spectra	Note 1	Site Specific Determination: Figure 2.5-12	SSAR
1.3.2 Peak Ground Acceleration	Note 1	0.26 g	SSAR
1.3.3 Time History	Note 1	NUREG/CR-6728	SSAR
1.3.4 Capable Tectonic Structures or Sources	Note 1	No active faults: < 25 mi Possible faults: > 25 mi < 200 mi	SSAR
<b>1.4 Site Water Level (Allowable)</b>			
1.4.1 Maximum Flood (or Tsunami)	Note 1	26.1 ft below grade	SSAR
1.4.2 Maximum Ground Water	Note 1	5 ft below grade	SSAR
<b>1.5 Soil Properties Design Bases</b>			
1.5.1 Liquefaction	Note 1	None at site below 60 ft below ground surface (bgs)  Soils above 60 ft bgs to be replaced or improved	SSAR
1.5.2 Minimum Bearing Capacity (Static)	Note 1	50,000 lbs/ ft <sup>2</sup>	SSAR
1.5.3 Minimum Shear Wave Velocity	Note 1	0 – 50 ft = 820 fps 50 – 285 ft = 1090 fps 285 – 310 ft = 2580 fps	SSAR

**TABLE 1.4-1**  
 Plant Parameters Envelope (PPE) EGC ESP Facility

<b>PPE Section</b>	<b>PPE Value</b>	<b>Site Characteristic Value</b>	<b>Usage</b>
<b>1.6 Tornado (Design Bases)</b>			
1.6.1 Maximum Pressure Drop	Note 1	2.0 psi	SSAR
1.6.2 Maximum Rotational Speed	Note 1	240 mph	SSAR
1.6.3 Maximum Translational Speed	Note 1	60 mph	SSAR
1.6.4 Maximum Wind Speed	Note 1	300 mph	SSAR
1.6.6 Radius of Maximum Rotational Speed	Note 1	150 ft	SSAR
1.6.7 Rate of Pressure Drop	Note 1	1.2 psi/sec	SSAR
<b>1.7 Wind</b>			
1.7.1 Basic Wind Speed	Note 1	75 mph	SSAR
1.7.2 Importance Factors	1.11 (Safety Related)	Not Applicable	SSAR
<b>2. Normal Plant Heat Sink</b>			
<b>2.3 Condenser</b>			
2.3.2 Condenser / Heat Exchanger Duty	15.08 E+09 Btu/hr	Not Applicable	SSAR ER
<b>2.4 Mechanical Draft Cooling Towers</b>			
2.4.1 Acreage	50 ac	Not Applicable	ER
2.4.3 Blowdown Constituents and Concentrations	See Table 1.4-2	Not Applicable	SSAR ER
2.4.4 Blowdown Flow Rate	12,000 gpm (49,000 gpm max.)	Not Applicable	SSAR ER
2.4.5 Blowdown Temperature	100°F	Not Applicable	SSAR ER
2.4.7 Evaporation Rate	31,500 gpm (Note 2)	Not Applicable	SSAR
2.4.8 Height	60 ft	Not Applicable	ER
2.4.9 Makeup Flow Rate	42,000 gpm	Not Applicable	ER
2.4.10 Noise	55 dBa @ 1,000 ft	Not Applicable	ER
2.4.12 Cooling Water Flow Rate	1,200,000 gpm	Not Applicable	SSAR
2.4.13 Heat Rejection Rate (Blowdown)	12,000 gpm (49,000 gpm max.) @ 100°F	Not Applicable	ER
2.4.14 Maximum Consumption of Raw Water	60,000 gpm	Not Applicable	ER
<b>2.5 Natural Draft Cooling Towers</b>			
2.5.1 Acreage	34.5 ac total (with 3 X 2.75 ac per reactor basin, 8.25 ac total for basins)	Not Applicable	ER

**TABLE 1.4-1**  
Plant Parameters Envelope (PPE) EGC ESP Facility

<b>PPE Section</b>	<b>PPE Value</b>	<b>Site Characteristic Value</b>	<b>Usage</b>
2.5.3	Blowdown Constituents and Concentrations	See Table 1.4-2	Not Applicable ER
2.5.4	Blowdown Flow Rate	12,000 gpm (49,000 gpm max.)	Not Applicable SSAR ER
2.5.5	Blowdown Temperature	100°F	Not Applicable SSAR ER
2.5.7	Evaporation Rate	31,500 gpm (Note 2)	Not Applicable SSAR
2.5.8	Height	550 ft	Not Applicable ER
2.5.9	Makeup Flow Rate	42,000 gpm	Not Applicable ER
2.5.10	Noise	55 dBa @ 1,000 ft	Not Applicable ER
2.5.12	Cooling Water Flow rate	1,200,000 gpm	Not Applicable SSAR ER
2.5.13	Heat Rejection Rate (Blowdown)	12,000 gpm normal (49,000 gpm max.) @ 100°F	Not Applicable ER
2.5.14	Maximum Consumption of Raw Water	60,000 gpm	Not Applicable ER
<b>3.</b>	<b>Ultimate Heat Sink</b>		
<b>3.2</b>	<b>CCW Heat Exchanger</b>		
3.2.1	Maximum Inlet Temp. to CCW Heat Exchanger	95 °F	Not Applicable SSAR
3.2.2	CCW Heat Exchanger Duty	225 E+06 Btu/hr 411.4E+06 Btu/hr (Shutdown)	Not Applicable SSAR ER
<b>3.3</b>	<b>Mechanical Draft Cooling Towers</b>		
3.3.1	Acreage	0.5 ac	Not Applicable ER
3.3.3	Blowdown Constituents and Concentrations	See Table 1.4-2	Not Applicable ER
3.3.4	Blowdown Flow Rate	144 gpm expected (700 gpm max.)	Not Applicable SSAR ER
3.3.5	Blowdown Temperature	95°F	Not Applicable SSAR ER
3.3.7	Evaporation Rate	411 gpm (700 gpm max.)	Not Applicable SSAR
3.3.8	Height	60 ft	Not Applicable ER
3.3.9	Makeup Flow Rate	555 gpm (1,400 gpm max)	Not Applicable SSAR ER

**TABLE 1.4-1**  
 Plant Parameters Envelope (PPE) EGC ESP Facility

<b>PPE Section</b>	<b>PPE Value</b>	<b>Site Characteristic Value</b>	<b>Usage</b>
3.3.10 Noise	55 dBa @ 1,000 ft	Not Applicable	ER
3.3.12 Cooling Water Flow rate	26,125 gpm normal (52,250 gpm shutdown)	Not Applicable	SSAR ER
3.3.13 Heat Rejection Rate (blowdown)	144 gpm expected (700 max. gpm) @ 95°F	Not Applicable	ER
<b>5. Potable Water/Sanitary Waste System</b>			
<b>5.1 Discharge to Site Water Bodies</b>			
5.1.1 Flow Rate	60 gpm expected (198 max gpm)	Not Applicable	SSAR ER
<b>5.2 Raw Water Requirements</b>			
5.2.1 Maximum Use	198 gpm	Not Applicable	ER
5.2.2 Monthly Average Use	90 gpm	Not Applicable	SSAR ER
<b>6. Demineralized Water System</b>			
<b>6.1 Discharge to Site Water Bodies</b>			
6.1.1 Flow Rate	110 gpm expected (145 gpm max.).	Not Applicable	ER
<b>6.2 Raw Water Requirements</b>			
6.2.1 Maximum Use	720 gpm	Not Applicable	ER
6.2.2 Monthly Average Use	550 gpm	Not Applicable	SSAR ER
<b>7. Fire Protection System</b>			
<b>7.1 Raw Water Requirements</b>			
7.1.1 Maximum Use	2500 gpm	Not Applicable	ER
7.1.2 Monthly Average Use	10 gpm	Not Applicable	SSAR ER
<b>8. Miscellaneous Drain</b>			
<b>8.1 Discharge to Site Water Bodies</b>			
8.1.1 Flow Rate	75 gpm total (150 gpm max)	Not Applicable	ER

**TABLE 1.4-1**  
Plant Parameters Envelope (PPE) EGC ESP Facility

<b>PPE Section</b>	<b>PPE Value</b>	<b>Site Characteristic Value</b>	<b>Usage</b>
<b>9. Unit Vent/Airborne Effluent Release Point</b>			
<b>9.1 Atmospheric Dispersion (CHI/Q) (Accident)</b>			
9.1.1 0-2 hr @ EAB (sec/m <sup>3</sup> )	Note 1	1.85E-04(5%) 3.56E-05 (50%)	SSAR ER
9.1.2 0-8 hr @ LPZ (sec/m <sup>3</sup> )	Note 1	2.49E-05 (5%) 3.40E-06 (50%)	SSAR ER
9.1.3 8-24 hr @ LPZ (sec/m <sup>3</sup> )	Note 1	1.68E-05 (5%) 2.85E-06 (50%)	SSAR ER
9.1.4 1-4 day @ LPZ (sec/m <sup>3</sup> )	Note 1	7.18E-06 (5%) 1.85E-06 (50%)	SSAR ER
9.1.5 4-30 day @ LPZ (sec/m <sup>3</sup> )	Note 1	2.11E-06 (5%) 1.00E-06 (50%)	SSAR ER
<b>9.2 Atmospheric Dispersion (CHI/Q)(Annual Average)</b>	Note 1	2.04E-06 sec/m <sup>3</sup> @ EAB	SSAR ER
<b>9.3 Dose Consequences</b>			
9.3.1 Normal	Note 1	Refer to SSAR 3.1.1 and 3.1.1.2 and ER 5.4	SSAR ER
9.3.2 Post-Accident	Note 1	Refer to SSAR 3.3 and ER 7.1	SSAR ER
<b>9.4 Release Point</b>			
9.4.2 Elevation (Normal)	Note 1	Ground Level	SSAR
9.4.3 Elevation (Post Accident)	Note 1	Ground Level	SSAR
9.4.4 Minimum Distance to Site Boundary	Note 1	1025 m (3,362 ft)	SSAR
<b>9.5 Source Term</b>			
9.5.1 Gaseous (Normal)	See Table 1.4-3 for isotopic breakdown.	Not Applicable	SSAR ER
9.5.2 Gaseous (Post-Accident)	Based on limiting DBAs. (Refer to SSAR 3.3)	Not Applicable	SSAR
9.5.3 Tritium (Normal)	See Table 1.4-3	Not Applicable	SSAR ER

**TABLE 1.4-1**  
 Plant Parameters Envelope (PPE) EGC ESP Facility

<b>PPE Section</b>	<b>PPE Value</b>	<b>Site Characteristic Value</b>	<b>Usage</b>
<b>10. Liquid Radwaste System</b>			
<b>10.1 Dose Consequences</b>			
10.1.1 Normal	Note 1	SSAR 3.1.2.2	SSAR
<b>10.2 Release Point</b>			
10.2.1 Flow Rate	Average daily discharge for 292 days per year with dilution flow of 2,400 gpm	Not Applicable	SSAR ER
<b>10.3 Source Term</b>			
10.3.1 Liquid	See Table 1.4-4 for isotopic listing.	Not Applicable	SSAR ER
10.3.2 Tritium	See Table 1.4-4	Not Applicable	SSAR ER
<b>11. Solid Radwaste System</b>			
<b>11.2 Solid Radwaste</b>			
11.2.1 Activity	See Table 1.4-5	Not Applicable	SSAR ER
11.2.2 Principal Radionuclides	See Table 1.4-5	Not Applicable	SSAR ER
11.2.3 Volume	15,087 ft <sup>3</sup> /yr avg.	Not Applicable	SSAR ER
<b>13. Auxiliary Boiler System</b>			
<b>13.1 Exhaust Elevation</b>	110 ft above grade	Not Applicable	ER
<b>13.2 Flue Gas Effluents</b>	See Table 1.4-6	Not Applicable	ER
<b>15. On-site/Off-site Electrical Power System</b>			
<b>15.1 Acreage</b>			
15.1.1 Switchyard	15 ac	Not Applicable	ER
<b>16. Standby Power System</b>			
<b>16.1 Diesel</b>			
16.1.2 Diesel Exhaust Elevation	30 ft above grade	Not Applicable	ER
16.1.3 Diesel Flue Gas Effluents	See Table 1.4-7	Not Applicable	ER
<b>16.2 Gas-Turbine</b>			
16.2.2 Gas-Turbine Exhaust Elevation	60 ft	Not Applicable	ER

**TABLE 1.4-1**  
Plant Parameters Envelope (PPE) EGC ESP Facility

<b>PPE Section</b>	<b>PPE Value</b>	<b>Site Characteristic Value</b>	<b>Usage</b>
16.2.3 Gas-Turbine Flue Gas Effluents	See Table 1.4-8	Not Applicable	ER
16.2.5 Gas-Turbine Fuel Type	Distillate	Not Applicable	ER
<b>17. Plant Characteristics</b>			
<b>17.3 Megawatts Thermal</b>	6,800 MWt	Not Applicable	SSAR ER
<b>17.4 Plant Design Life</b>	60 years	Not Applicable	ER
<b>17.5 Plant Population</b>			
17.5.1 Operation	580 people	Not Applicable	ER EP
17.5.2 Refueling / Major Maintenance	1,000 people	Not Applicable	EP
<b>18. Construction</b>			
<b>18.2 Acreage</b>			
18.2.1 Laydown Area	29 ac	Not Applicable	ER
18.2.2 Temporary Construction Facilities	52 ac	Not Applicable	ER
<b>18.3 Construction</b>			
18.3.1 Noise	76-101 dBa at 50 ft	Not Applicable	ER
<b>18.4 Plant Population</b>			
18.4.1 Construction	3,150 people (max.)	Not Applicable	ER
<b>18.5 Site Preparation Duration</b>	18 months	Not Applicable	ER

## Note:

- 1 Surrogate PPE value not used since actual site characteristic value is available.
- 2 5% margin added to vendor supplied PPE quantity to establish value

**TABLE 1.4-2**  
 Blowdown Constituents and Concentrations EGC ESP Facility

Constituent	Concentration (ppm) <sup>a</sup>		
	River Source	Well/ Treated Water	Envelope
Chlorine demand	10.1		10.1
Free available chlorine	0.5		0.5
Chromium			NA
Copper		6	6
Iron	0.9	3.5	3.5
Zinc		0.6	0.6
Phosphate		7.2	7.2
Sulfate	599	3,500	3,500
Oil and grease			NA
Total dissolved solids		17,000	17,000
Total suspended solids	49.5	150	150

<sup>a</sup> Assumed cycles of concentration equals 4.

**TABLE 1.4-3**  
Composite Average Annual Normal Gaseous Release EGC ESP Facility

<b>Isotope</b>	<b>Release – Ci/yr</b>	<b>Isotope</b>	<b>Release – Ci/yr</b>
Kr-83m	8.38E-04	Sr-89	6.00E-03
Kr-85m	7.20E+01	Sr-90	2.40E-03
Kr-85	8.20E+03	Y-90	4.59E-05
Kr-87	3.00E+01	Sr-91	1.00E-03
Kr-88	9.20E+01	Sr-92	7.84E-04
Kr-89	2.41E+02	Y-91	2.41E-04
Kr-90	3.24E-04	Y-92	6.22E-04
Xe-131m	3.60E+03	Y-93	1.11E-03
Xe-133m	1.74E+02	Zr-95	2.00E-03
Xe-133	9.20E+03	Nb-95	8.38E-03
Xe-135m	4.05E+02	Mo-99	5.95E-02
Xe-135	6.60E+02	Tc-99m	2.97E-04
Xe-137	5.14E+02	Ru-103	3.51E-03
Xe-138	4.32E+02	Rh-103m	1.11E-04
Xe-139	4.05E-04	Ru-106	1.56E-04
I-131	2.59E-01	Rh-106	1.89E-05
I-132	2.19E+00	Ag-110m	2.00E-06
I-133	1.70E+00	Sb-124	1.81E-04
I-134	3.78E+00	Sb-125	1.22E-04
I-135	2.41E+00	Te-129m	2.19E-04
C-14	1.46E+01	Te-131m	7.57E-05
Na-24	4.05E-03	Te-132	1.89E-05
P-32	9.19E-04	Cs-134	6.22E-03
Ar-41	4.00E+02	Cs-136	5.95E-04
Cr-51	3.51E-02	Cs-137	9.46E-03
Mn-54	5.41E-03	Cs-138	1.70E-04
Mn-56	3.51E-03	Ba-140	2.70E-02
Fe-55	6.49E-03	La-140	1.81E-03
Co-57	1.64E-05	Ce-141	9.19E-03
Co-58	4.60E-02	Ce-144	1.89E-05
Co-60	1.74E-02	Pr-144	1.89E-05
Fe-59	8.11E-04	W-187	1.89E-04
Ni-63	6.49E-06	Np-239	1.19E-02
Cu-64	1.00E-02	Total (w/o H-3)	24,045
Zn-65	1.11E-02	H-3	3,530
Rb-89	4.32E-05	Total	27,575

**TABLE 1.4-4**  
 Composite Average Annual Normal Liquid Release EGC ESP Facility

Isotope	Release – Ci/yr	Isotope	Release – Ci/yr
C-14	4.40E-04	Rh-103m	9.86E-03
Na-24	3.26E-03	Ru-106	1.47E-01
P-32	1.80E-04	Rh-106	1.47E-01
Cr-51	7.70E-03	Ag-110m	2.10E-03
Mn-54	2.60E-03	Ag-110	2.80E-04
Mn-56	3.81E-03	Sb-122	4.12E-04
Fe-55	5.81E-03	Sb-124	1.78E-03
Fe-59	4.00E-04	Sb-125	2.00E-04
Ni-63	1.40E-04	Te-129m	2.40E-04
Cu-64	7.51E-03	Te-129	3.00E-04
Co-56	5.19E-03	Te-131m	1.80E-04
Co-57	7.19E-05	Te-131	6.00E-05
Co-58	6.72E-03	I-131	2.83E-02
Co-60	9.11E-03	Te-132	4.80E-04
Zn-65	8.20E-04	I-132	3.28E-03
W -187	2.60E-04	I-133	1.34E-02
Np-239	3.11E-03	I-134	1.70E-03
Br-84	4.00E-05	Cs-134	1.99E-02
Rb-88	5.40E-04	I-135	9.94E-03
Rb-89	4.41E-05	Cs-136	1.26E-03
Sr-89	2.00E-04	Cs-137	2.66E-02
Sr-90	3.51E-05	Cs- 138	1.90E-04
Sr-91	9.00E-04	Ba-137m	2.49E-02
Y-90	3.11E-06	Ba-140	1.10E-02
Y-91	1.10E-04	La-140	1.49E-02
Sr-92	8.00E-04	Ce-141	1.80E-04
Y-91m	2.00E-05	Ce-143	3.80E-04
Y-92	6.00E-04	Pr-143	2.60E-04
Y-93	9.00E-04	Ce-144	6.32E-03
Zr-95	1.04E-03	Pr-144	6.32E-03
Nb-95	1.91E-03		
Mo-99	1.14E-03	Total (w/o H-3)	5.53E-01
Tc-99m	1.10E-03	H-3	3,100
Ru-103	9.86E-03	Total	3,100.553

**TABLE 1.4-5**  
Composite Principal Radionuclides in Solid Radwaste EGC ESP Facility

<b>Radionuclide</b>	<b>Quantity Ci/yr</b>
Fe-55	1,761.37
Fe-59	2.70
Co-60	395.92
Mn-54	347.22
Cr-51	97.14
Co-58	187.20
Zn-65	51.40
Nb-95	162
Ag-110m	2.18
Zr-95	76.45
Ba-137m	1014
Ba-140	1.06
La-140	1.21
Cs-134	628
Cs-136	0.06
Cs-137	1014
Sr-89	1.77
Sr-90	2.48
Y-90	2.48
I-131	81.91
I-133	4.55
Na-24	0.44
Rh-106	0.12
Ru-103	2.18
Ru-106	1.37
Sb-124	11.29
Ce-141	0.14
Ce-144	0.11
Gd-153	3.09
Other	72.86
Total (rounded to nearest hundred)	5,900

**TABLE 1.4-6**  
 Emissions from Auxiliary Boilers EGC ESP Facility

<b>Pollutant Discharged</b>	<b>Quantity (lbs/yr)</b>
Particulates	34,500
Sulfur oxides	115,000
Carbon monoxide	1,749
Hydrocarbons	100,200
Nitrogen oxides	19,022

Note: Emissions are based on 30 days per year of operation

**TABLE 1.4-7**  
 Emissions from Standby Diesel Generators EGC ESP Facility

<b>Pollutant Discharged</b>	<b>Quantity (lbs/yr)</b>
Particulates	1,620
Sulfur oxides	5,010
Carbon monoxide	4,600
Hydrocarbons	3,070
Nitrogen oxides	28,968

Note: Emissions are based on 4 hr/month operation for each of the generators

**TABLE 1.4-8**  
Standby Power System Gas Turbine Flue Gas Effluents EGC ESP Facility

Fuel: Distillate 20°F Ambient 9,890 Btu/kWH (LHV)  
10,480 Btu/kWH (HHV)  
96,960 lb/hr Fuel Consumption Rate

Effluent	PPMVD	Quantity (lbs/yr)
NO <sub>x</sub> (PPMVD @ 15% O <sub>2</sub> )	95	-
NO <sub>x</sub> as NO <sub>2</sub>	-	725
CO	25	85
UHC	10	20
VOC	5	10
SO <sub>2</sub>	55	470
SO <sub>3</sub>	5	30
Sulfur Mist	-	50
Particulates	-	22
<b>Exhaust Analysis</b>		<b>% Vol</b>
Argon		0.86
Nitrogen		72.56
Oxygen		11.2
Carbon Dioxide		5.19
Water		9.87

Note: Emissions are based on 4 hr/month operation for each of the generators

**TABLE 1.4-9**  
 Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
<b>1.</b>	<b>Structure</b>			
<b>1.1</b>	<b>Building Characteristics</b>			
1.1.1	Height	ft	The height from finished grade to the top of the tallest power block structure, excluding cooling towers.	Maximum
1.1.2	Foundation Embedment	ft	The depth from finished grade to the bottom of the basemat for the most deeply embedded power block structure.	Maximum
<b>1.2</b>	<b>Precipitation (for Roof Design)</b>			
1.2.1	Maximum Rainfall Rate	in per hr/in per 5 min	The probable maximum precipitation (PMP) value that can be accommodated by a plant design. Expressed as maximum precipitation for 1 hr in 1 mi <sup>2</sup> with a ratio for five minutes to the 1 hr PMP of 0.32 as found in National Weather Service Publication HMR No. 52.	Minimum
1.2.2	Snow Load	lbs/ft <sup>2</sup>	The maximum load on structure roofs due to the accumulation of snow that can be accommodated by a plant design.	Minimum
<b>1.3</b>	<b>Safe Shutdown Earthquake (SSE)</b>			
1.3.1	Design Response Spectra	Not Applicable	The assumed design response spectra used to establish a plant's seismic design.	
1.3.2	Peak Ground Acceleration	Fraction of gravity acceleration	The maximum earthquake ground acceleration for which a plant is designed; this is defined as the acceleration which corresponds to the zero period in the response spectra taken in the free field at plant grade elevation.	Minimum
1.3.3	Time History	Not Applicable	The plot of earthquake ground motion as a function of time used to establish a plant's seismic design.	Minimum
1.3.4	Capable Tectonic Structures or Sources	Not Applicable	The assumption made in a plant design about the presence of capable faults or earthquake sources in the vicinity of the plant site (for example, no fault displacement potential within the investigative area).	Minimum

**TABLE 1.4-9**  
Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
<b>1.4</b>	<b>Site Water Level (Allowable)</b>			
1.4.1	Maximum Flood (or Tsunami)	ft	Design assumption regarding the difference in elevation between finished plant grade and the water level due to the probable maximum flood (defined in ANSI/ANS 2.8-1983) used in the plant design.	Minimum (i.e. lowest elevation)
1.4.2	Maximum Ground Water	ft	Design assumption regarding the difference in elevation between finished plant grade and the maximum site ground water level used in the plant design.	Minimum (i.e. lowest elevation)
<b>1.5</b>	<b>Soil Properties Design Bases</b>			
1.5.1	Liquefaction	Not Applicable	Design assumption regarding the presence of potentially liquefying soils at a site (for example, None at Site-Specific SSE).	Minimum
1.5.2	Minimum Bearing Capacity (Static)	lbs/ft <sup>2</sup>	Design assumption regarding the capacity of the competent load-bearing layer required to support the loads exerted by plant structures used in the plant design.	Maximum
1.5.3	Minimum Shear Wave Velocity	fps	The assumed limiting propagation velocity of shear waves through the foundation materials used in the plant design.	Maximum
<b>1.6</b>	<b>Tornado (Design Bases)</b>			
1.6.1	Maximum Pressure Drop	psi	The design assumption for the decrease in ambient pressure from normal atmospheric pressure due to the passage of the tornado.	Minimum
1.6.2	Maximum Rotational Speed	mph	The design assumption for the component of tornado wind speed due to the rotation within the tornado.	Minimum
1.6.3	Maximum Translational Speed	mph	The design assumption for the component of tornado wind speed due to the movement of the tornado over the ground.	Minimum
1.6.4	Maximum Wind Speed	mph	The design assumption for the sum of maximum rotational and maximum translational wind speed components.	Minimum
1.6.6	Radius of Maximum Rotational Speed	ft	The design assumption for distance from the center of the tornado at which the maximum rotational wind speed occurs.	Minimum
1.6.7	Rate of Pressure Drop	psi/sec	The assumed design rate at which the pressure drops due to the passage of the tornado.	Minimum

**TABLE 1.4-9**  
 Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
<b>1.7</b>	<b>Wind</b>			
1.7.1	Basic Wind Speed	mph	The design wind, or “fastest mile of wind” with a 100-year return period (NUREG-0800, Sections 2.3.1 and 3.3.1) for which the facility is designed.	Minimum
1.7.2	Importance Factors	Not Applicable	Multiplication factors (as defined in ANSI A58.1-1982) applied to basic wind speed to develop the plant design.	Minimum
<b>2.</b>	<b>Normal Plant Heat Sink</b>			
<b>2.3</b>	<b>Condenser</b>			
2.3.2	Condenser / Heat Exchanger Duty	Btu/hr	Design value for the waste heat rejected to the circulating water system across the condensers.	Maximum
<b>2.4</b>	<b>Mechanical Draft Cooling Towers</b>			
<b>2.5</b>	<b>Natural Draft Cooling Towers</b>			
2.4.1, 2.5.1	Acreage	ac	The land required for cooling towers or ponds, including support facilities such as equipment sheds, basins, canals, or shoreline buffer areas.	Maximum
2.4.3, 2.5.3	Blowdown Constituents and Concentrations	ppm	The maximum expected concentrations for anticipated constituents in the cooling water systems blowdown to the receiving water body.	Maximum
2.4.4, 2.5.4	Blowdown Flow Rate	gpm	The normal (and maximum) flow rate of the blowdown stream from the cooling water systems to the receiving water body for closed system designs.	Maximum
2.4.5, 2.5.5	Blowdown Temperature	°F	The maximum expected blowdown temperature at the point of discharge to the receiving water body.	Maximum
2.4.7, 2.5.7	Evaporation Rate	gpm	The expected (and maximum) rate at which water is lost by evaporation from the cooling water systems.	Maximum
2.4.8, 2.5.8	Height	ft	The vertical height above finished grade of either natural draft or mechanical draft cooling towers associated with the cooling water systems.	Maximum
2.4.9, 2.5.9	Makeup Flow Rate	gpm	The expected (and maximum) rate of removal of water from a natural source to replace water losses from closed cooling water systems	Maximum

**TABLE 1.4-9**  
Plant Parameter Definitions

Parameter	Units	Definition	Bounding Value <sup>a</sup>
2.4.10, 2.5.10 Noise	dBa	The maximum expected sound level produced by operation of cooling towers, measured at 1000 feet from the noise source.	Maximum
2.4.12, 2.5.12 Cooling Water Flow Rate	gpm	The total cooling water flow rate through the condenser/heat exchangers.	Maximum
2.4.13, 2.5.13 Heat Rejection Rate (blowdown)	gpm @ °F	The expected heat rejection rate to an off-site receiving waterbody expressed as flow in GPM at temperature.	Maximum
2.4.14, 2.5.14 Maximum Consumption of Raw Water	gpm	The expected maximum short-term consumptive use of water by the cooling water systems.	Maximum
<b>3. Ultimate Heat Sink</b>			
<b>3.2 CCW Heat Exchanger</b>			
3.2.1 Maximum Inlet Temp to CCW Heat Exchanger	°F	The maximum temperature of safety-related service water at the inlet of the UHS component cooling water heat exchanger.	Minimum
3.2.2 CCW Heat Exchanger Duty	Btu/hr	The heat transferred to the safety-related service water system for rejection to the environment in UHS heat removal devices.	Maximum
<b>3.3 Mechanical Draft Cooling Towers</b>			
3.3.1 Acreage	ac	The land required for UHS cooling towers or ponds, including support facilities such as equipment sheds, basins, canals, or shoreline buffer areas.	Maximum
3.3.3 Blowdown Constituents and Concentrations	ppm	The maximum expected concentrations for anticipated constituents in the UHS blowdown to the receiving water body.	Maximum
3.3.4 Blowdown Flow Rate	gpm	The normal (and maximum) flow rate of the blowdown stream from the UHS system to receiving water body for closed system designs.	Maximum
3.3.5 Blowdown Temperature	°F	The maximum expected UHS blowdown temperature at the point of discharge to the receiving water body.	Maximum
3.3.7 Evaporation Rate	gpm	The expected (and maximum) rate at which water is lost by evaporation from the UHS system.	Maximum

**TABLE 1.4-9**  
 Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
3.3.8	Height	ft	The vertical height above finished grade of mechanical draft cooling towers associated with the UHS system	Maximum
3.3.9	Makeup Flow Rate	gpm	The expected (and maximum) rate of removal of water from a natural source to replace water losses from the UHS system.	Maximum
3.3.10	Noise	dBa	The maximum expected sound level produced by operation of mechanical draft UHS cooling towers, measured at 1000 ft from the noise source.	Maximum
3.3.12	Cooling Water Flow Rate	gpm	The total cooling water flow rate through the UHS system.	Maximum
3.3.13	Heat Rejection Rate (blowdown)	gpm @ °F	The expected heat rejection rate to an off-site receiving waterbody expressed as flow in GPM at temperature.	Maximum
<b>5.</b>	<b>Potable Water/Sanitary Waste System</b>			
<b>5.1</b>	<b>Discharge to Site Water Bodies</b>			
5.1.1	Flow Rate	gpm	The expected (and maximum) effluent flow rate from the potable and sanitary waste water systems to the receiving water body.	Maximum
<b>5.2</b>	<b>Raw Water Requirements</b>			
5.2.1	Maximum Use	gpm	The maximum short-term rate of withdrawal from the water source for the potable and sanitary waste water systems.	Maximum
5.2.2	Monthly Average Use	gpm	The average rate of withdrawal from the water source for the potable and sanitary waste water systems.	Maximum
<b>6.</b>	<b>Demineralized Water System</b>			
<b>6.1</b>	<b>Discharge to Site Water Bodies</b>			
6.1.1	Flow Rate	gpm	The expected (and maximum) effluent flow rate from the demineralized system to the receiving water body.	Maximum

**TABLE 1.4-9**  
Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
<b>6.2</b>	<b>Raw Water Requirements</b>			
6.2.1	Maximum Use	gpm	The maximum short-term rate of withdrawal from the water source for the demineralized water system.	Maximum
6.2.2	Monthly Average Use	gpm	The average rate of withdrawal from the water source for the demineralized water system.	Maximum
<b>7.</b>	<b>Fire Protection System</b>			
7.1	Raw Water Requirements			
7.1.1	Maximum Use	gpm	The maximum short-term rate of withdrawal from the water source for the fire protection water system.	Maximum
7.1.2	Monthly Average Use	gpm	The average rate of withdrawal from the water source for the fire protection water system.	Maximum
<b>8.</b>	<b>Miscellaneous Drain</b>			
<b>8.1</b>	<b>Discharge to Site Water Bodies</b>			
8.1.1	Flow Rate	gpm	The expected (and maximum) effluent flow rate from miscellaneous drains to the receiving water body.	Maximum
<b>9.</b>	<b>Unit Vent/Airborne Effluent Release Point</b>			
<b>9.1</b>	<b>Atmospheric Dispersion (CHI/Q) (Accident)</b>	sec/m <sup>3</sup>	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases	
9.1.1	0-2 hr @ EAB		.	Minimum
9.1.2	0-8 hr @ LPZ			Minimum
9.1.3	8-24 hr @ LPZ			Minimum
9.1.4	1-4 day @ LPZ			Minimum
9.1.5	4-30 day @ LPZ			Minimum
<b>9.2</b>	<b>Atmospheric Dispersion (CHI/Q) (Annual Average)</b>	sec/m <sup>3</sup>	The atmospheric dispersion coefficient used in the safety analysis for the dose consequences of normal airborne releases.	Minimum

**TABLE 1.4-9**  
 Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
<b>9.3</b>	<b>Dose Consequences</b>	sec/m <sup>3</sup>		
9.3.1	Normal	rem	The estimated design radiological dose consequences due to gaseous releases from normal operation of the plant.	Maximum
9.3.2	Post-Accident	rem	The estimated design radiological dose consequences due to gaseous releases from postulated accidents.	Maximum
<b>9.4</b>	<b>Release Point</b>			
9.4.2	Elevation (Normal)	ft	The elevation above finished grade of the release point for routine operational releases.	Minimum
9.4.3	Elevation (Post Accident)	ft	The elevation above finished grade of the release point for accident sequence releases.	Minimum
9.4.4	Minimum Distance to Site Boundary	m	The minimum lateral distance from the release point to the site boundary.	Minimum
<b>9.5</b>	<b>Source Term</b>			
9.5.1	Gaseous (Normal)	Ci/yr	The annual activity, by isotope, contained in routine plant airborne effluent streams.	Maximum
9.5.2	Gaseous (Post-Accident)	Ci	The activity, by isotope, contained in post-accident airborne effluents.	Maximum
9.5.3	Tritium (Normal)	Ci/yr	The annual activity of tritium contained in routine plant airborne effluent streams.	Maximum
<b>10.</b>	<b>Liquid Radwaste System</b>			
<b>10.1</b>	<b>Dose Consequences</b>			
10.1.1	Normal	rem	The estimated design radiological dose consequences due to liquid effluent releases from normal operation of the plant.	Maximum
<b>10.2</b>	<b>Release Point</b>			
10.2.1	Flow Rate	gpm	The discharge (and minimum dilution) flow rate of liquid potentially radioactive effluent streams from plant systems to the receiving waterbody.	Minimum
<b>10.3</b>	<b>Source Term</b>			
10.3.1	Liquid	Ci/yr	The annual activity, by isotope, contained in routine plant liquid effluent streams.	Maximum
10.3.2	Tritium	Ci/yr	The annual activity of tritium contained in routine plant airborne effluent streams.	Maximum

**TABLE 1.4-9**  
Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
<b>11.</b>	<b>Solid Radwaste System</b>			
<b>11.2</b>	<b>Solid Radwaste</b>			
11.2.1	Activity	Ci/yr	The annual activity, by isotope, contained in solid radioactive wastes generated during routine plant operations.	Maximum
11.2.2	Principal Radionuclides	Ci/yr	The principal radionuclides contained in solid radioactive wastes generated during routine plant operations.	Maximum
11.2.3	Volume	ft <sup>3</sup> /yr	The expected volume of solid radioactive wastes generated during routine plant operations.	Maximum
<b>13.</b>	<b>Auxiliary Boiler System</b>			
<b>13.1</b>	<b>Exhaust Elevation</b>	ft	The height above finished plant grade at which the flue gas effluents are released to the environment.	Minimum
<b>13.2</b>	<b>Flue Gas Effluents</b>	lbs/yr	The expected combustion products and anticipated quantities released to the environment due to operation of the auxiliary boilers, diesel engines and gas turbines.	Maximum
<b>15.</b>	<b>On-site/Off-site Electrical Power System</b>			
<b>15.1</b>	<b>Acreage</b>			
15.1.1	Switchyard	ac	The land usage required for the high voltage switchyard used to connect the plant to the transmission grid.	Maximum
<b>16.</b>	<b>Standby Power System</b>			
<b>16.1</b>	<b>Diesel</b>			
16.1.2	Diesel Exhaust Elevation	ft	The elevation above finished grade of the release point for standby diesel exhaust releases.	Minimum
16.1.3	Diesel Flue Gas Effluents	lbs/yr	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby diesel generators.	Maximum
16.1.4	Diesel Noise	dBa	The maximum expected sound level produced by operation of diesel engines turbines, measured at 50 feet from the noise source.	Maximum

**TABLE 1.4-9**  
 Plant Parameter Definitions

	<b>Parameter</b>	<b>Units</b>	<b>Definition</b>	<b>Bounding Value<sup>a</sup></b>
<b>16.2</b>	<b>Gas-Turbine</b>			
16.2.2	Gas-Turbine Exhaust Elevation	ft	The elevation above finished grade of the release point for standby gas-turbine exhaust releases.	Minimum
16.2.3	Gas-Turbine Flue Gas Effluents	lbs/yr	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby gas-turbine generators.	Maximum
16.2.5	Gas-Turbine Fuel Type	Not Applicable	The type of fuel oil required for proper operation of the gas-turbines.	N/A
<b>17.</b>	<b>Plant Characteristics</b>			
<b>17.3</b>	<b>Megawatts Thermal</b>	MWt	The thermal power generated by all units.	Maximum
<b>17.4</b>	<b>Plant Design Life</b>	Years	The operational life for which the plant is designed.	Maximum
<b>17.5</b>	<b>Plant Population</b>			
17.5.1	Operation	Persons	The number of people required to operate the plant.	Maximum
17.5.2	Refueling / Major Maintenance	Persons	The additional number of temporary staff required to conduct refueling and major maintenance activities.	Maximum
<b>18.</b>	<b>Construction</b>			
<b>18.2</b>	<b>Acreage</b>			
18.2.1	Laydown Area	ac	The land area required to provide space for construction support facilities.	Maximum
18.2.2	Temporary Construction Facilities	ac		Maximum
<b>18.3</b>	<b>Construction</b>			
18.3.1	Noise	dBa	The maximum expected sound level due to construction activities, measured at 50 feet from the noise source.	Maximum
<b>18.4</b>	<b>Plant Population</b>			
18.4.1	Construction	Persons	The number of people required to construct the plant.	Maximum
<b>18.5</b>	<b>Site Preparation Duration</b>	Months	Length of time required to prepare the plant site for construction.	Maximum

<sup>a</sup> The bounding (minimum or maximum) value associated with the alternative reactor technology plant parameter is selected based upon the largest or smallest value that would be required to satisfy a plant design constraint or result in a limiting environmental impact.

**TABLE 1.5-1**  
Regulatory Guide Applicability/Conformance

<b>Guide Number</b>	<b>Title</b>	<b>Rev.</b>	<b>SSAR Section</b>	<b>Conformance/Comments</b>
1.3	Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors	2	3.3.4.10	C.1: Conforms. C.2: Conforms except for meteorology, dose conversion and iodine retention. ESP uses Regulatory Guides 1.145 and 1.183 methods for meteorology and dose conversion, respectively. Suppression pool retention of iodine is credited in ABWR standard design.
1.23	On-site Meteorological Programs (Safety Guide 23)	--	2.3.2.1.3.6 2.3.3 2.3.4.2	C.1: Conforms. C.2: Conforms. C.3: Not applicable for ESP – Currently located in CPS Control Room. C.4: Conforms. C.5: Conforms. C.6: Conforms. C.7: Not applicable. C.8: Conforms with RG 1.23, with some minor exceptions (as noted in the CPS USAR) that have previously been approved by NRC.
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 (Safety Guide 25)	--	3.3.4.13	C.1: Conforms. C.2: Conforms with exception of using Regulatory Guide 1.145 accident meteorology. C.3: Conforms with exception of using Regulatory Guide 1.183 dose conversion methodology.
1.27	Ultimate Heat Sink for Nuclear Power Plants	2	2.3.1.2.4 2.4.11.5 3.2.2	C.1: Conforms. C.2: Conforms except item 2.b which is not applicable. C.3: Conforms. C.4: Not applicable for ESP.

**TABLE 1.5-1**  
 Regulatory Guide Applicability/Conformance

<b>Guide Number</b>	<b>Title</b>	<b>Rev.</b>	<b>SSAR Section</b>	<b>Conformance/Comments</b>
1.59	Design Basis Floods for Nuclear Power Plants	2	2.4.2.2 2.4.3	C.1: Conforms except for items a, c, and d which are not applicable for ESP. C.2: Conforms. C.3: Not applicable for ESP. C.4: Not applicable.
1.70	Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)	3	1.1.1 2.1.3.6 2.2.2.5.3 3.4.1.8	Used for general guidance for format and content, as applicable.
1.76	Design Basis Tornado for Nuclear Power Plants	--	2.3.1.2.2	C.1: Not used – later guidance utilized. C.2: Not applicable.
1.77	Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors	--	3.3.4.4	C.1: Conforms. C.2: Conforms. C.3: Conforms with the exception that offsite dose consequence acceptance criteria and radiological assumptions used are per Regulatory Guide 1.183, (Appendix H).
1.78	Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release	1	2.2.3.1.3	C.1: Conforms for ESP screening evaluations, other positions not applicable for ESP. C.2: Not applicable for ESP. C.3: Not applicable for ESP. C.4: Not applicable for ESP. C.5: Not applicable for ESP.
1.91	Evaluations of Explosions Postulated To Occur on Transportation Routes Near Nuclear Power Plants	1	2.2.3.1.2	C.1: Conforms. C.2: Conforms. C.3: Not applicable based on C.1 and C.2 conformance.

**TABLE 1.5-1**  
Regulatory Guide Applicability/Conformance

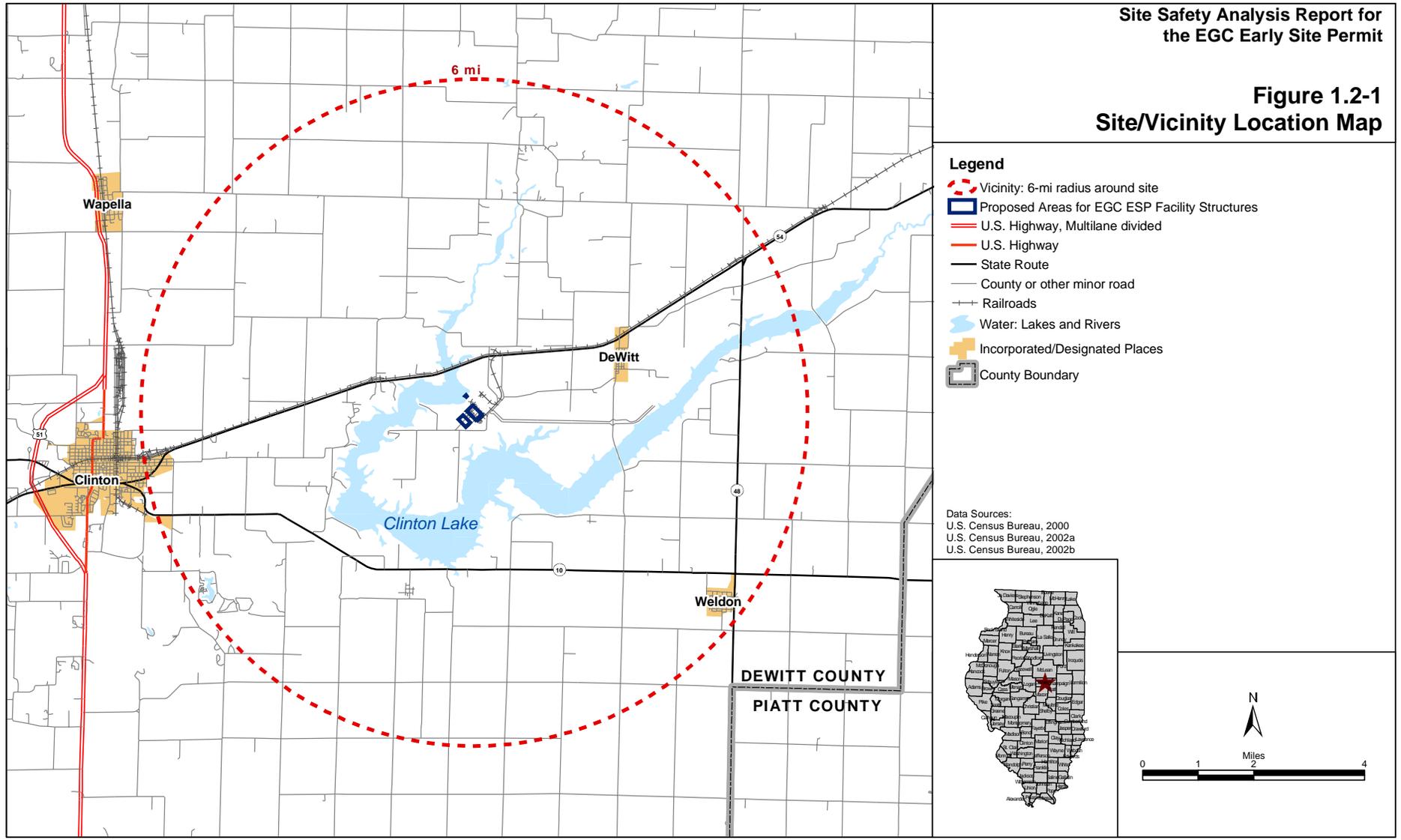
Guide Number	Title	Rev.	SSAR Section	Conformance/Comments
1.101	Emergency Planning and Preparedness for Nuclear Power Reactors	3	Emergency Plan	Conforms: The Emergency Plan has been developed to comply with 10 CFR 52.17 using the guidance provided in NUREG-0654/FEMA-REP-1, Rev. 1, Supplement 2.
1.109	Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I	1	2.3.5.1 3.1.1.2 3.1.2.2	C.1: Conforms. C.2: Conforms. C.3: Conforms. C.4: Conforms. C.5: Conforms.
1.111	Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors	1	2.3.5.1 3.1.1.2	C.1: Conforms. C.2: Conforms. C.3: Conforms. C.4: Conforms.
1.113	Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I	1	3.1.2.2	C.1: Conforms. C.2: Conforms per C.1. C.3: Conforms.
1.132	Site Investigations for Foundations of Nuclear Power Plants	1	2.4.13 2.5.1 2.5.4.2 2.5.4.3 2.5.4.4 Appendix A	C.1: Conforms with exceptions related to specific foundation design which is not applicable for ESP. C.2: Conforms. C.3: Conforms. C.4: Conforms. C.5: Conforms with exceptions related to spacing and depth in Appendix, which is related to foundation design and therefore not applicable for ESP. C.6: Conforms with exceptions of sample interval which is related to foundation design and therefore not applicable for ESP. C.7: Conforms.

**TABLE 1.5-1**  
 Regulatory Guide Applicability/Conformance

Guide Number	Title	Rev.	SSAR Section	Conformance/Comments
1.138	Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants	--	2.5.4.2 Appendix A	C.1: Conforms with exceptions related to specific foundation design which is not applicable for ESP. C.2: Conforms. C.3: Conforms. C.4: Conforms. C.5: Conforms.
1.145	Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants	1	2.3.4 3.3.2	C.1: Conforms for ground level releases. C.2: Conforms to general methods sections. C.3: Conforms. C.4: Conforms.
1.165	Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion	--	2.5.1 2.5.2 2.5.3 2.5.4 Appendix A Appendix B	C.1: Conforms. C.2: Conforms. C.3: <u>Alternate method used to conduct probabilistic seismic hazard analysis.</u> C.4: Conforms.
1.183	Alternative Radiological Source Terms For Evaluating Design Basis Accidents At Nuclear Power Reactors	-	3.3.1 3.3.2 3.3.3 3.3.4	C.1: Conforms for AP1000 DBAs and ESBWR LOCA. C.2: Conforms for AP1000 and ESBWR. C.3: Conforms for AP1000 and ESBWR. C.4: Conform with the exception of Control room and NUREG 0737 considerations which are not applicable for ESP. C.5: Conforms for AP1000 DBAs and ESBWR LOCA. C.6: Not Applicable for ESP.

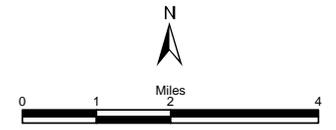
Site Safety Analysis Report for  
the EGC Early Site Permit

Figure 1.2-1  
Site/Vicinity Location Map



- Legend**
- Vicinity: 6-mi radius around site
  - Proposed Areas for EGC ESP Facility Structures
  - U.S. Highway, Multilane divided
  - U.S. Highway
  - State Route
  - County or other minor road
  - Railroads
  - Water: Lakes and Rivers
  - Incorporated/Designated Places
  - County Boundary

Data Sources:  
U.S. Census Bureau, 2000  
U.S. Census Bureau, 2002a  
U.S. Census Bureau, 2002b



Site Safety Analysis Report for  
the EGC Early Site Permit

Figure 1.2-2  
Aerial View of Site



Legend

- Proposed Areas for EGC ESP Facility Structures
- ESP Exclusion Area Boundary (1025 meters)
- Water: Lakes and Rivers

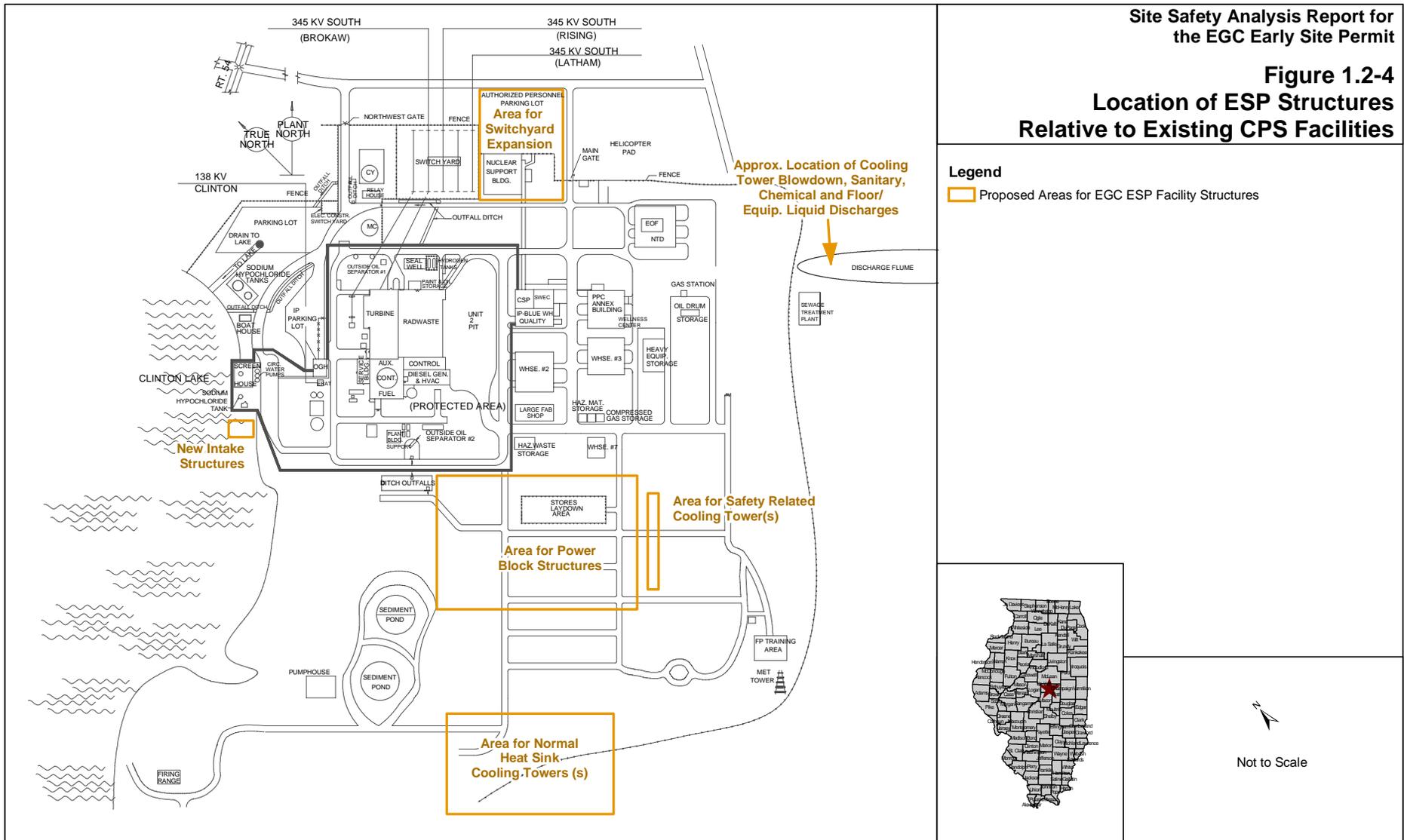
Data Sources:  
IDNR, 1998 and 1999





Site Safety Analysis Report for  
the EGC Early Site Permit

**Figure 1.2-4**  
**Location of ESP Structures**  
**Relative to Existing CPS Facilities**



Not to Scale

# Site Characteristics

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This chapter provides information on the EGC ESP Site location, on-site activities and controls, present and projected population distribution, meteorological, hydrological, geological, and seismological characteristics. The purpose of presenting this information is to provide the bases for demonstrating the adequacy of the site characteristics from a site safety viewpoint and to provide input to support environmental characterization. The influence of the EGC ESP site characteristics on the design and operation of a possible future nuclear power facility will be assessed at the construction and operating license (COL) stage pursuant to [10 CFR 52](#) Subpart C.



## 2.1 Geography and Demography

### 2.1.1 Site Location and Description

#### 2.1.1.1 Specification of Location

The EGC ESP Facility will be co-located on the property of the existing CPS Facility and its associated 4,895 ac man-made cooling reservoir (Clinton Lake) (CPS, 2002). The EGC ESP Facility will be located approximately 700 ft south of the existing CPS Facility. The CPS Facility lies within Zone 16 of the Universal Transverse Mercator (UTM) coordinates. The exact UTM coordinates for the EGC ESP Facility will depend upon the specific reactor technology selected for deployment and will be finalized at COL.

As shown on Figures 1.2-1 and 2.1-1 there is a complex transportation system surrounding the EGC ESP Site. The nearest major highways are Illinois State Routes 54, 10, and 48, all of which cross the CPS Facility property. Other major highways within the region include Interstate 155 in the west, Interstate 72 in the southeast, Interstate 55 in the northwest, Interstate 74 in the northeast, Interstate 39 in the north, and Interstate 57 in the east (U.S. Census Bureau, 2000).

The nearest railroad is the Canadian National Railroad (formerly Illinois Central) that runs parallel to State Route 54 and traverses the CPS Facility property approximately 1 mi north of the EGC ESP Facility footprint.

The EGC ESP Site is located in DeWitt County in east-central Illinois, about 6 mi east of the City of Clinton (USGS, 1990). The majority of the site is located in the eastern half of DeWitt County with the arms of the lake extending into the northeastern area of the county. The site is located within Townships 19, 20, and 21 North, Range 3 East of the Third Principal Meridian, Townships 19, 20, and 21 North, Range 4 East of the Third Principal Meridian, and Townships 20 and 21 North, Range 5 East of the Third Principal Meridian. The reactor is located in Harp Township but the size and irregular shape of the site place it in several political subdivisions. These are the townships of Harp, Wilson, Rutledge, DeWitt, Creek, Nixon, and Santa Anna.

The EGC ESP Site is located between the cities of Bloomington and Decatur, 22 mi to the north and 22 mi to the south, respectively. In addition, the EGC ESP Site is located between the cities of Lincoln and Champaign-Urbana, 28 mi to the west and 30 mi to the east, respectively. Figure 2.1-1 shows the site in reference to major towns and cities within a 50 mi radius. The EGC ESP Site is also approximately 51 mi northeast of Springfield, and almost equidistant (approximately 150 mi) between St. Louis and Chicago.

#### 2.1.1.2 Site Area Map

Figure 1.2-3 shows the EGC ESP Site area including the plant footprint, the Exclusion Area Boundary (EAB), and Low Population Zone (LPZ), as defined in 10 CFR 100. Also shown are the distances by sector to the existing property line.

The exclusion area is entirely within the property boundary and is the area encompassed by a radius of 1,025 m (3,362 ft) from the center of the ESP Facility footprint. The low population zone is the area encompassed by a circle of 4,018 m (2.5 mi) radius.

The EGC ESP Site boundary is the same as the CPS property lines as shown in [Figure 1.2-3](#). The site and its environs consist primarily of the future EGC ESP and CPS facilities, Lake Clinton, woodlands, pasture land, cultivated farmland, and the recreational areas. The total area encompassed by the site boundary is about 14,180 ac. Of this acreage about 452 ac are not owned by AmerGen and consists of Illinois Power property (~363 ac), a Shell oil pumping station (~23 ac), railroad (~20 ac), unimproved areas (~16 ac), residence (~14 ac), state highways (~9 ac), and cemeteries (~7 ac). Except for CPS, the CPS Energy and Environmental Center, and the site recreational facilities, there are no industrial, commercial, or institutional structures on the site property. Four residential structures on the site property are leased by AmerGen.

The site includes an area that extends approximately 14 mi along Salt Creek and approximately 8 mi along the North Fork of Salt Creek. The balance of the site, except for the area around the Lake Clinton dam and spillways and land leased for agriculture, is developed for recreation.

The only other uses of site property not related to electrical production or recreation are for agriculture and water supply. Approximately 1500 ac of land is leased and in agricultural use. A water well located south of the EGC ESP Facility footprint will be a primary source of water for the village of DeWitt.

The CPS facilities and the 3.4 mile discharge flume occupy about 150 ac and 130 ac, respectively. [Figure 1.2-4](#) is a site development drawing showing the location of the EGC ESP Facilities footprint on the CPS site property. The future EGC ESP Facility is expected to occupy about 150 ac.

Lake Clinton, formed by the dam constructed near the confluence of Salt Creek and the North Fork of Salt Creek, has a surface area at normal lake level (690 feet above msl) of approximately 4,895 ac with an average depth of about 15.6 ft. Lake Clinton is totally within the site property boundary. The CPS cooling water intake is about 3 mi northeast of the confluence of Salt Creek and the North Fork of Salt Creek. The intake for the EGC ESP Facility would be located adjacent to the existing intake structure ([CPS, 2002](#)).

### 2.1.1.3 Boundaries for Establishing Effluent Release Limits

For the purpose of evaluating compliance with the [10 CFR 20](#), the boundary of the restricted area for the EGC ESP Site is defined as the EGC ESP Site EAB. This boundary distance is established as a site characteristic (see [Table 1.4-1, Section 9.4.4](#)). There are no residential quarters in the restricted area. The radiation dose limits given in [10 CFR 20.1301](#) and the concentration limits of radioactive material in effluents given in [10 CFR 20.1302](#) will be met at the restricted area boundary. Access to the restricted area will be controlled by positive means such as fencing and posting of no trespassing signs on land and buoys with posting in Clinton Lake. The distance from the outside boundary of the EGC ESP footprint to the existing property line by compass sectors is shown in [Figure 1.2-3](#). The guidelines for keeping the radiation exposures as low as is reasonably achievable (ALARA), as given in [10 CFR 50, Appendix I \(10 CFR 50\)](#), are applied at the site boundary taken herein to be the EGC ESP Site EAB distance of 1,025 m. The liquid effluents from the station are discharged into Clinton Lake, the outfall of which joins the Sangamon River approximately 56 mi downstream. The Sangamon River joins the Illinois River approximately 80 mi west of the

site. The closest sizeable lake is Lake Decatur on the Sangamon River, located approximately 20 mi south of the site. There is no plausible way for liquid effluents to get to Lake Decatur since the outfall from Clinton Lake enters the Sangamon River downstream of Lake Decatur. The liquid effluents from the ESP Facility will be discharged into Clinton Lake through the existing CPS discharge flume shown on [Figure 1.2-3](#).

## 2.1.2 Exclusion Area Authority and Control

### 2.1.2.1 Authority

EGC will ensure that it has or will be granted the necessary authority, rights, and control of the EGC ESP Site, including the exclusion area prior to commencing actions allowed pursuant to any ESP granted from this Application.

The exclusion area for the EGC ESP Site meets the requirements of [10 CFR 100](#) as demonstrated in [Section 3.3](#). The boundary line of the EGC ESP Site exclusion area is shown in [Figure 1.2-3](#). The EGC ESP Site overlaps the CPS Facility exclusion area; however, the two are not concentric.

AmerGen owns the property in the EGC ESP Site exclusion area with the exception of a right-of-way for the township road that traverses the exclusion area. This road provides access to privately owned property which lies outside the EGC ESP Site exclusion area within the peninsula area between the Salt Creek finger and the North Fork of the Salt Creek finger of Clinton Lake. In an emergency, EGC together with the local law enforcement agency (DeWitt County Sheriff's Department) will control access via this road to the exclusion area. The property ownership and mineral rights provide AmerGen the authority to control activities, including exclusion and removal of personnel and property, within the exclusion area.

There are no active pipelines within the EGC ESP Facility exclusion area.

The primary activities in the CPS Facility exclusion area are those associated with the generation and distribution of electricity by the CPS Facility. The primary activities in the EGC ESP Facility exclusion area will be those associated with the generation and distribution of electricity by the EGC ESP Facility and CPS Facility. There are no residences in either exclusion area.

A private rail spur from the Canadian National Railroad track, which is located to the north of the site, was constructed to the existing CPS. AmerGen has the control authority to restrict the use of this rail spur. With the exception of the single township road, there are no other public highways, waterways, or railroads that traverse either exclusion area.

### 2.1.2.2 Control of Activities Unrelated to Plant Operation

In those areas subject to radiation from the CPS Facility, AmerGen provides surveillance and controls over worker occupancy, as appropriate. EGC will coordinate worker access and occupancy with AmerGen during the construction of the EGC ESP Facility.

None of the land within the EGC ESP Site exclusion area is planned for public recreational use. A small area of Clinton Lake lies within the EGC ESP Site exclusion area and is used for public recreation lake activities. Only those activities will be authorized which provide

assurance, under appropriate limitations, that no significant hazards would result to the public health and safety. Details of evacuation times and procedures in case of emergencies are provided in the Illinois Plan for Radiological Accidents (IPRA, 2001) and the Emergency Plan for the EGC ESP.

### 2.1.2.3 Arrangement for Traffic Control

In an emergency, the DeWitt County Sheriff's Department, as assisted by other law enforcement agencies, will provide area control, communication assistance, and handling of the public should evacuation be necessary. The Sheriff's office located in Clinton, Illinois will be notified of an emergency by the site emergency response organization. Details of evacuation procedures in case of emergencies are provided in the Illinois Plan for Radiological Accidents (IPRA, 2001) and the Emergency Plan (EP) for the EGC ESP.

### 2.1.2.4 Abandonment or Relocation of Roads

Parts of two township roads, which were located in the exclusion area for CPS Facility, have been vacated. One of these roads has been relocated while the other was abandoned. The abandoned roadway has no public access or usage and is under the complete control of the CPS Facility. The relocated roadway provides access to privately owned property which lies outside the EGC ESP exclusion area within the peninsula area between the Salt Creek finger and the North Fork of the Salt Creek finger of Clinton Lake (CPS, 2002). No abandonment or relocation of roadways is required for the EGC ESP Site.

## 2.1.3 Population Distribution

This section discusses current, projected, transient and migratory populations within the vicinity and region. Data on population were gathered using U. S. Census Bureau 2000 data. Projected population was determined based upon projection data provided by Illinois State University.

### 2.1.3.1 Population Within 16 km (10 mi)

The 2000 total residential population within 16 km (10 mi) of the site is 12,358 persons (U.S. Census Bureau, 2001). Figure 2.1-2 shows the significant population groupings (for example, towns and cities) within 16 km (10 mi) of the site. Figure 2.1-2 also shows a 0 to 16 km (0 to 10 mi) sector chart, which is used as a key for the population distribution tables described below.

Table 2.1-1 shows the population and transient population within the sectors shown in Figure 2.1-2. The table indicates that the majority of the population lives in the west sector, 8 to 16 km (5 to 10 mi) from the site. The west sector includes the community of Clinton, which has a population of over 7,000 persons. A Geographic Information System (GIS), in conjunction with the U.S. Census Bureau data from 2000, was used to determine the population by sector. Data was grouped by each census block, which is the smallest unit area of U.S. Census Bureau data collected. There are approximately 290 census blocks within a 16 km (10 mi) radius of the site. It was then assumed that population was evenly distributed within a census block. For example, if a sector made up 50 percent of a census block, it was assumed that the sector had 50 percent of the population in that census block.

For determining transient population, the following categories of transient population were

estimated:

- Seasonal Population – This population was based on the number of temporary houses used for recreation or other seasonal work provided by the 2000 census ([U.S. Census Bureau, 2001](#)).
- Transient Business Population – For commercial and manufacturing business within the 16 km (10 mi) radius, it was assumed, based on reasonable judgment, that business workers lived outside the 16 km (10 mi) radius. Therefore, to be conservative, employees of businesses within the 16 km (10 mi) radius were considered transients. Approximately 130 small businesses were estimated to have three or less employees, for a total of 390 ([CCC, 2002](#)). Larger businesses were surveyed during August and September 2002 and were verified by the DeWitt County Emergency Services and Disaster Agency Coordinator.
- Hotel/Motel Population – Within the 16 km (10 mi) radius, information was collected on the number of rooms for each hotel or motel. To be conservative and based on reasonable judgment, it was assumed that one person occupied each room, on any given day.
- Recreation Areas – Data was obtained from the IDNR on the number of visitors to state parks including Clinton Lake State Recreation Area. These visitors were considered transients. Data was also obtained for smaller recreational facilities in the region by survey during August and September 2002 and verified by the DeWitt County Emergency Services and Disaster Agency Coordinator.
- Special Population (Schools, Hospitals, Nursing Homes, and Correctional Facilities) – To be conservative, special population within the 16 km (10 mi) radius, was assumed to be transient. Population estimates were collected by surveys conducted during August and September 2002 and verified by the DeWitt County Emergency Services and Disaster Agency Coordinator.
- Festivals – Data was obtained from the Clinton Chamber of Commerce on the attendees at the annual Apple and Pork Festival that is held in Clinton. In 2002, 22,000 people, in addition to residents of Clinton, attended this festival. These people were not included, however, in the summary of transients within the 16 km (10 mi) radius, since this event occurs only one weekend each year, the last full weekend of September.
- Migrant Workers – Based on average statewide statistics on the percentage of migrant workers supplied by the Illinois Agricultural Statistics Service, ([Illinois Agricultural Statistics Service, 2002](#)), it was estimated that the number of migrant farm workers in the area is 13.6 percent of the agricultural labor force. Data on the amount of agricultural labor was obtained by the county from the Bureau of Economic Analysis, ([USDOC, 2002](#)). The migrant workers were considered transients.

Table 2.1-2 shows population projections for 10 yr increments up to 60 years from the latest decennial census. Illinois State University provided population projections for 2010 and 2020 for each county ([ISU, 2002](#)). Based on this data, the expected population change rates (percent change) between 2000 and 2010 and between 2010 and 2020 were estimated for each county. It was assumed that the expected population change rate for the four 10 yr

increments between 2020 and 2060 would be similar to the estimated population change rate between 2010 and 2020. These population rates were then applied using U.S. Census Bureau data from 2000 to each census block within a county. Population forecasts for each sector were calculated by assuming an even distribution of population throughout the census block. Transient population was forecast using the same growth percentages.

### 2.1.3.2 Population Between 16 and 80 km (10 and 50 mi)

The total residential population within 80 km (50 mi) of the site is 752,008 (U.S. Census Bureau, 2001). More than 70 percent of this population lives outside of a 40 km (25 mi) radius from the site (U.S. Census Bureau, 2001). Figure 2.1-3 shows the location of communities and cities within 80 km (50 mi) of the site, as well as a 0 to 80 km (0 to 50 mi) sector chart, which is used as a key for the population distribution tables described below.

Table 2.1-3 presents the resident and transient population within the sectors depicted in Figure 2.1-3. The most heavily populated sector within 16 and 80 km (10 and 50 mi) of the site is the east sector. The high population in this sector is due primarily to the cities of Champaign and Urbana with an approximate population of 67,518 and 36,395, respectively. The northeast sector has the lowest population. A GIS, in conjunction with U.S. Census Bureau data, as described in Section 2.1.3.1, was used to determine the population by sector.

For determining transient population, the following categories of transient population were estimated:

- Seasonal Population – The same methodology was used that is described in Section 2.1.3.1.
- Transient Business Population – For commercial and manufacturing business within the 80 km (50 mi) radius, it was assumed, because of the large area and based on reasonable judgment, that there is a no net change in population. In other words, on any given business day, the number of workers commuting into the 80 km (50 mi) radius is the same as the number of workers commuting out of the 80 km (50 mi) radius.
- Hotel/Motel Population – Information was collected on the location and number of hotels or motels within the 16 to 80 km (10 to 50 mi) radius. It was assumed, based on data collected for the 0 to 16 km (0 to 10 mi) and surveys of selected hotels and motels with the 80 km (50 mi) radius that on average 25 rooms were available in each motel and 75 rooms were available in each hotel. Based on reasonable judgment, it was assumed that one person occupied each room.
- Special Population (Schools, Hospitals, Nursing Homes, and Correctional Facilities) – For special population within the 80 km (50 mi) radius, it was assumed, because of the large area and based on reasonable judgment, that there is no net change in population. In other words, students and staff of schools within the region, likely live within the region. University students living in dormitories or apartments are counted in residential totals, based on U.S. Census Bureau procedure. Staff and residences temporarily in hospitals and nursing homes also likely live within the region. Residence of correctional facilities or long-term residences of nursing homes, hospitals, and other institutions are counted in residential totals, based on the U.S. Census Bureau procedure.

- Recreation Areas – Data was obtained from the IDNR on the number of visitors to state parks, which was then used to estimate transient population. Visitors to nature preserves and county or local parks were not included in estimates of transient population because it was assumed that these visitors would likely originate from within the area encompassed by an 80 km (50 mi) radius.
- Migrant Workers – The same methodology was used that is described in [Section 2.1.3.1](#)

[Table 2.1-4](#) presents population projections starting with 2010, and for 10 yr increments up to 60 years from the latest decennial census. The methodology used to forecast the population in the 16 to 80 km (10 to 50 mi) radii is the same as was used for the 0 to 16 km (0 to 10 mi) radius, see [Section 2.1.3.1](#).

### 2.1.3.3 Transient Population

Transient population is important in order to determine the number of people in the vicinity of the site that would not normally be counted in census figures. Transient population may include recreational facility population, seasonal residents, special population (for example, schools, hospitals, nursing homes, and correctional facilities) and business and migrant workers that do not normally live in the area. The assumptions used to estimate transient populations are described in [Section 2.1.3.1](#) and [Section 2.1.3.2](#). As noted in those sections, significant variations due to transient land use are not expected. Further, the significant transient population in the region is a result of recreational travel to state parks in the area. The year 2000 and 10 year incremental forecast to 2060 of the transient population surrounding the EGC ESP Facility are included on [Tables 2.1-1 through 2.1-4](#).

### 2.1.3.4 Low Population Zone

The low population zone, shown in [Figure 1.2-3](#), is the area immediately surrounding the exclusion area encompassed by a circle of 4,018 m (2.5 mi radius) centered on the EGC ESP Facility footprint. [Table 2.1-1](#) gives the population distribution for the LPZ and includes permanent residents and transients. There are no schools, hospitals, or institutions located within the zone and it does not include the city of DeWitt.

The LPZ was selected to provide reasonable probability that appropriate protective measures could be taken on behalf of the permanent and transient residents. The number and density of residents in the LPZ are low and this will enable effective evacuation procedures to be followed in the event of a serious accident.

[Figures 1.2-1 and 2.1-1](#) show the highway network around the site and in the surrounding area. The roads and highways within the area will be the primary transportation routes for evacuation. [Table 2.1-5](#) lists the facilities and institutions in the vicinity of the LPZ that may require special consideration in evaluating emergency plans.

The average and peak daily recreational users at recreational facilities in the vicinity of the EGC ESP Site including Clinton Lake State Park are shown on [Tables 2.1-6, 2.1-7, and 2.1-8](#).

### 2.1.3.5 Population Center

A population center is defined in [10 CFR 100](#) as a densely populated center where there are about 25,000 inhabitants or more. The closest such center with the largest population is

Decatur, Illinois, located approximately 22 mi south-southwest of the site, which had a 2000 population of 81,860. This distance was determined from the center-point of the corporate boundary and satisfies the 10 CFR 100 criteria that the population center be at least one and one third times the distance from the outer boundary of the LPZ or, in this case, approximately 3.3 mi. Table 2.1-9 shows the 2000 populations, distances, and directions from the site of cities, towns, and villages within approximately 50 mi of the site. Figure 2.1-1 shows major population centers within 50 mi of the CPS site, which are included in Table 2.1-9. Transient population was not considered in establishing the population center. As noted in Tables 2.1-2 and 2.1-4, the population within 50 mi of the plant is not projected to change significantly through 2060; therefore, it is reasonable to expect that there will be no change in the population center.

### 2.1.3.6 Population Density

The current and projected resident population density in the vicinity and in the regional area surrounding the EGC ESP site is presented in Figures 2.1-4 through 2.1-7. Most of the area within a 16 km (10 mi) radius of the site is rural, with an average population density of 39 people per square mi. The average population density within 80 km (50 mi) of the site is 97 people per square mi. The area between 25 and 37 mi of the site is the most densely populated, with a population of 267,376 and an average population density of 110 per square mi (U.S. Census Bureau, 2001). As noted these values are all well within the Regulatory Guide 1.70 criteria of 500 people per square mi. Also, as seen on Tables 2.1-2 and 2.1-4, the population within 16 km (10 mi) is projected to decrease and the population between 16 km (10 mi) and 80 km (50 mi) is projected to have a nominal increase through 2060. Therefore, the population densities are not projected to significantly change through 2060.

## 2.2 Nearby Industrial, Transportation, and Military Facilities

### 2.2.1 Locations and Routes

The location of the EGC ESP Site with respect to principal highway, rail and pipelines is depicted in [Figure 2.2-1](#). [Figure 2.2-2](#) is a regional map of the site and utilities, including electrical transmission lines within a 50 mi radius of the site. The nearest highways to the site are Illinois State Routes 54, 48, and 10 and U.S. Highway 51. Illinois State Route 54 passes through CPS facility property approximately 1 mi north of the EGC ESP Facility. Illinois State Route 10, approximately 3 mi to the south, and Illinois State Route 48, approximately 4.5 mi to the east, also pass through CPS facility property.

U.S. Highway 51, located approximately 6 mi west of the EGC ESP Facility, is the most heavily traveled highway in the vicinity averaging approximately 13,000 cars per day. State Routes 10 and 54 are moderately well traveled having a 24 hour annual average traffic flow of over 2,000 cars/day ([SIDOT, 2002](#)).

There is only one rail line within 5 mi of the site. The Gilman Line of the Canadian National Railroad runs parallel to and closely follows State Route 54, traversing the CPS Facility property approximately 1 mi north of the EGC ESP Facility footprint.

There are three National Guard aviation units in the general area of the EGC ESP Site. There is an Army National Guard unit at the Decatur Airport (25 mi south-southwest) with UH-60A Blackhawk and C-12F Twin Engine Pax-10 helicopters. There is an Air National Guard unit at the Springfield Airport (49 mi west-southwest) with F-16C fighters. The Illinois Air National Guard also has a unit at the Peoria Airport (55 mi north-northwest) that operates C-130E aircraft and UH-060A Blackhawk and CH-47D Chinook helicopters.

There are no military bases in the vicinity of the EGC ESP Site. The closest installations are several military reserve unit armories located in the general area as listed in [Table 2.2-1](#). There are no military missile sites within 50 mi of the EGC ESP Site.

The nearest industry to the EGC ESP Facility is the CPS facility. [Table 2.2-2](#) provides a list of other industries within 5 mi of the site.

DeWitt County has no passenger air service or public airports. There are seven private grass strips scattered throughout the county. Three of these strips are within 6 mi of the EGC ESP Site as shown in [Figure 2.2-1](#). The EGC ESP Site lies midway between the Central Illinois Regional Airport (formerly the Bloomington-Normal Airport) and the Decatur Airport, which are located approximately 22.5 mi north and south, respectively. These are the closest airports with commercial traffic. Low altitude federal airways in the vicinity of the EGC ESP Site are shown on [Figure 2.2-3](#).

### 2.2.2 Descriptions

#### 2.2.2.1 Description of Facilities

The CPS Facility is adjacent to the EGC ESP Facility and is the largest industrial facility in the vicinity of the EGC ESP Facility.

Other industries within 5 mi of the EGC ESP Facility are listed in [Table 2.2-2](#) along with their respective products and approximate employment. As shown in [Table 2.2-2](#), the area within 5 mi of the site is not heavily industrialized.

### 2.2.2.2 Description of Products and Materials

CPS stores a variety of chemicals and materials to support facility operation as listed in [Table 2.2-3](#).

There are two other industries within 5 mi of the EGC ESP Facility that regularly manufacture, store, or use hazardous material. Van Horn-DeWitt stores agricultural chemicals (herbicides, insecticides, and fertilizers), and Cornbelt FS maintains a large propane tank at their facility in DeWitt. Aside from the propane storage, the limiting hazard from agricultural chemical storage is anhydrous ammonia in DeWitt. In addition, Weldon Fertilizer and Lumber, Inc. also stores lesser quantities of potentially hazardous materials (for instance, agricultural chemicals).

### 2.2.2.3 Pipelines

There are five pipelines that cross the CPS property and are in the vicinity of the EGC ESP Facility (See [Table 2.2-4](#)). One pipeline traverses the CPS exclusion area within 1 mi of the ESP Site. (This closest pipeline was relocated prior to initial operation of the CPS Facility to provide additional distance from the facility.) It is a 14 inch diameter pipeline owned and operated by the Shell Pipeline Company (Equilon). The pipeline is currently used for transporting lower volatility, refined petroleum products such as gasoline and diesel fuel, but the pipeline is configured and has the capacity for the transport of propane and other higher volatility products. The potential for the transport of propane through the pipeline represented a design basis concern during the licensing of CPS, and the aforementioned relocation of the pipeline was performed to address this concern. In addition to its relocation, Shell/Equilon agreed to notify CPS in the event that propane was to be moved through the pipeline. Shell/Equilon also agreed to the implementation of certain safety measures designed to mitigate the risk associated with such transport. These actions are delineated in the CPS USAR ([CPS 2002](#)).

Recent discussions with Shell/Equilon officials as part of the preparation of the EGC ESP application indicate that future transport of propane through this pipeline is unlikely. The pipeline company's current business plan indicates indefinite use of the pipeline for liquid petroleum product(s), and conversion of the pipeline from the current petroleum product to propane would entail a substantial effort. Consequently, the existing location of this pipeline does not represent a design concern for the EGC ESP Site. In the unlikely event that Shell/Equilon or a successive owner of this pipeline were to find it desirable to transport propane, analyses or mitigating factors such as minimizing propane transport or relocation of the pipeline to a safe distance from safety-related ESP facilities would be implemented.

There are three other pipelines that cross the site property approximately 13,700 ft from the EGC ESP Facility. One is a 24 inch diameter line owned and operated by the Explorer Pipeline Company. The Phillips Pipe Line Company owns and operates two parallel 8 inch diameter pipelines. These three pipelines carry refined petroleum products similar to the

Shell/Equilon pipeline on a daily basis. Due to the large separation distance from the site to these pipelines, Explorer and Phillips are not required to notify CPS of pipeline usage.

There is also a 2 inch natural gas pipeline owned by Illinois Power Company that passes within approximately 12,000 ft of the EGC ESP Facility.

Based on the large distances (12,000 and 13,700 ft) between these four pipelines and the CPS facility relative to the distance of the Shell/Equilon pipeline, CPS was deemed adequate to preclude them from presenting an explosion or fire hazard to CPS. This conclusion is also valid for the ESP Site based on similar large distances from the pipelines to the EGC ESP footprint.

Table 2.2-4 lists the size, age, operating pressure, burial depth, and location and type of isolation valves of each line of the pipelines discussed above.

#### 2.2.2.4 Waterways

The ESP Site is located between the two fingers of an impoundment (Clinton Lake) created by the damming of Salt Creek and the North Fork of Salt Creek. Clinton Lake was originally designed to provide cooling water for the CPS Facility and will be used as a source of raw water for the EGC ESP Facility. There is no commercial traffic on Clinton Lake or on either creek. There is some recreational boating and fishing on Clinton Lake. The recreational facilities associated with the CPS Site, which include a marina, are identified in Tables 2.1-6 and 2.1-7.

#### 2.2.2.5 Airports and Airways

##### 2.2.2.5.1 Airports and Heliports

DeWitt County has no passenger air service or public airports. There are seven private airstrips scattered throughout the county. Three of these strips are within 6 mi of the EGC ESP Facility as shown in Figure 2.2-1. The Martin RLA Airport, located approximately 4 mi south of the site, has one runway 2,000 ft long. Thorp Airport located approximately 5 mi northwest has two 1,500 ft runways; one oriented east-west and the other north-south. The Bakers Strip, located approximately 5.5 mi southeast of the site has a 2,000 ft runway running north south (Bureau of Transportation Statistics, 2000). There is also a non-operational (Spencer) airport owned by AmerGen, located approximately 2 mi west-southwest. These facilities are private strips that can only accommodate small, light single or twin-engine propeller aircraft. They are available for public use only in emergencies.

The ESP Site lies midway between the Central Illinois Regional Airport (formerly the Bloomington-Normal Airport) and the Decatur Airport, which are located approximately 22.5 mi north and south, respectively. These are the closest airports with commercial traffic.

A heliport is located on site at CPS for use by company helicopters (CPS, 2002).

##### 2.2.2.5.2 Airways

Low altitude federal airways in the vicinity of the EGC ESP Facility are shown on Figure 2.2-3. The closest low altitude federal airway to the EGC ESP Facility is V313 with its centerline passing within 2 mi east. Other low altitude federal airways in the vicinity of the site are V233 passing within 3 mi northwest, V72 with a centerline approximately 5 mi

northeast, and V434 with centerline approximately 6 mi north-northeast. These airways are used by aircraft operating below 18,000 ft (msl) (CSAC, 2001).

### 2.2.2.5.3 Aircraft Hazards

Hazards associated with aircraft and airways were evaluated against the criteria in Regulatory Guide 1.70 (USNRC, 1978a) and NUREG-0800, Section 3.5.1.6, Aircraft Hazards, (USNRC, 1981). Additionally, aircraft accident probability for the ESP Site was evaluated using criteria delineated in the current draft USNRC Standard Review Plan (SRP), Section 3.5.1.6 (USNRC, 2002).

The three private airstrips within the 6 mi radius do not accommodate routine, commercial, or public traffic. A query of aviation accidents from January, 1988 to the April, 2003 indicated that there were no aviation accidents at these facilities (NTSB, 2003). In addition, the Regional Flight Safety Coordinator for the Illinois Department of Transportation (DOT) and the Safety Program Manager for the Federal Aviation Administration (FAA) office in Springfield were contacted during the preparation of the EGC ESP application indicated that they also have no record of recent accidents associated with these facilities.

There are no airports within 10 mi of the site with existing or projected operations greater than the  $500d^2$  ( $d$  equals distance in mi) movements per year criterion provided in Regulatory Guide 1.70.

There are three airports (two commercial and one municipal) near the EGC ESP Site.

The Central Illinois Regional Airport is located 23 mi north-northwest of the site and is serviced by several commercial, commuter carriers (AirTran, Northwest AirlinK, American Connection and United Express). Aircraft currently in use by these carriers include Boeing B 717, MD- DC-9, Saab 340B, BAE J-41 and CRJ-700. Year 2001 air operations at Central Illinois totaled 51,598.

The Decatur Airport (25 mi south) has scheduled commuter service through American Connection, currently flying BAE-J41 aircraft. The airport had 54,000 operations in 2001.

The Rantoul National Aviation Center Airport-Frank Elliott Field is located 37 mi east northeast of the ESP Site. Rantoul is a public airport but has no routinely scheduled commercial flights. The airfield averages 44 operations per day (16,000 per yr).

The incidence of operations for these three facilities lies well within the  $1000d^2$  criterion (USNRC, 2002); thus, accident statistics for these operations are not further evaluated.

The low altitude federal airways described above are identical to those in existence at the time of the CPS USAR. The probability of incidence of an aircraft crash from these airways was determined in the CPS USAR to be within guidelines in the NUREG-0800, Section 3.5.1.6 (USNRC, 1981) and did not constitute a design consideration (CPS, 2002). This conclusion is substantiated in Table 3.5-7 of the CPS USAR where it is demonstrated that impact probability is within the nominal acceptance criteria from the SRP (USNRC, 1981) of  $<1.0E-7$  per yr.

Aircraft impact probability for EGC ESP Site-located facilities would be a function of the magnitude of the footprint of those facilities. An extrapolation to determine the maximum

footprint allowable for ESP safety related facilities was made based upon the probability criteria in the draft SRP Section 3.5.1.6 (USNRC, 2002) used in conjunction with the data in the CPS USAR Table 3.5-7. This extrapolation indicates that ESP safety related facilities would have to be sited within a footprint of 386,000 ft<sup>2</sup> in order to meet the 1.0E-7 impact probability criterion. This area is less than the effective impact area computed for Clinton, which range from 235,000 ft<sup>2</sup> to 192,000 ft<sup>2</sup>.

Locating ESP safety related facilities within the extrapolated area of 386,000 ft<sup>2</sup> is reasonable for the reactor designs under consideration. In addition, several conditions exist that strongly indicate that this criterion is substantially conservative.

- The effective areas as found in CPS USAR Table 3.5-7 includes shadow and skid areas identified in the earlier USNRC criteria (USNRC, 1981) but not required by the proposed, draft criteria (USNRC, 2002). The actual siting areas are smaller than these tabulated values and the impact probabilities also correspondingly smaller.
- The tabulated probabilities in CPS USAR Table 3.5-7 do not fully credit the separation distance of 4 of the 5 runways resulting in the tabulated probabilities being conservative.
- The determination of probabilities in CPS USAR Table 3.5-7 are derived using a commercial aircraft crash probability of 3.0E-9 per mi per yr, whereas the current and proposed SRP rate is 4.0E-10 per mi per yr (USNRC, 1981 and USNRC, 2002), further decreasing crash probability from that determined in the CPS USAR.

Based upon these conditions, aircraft impact is not considered to be a design concern for the EGC ESP Site.

#### 2.2.2.6 Projections of Industrial Growth

Current industries in the vicinity of the station are listed in Table 2.2-2. While DeWitt County's Comprehensive Plan identifies industrial growth, including a public airport, as intermediate term objectives, there are no pending new industries or expansion of existing industries in the vicinity of the EGC ESP Site.

Table 2.2-4 lists the pipelines within 5 mi of the facility. There is also no planned expansion for any of the existing pipelines.

#### 2.2.3 Evaluation of Potential Accidents

The nearest highway is State Route 54 passing approximately 1 mi from the EGC ESP Facility. U.S. Highway 51 is approximately 6 mi from the site. Effects of accidents on these transportation routes were evaluated in the CPS USAR and concluded that they need not be considered as design basis events for the CPS. Given that the EGC ESP Facility is no closer to these routes and that there has been no distinguishable increase in traffic volumes on these routes since the CPS analysis, this conclusion is valid for the EGC ESP Facility as well (SIDOT, 2002).

The nearest railroad is the Gilman Line of the Canadian National Railroad that runs parallel to and closely follows State Route 54, traversing the CPS Facility property approximately 1 mi north of the ESP Facility footprint. Railroad transportation hazards were determined based upon patterns of hazardous material shipping for the Gilman Line of the Canadian

National Railroad during the licensing of the CPS and subsequent 3 year surveys of hazardous material shipments on this line until 1998, in compliance with the CPS USAR. The triennial surveys have indicated that the conclusion of the initial analysis remains bounding.

The EGC ESP Site is not located near a large navigable waterway. Airway hazards are addressed in [Section 2.2.2.5](#).

### 2.2.3.1 Determination of Design Basis Events

The accident categories given below have been evaluated.

Hazards associated with flammable, explosive, chemical and toxic material storage at CPS were not considered in the CPS USAR to constitute a design concern ([CPS, 2002](#)). The presence and operation of CPS and these materials is therefore not considered to constitute the need for further analysis for determining EGC ESP Site acceptability.

#### 2.2.3.1.1 Explosions

Fluids, explosives, munitions, and chemicals stored or being transported in the vicinity of the EGC ESP Site that may pose hazards to the facilities and/or operations of a facility located on the site have been evaluated in the CPS USAR ([CPS, 2002](#)).

Cornbelt FS maintains a large propane tank at their facility in DeWitt, located approximately 2.6 mi from the Exelon ESP Site. The transport of propane to this location and the storage of a large quantity of propane constitute a potential explosion concern. The propane stored and used by Cornbelt FS is transported to the location in DeWitt by truck on Highway 54 and Illinois State Route 48. At the closest approach (approximately 0.75 mi) of the closest highway to CPS, Highway 54, the risk of an explosion involving approximately 90 tons of hydrocarbon fuel (standard tank trucks are limited to a gross weight of 40 tons) was reviewed in the CPS USAR, and the safety-related structures at the station demonstrated being capable of withstanding well in excess of the overpressure associated with detonation of this (90 tons) quantity of fuel ([CPS, 2002](#)). Structures to be located at the EGC ESP Site, by virtue of having a similar or greater separation (closest approach of Highway 54 is approximately 1 mi from the ESP Site) from such an event, will not be subjected to overpressures requiring specific design considerations.

CPS evaluated, the amount of propane stored at DeWitt (1,000,000 lbs) (at the distance from the DeWitt facility to the CPS) and it was determined to be more than an order of magnitude below the level (13,240,000 lbs) that would constitute a design concern for CPS. This conclusion is valid for the EGC ESP Facility as well due to a similar or greater separation from a potential event ([Illinois Power, 1998](#)).

#### 2.2.3.1.2 Flammable Vapor Clouds

The shipment of compressed flammable gas on the Gilman Line of the Canadian National Railroad represents the potential for a flammable vapor cloud in the vicinity of the EGC ESP Site.

An estimate of the probability of a rail accident on the Gilman Line resulting in a flammable vapor cloud and subsequent explosion capable of producing a pressure pulse exceeding the

Regulatory Guide 1.91 (USNRC, 1978b) acceptance criteria of one psig at CPS was shown to be less than 1E-06 per year. Consistent with Regulatory Guide 1.91, the low probability of such an accident on the Canadian National Railroad eliminates this source as a design basis event for CPS (CPS, 2002) and for the EGC ESP Facility by virtue of the EGC ESP Facility having a similar or greater separation from such an event.

### 2.2.3.1.3 Toxic Chemicals

The chemicals and other materials maintained in inventory at CPS were evaluated in the CPS USAR for potential impact on design and operation of the facility. It was concluded that these materials did not constitute a design concern at CPS, and would therefore not pose such a concern for the ESP Facility.

Van Horn-DeWitt is the only facility within 5 mi of the EGC ESP Site that manufactures, uses, or stores toxic chemicals. Van Horn-DeWitt is a distributor of agricultural products and chemicals (such as pesticides, herbicides, and fertilizers) and their facility in DeWitt is located approximately 2.6 mi from the EGC ESP Site. A list of chemicals distributed by Van Horn-DeWitt was reviewed in the preparation of the CPS USAR. This review was updated as part of the EGC ESP application development, and it was determined that with the exception of anhydrous ammonia, none of the chemicals in Van Horn-DeWitt's inventory require evaluation for their potential effect on control room habitability (due to an accidental spill or release) in accordance with Regulatory Guide 1.78 (USNRC, 2001).

CPS demonstrated that the postulated accidents of anhydrous ammonia nurse tanks and tanker trucks used by farmers and suppliers do not adversely affect the site (CPS, 2002). This conclusion applies to the EGC ESP Facility by virtue of the EGC ESP Facility having a similar or greater separation from such an event.

The anhydrous ammonia stored and distributed by Van Horn-DeWitt is transported to the facility by truck on Highway 54. The primary transportation route is generally from the east and does not traverse through the nominal 3 mi of the truck route that are within 5 mi of the ESP Site. The potential of such a spill is small because of the small number of anhydrous ammonia shipments, the fact that there is only one wind direction that could possibly impact the EGC ESP Facility, and that the truck accident rate is fairly small. The potential for hazard was low enough that transportation of ammonia in the area surrounding CPS Facility did not need to be considered in the design. Since the traffic volumes and ammonia storage for the EGC ESP Facility are the same as CPS, ammonia from a trucking accident is not a design basis concern for the EGC ESP Facility.

Since the Van Horn-DeWitt facility is within 5 mi of the ESP Site, the accidental release of a hazardous chemical from the facility is subject to consideration for analysis in accordance with Regulatory Guide 1.78. There are two 40 ton tanks and a number of smaller tanks (nursing tanks) for storage of anhydrous ammonia at the Van Horn-DeWitt facility. Hazards to the CPS Facility from storage of ammonia at Van Horn-DeWitt were evaluated by CPS. The largest single volume (40 ton tank) of anhydrous ammonia stored at Van Horn-DeWitt exceeded the threshold values specified in Table C-2 of Regulatory Guide 1.78 (based on the toxicity limit of anhydrous ammonia, the distance of the tank from the CPS Facility, and the type of control room). The potential effect of an anhydrous ammonia release on control room habitability was evaluated, and it was determined that the

probability of an event at this location resulting in uninhabitability of the control room was sufficiently low so as to allow this source to be eliminated from concern. An analysis specific to the location of the EGC ESP Facility control room evaluating the impact of an ammonia release from this source will be required at the COL stage to determine if ammonia detection and isolation capability will be required in the facility design.

The Gilman Rail Line running parallel to State Route 54 is used to transport a wide variety of commodities, including hazardous materials. Illinois Power Company performed a comprehensive survey of the Gilman Line from Illinois Central (prior owner of the Gilman Line) shipping records for the one year period of December 1, 1981 to November 30, 1982. The survey found 19 hazardous materials shipped at least 30 times per year (based on evaluation criteria dictated by Regulatory Guide 1.78). These 19 chemicals are listed in [Table 2.2-5](#). This inventory was used as the basis for determining the potential impact of hazardous materials from this source. The 19 materials and their respective quantities (for example, maximum quantity per shipment) were evaluated in the CPS USAR for impact on control room habitability. This analysis resulted in a determination that rail line shipments did not present the potential for control room habitability concerns. The CPS USAR also identified a commitment to perform a periodic (3 year) survey of hazardous materials moved on the Gilman Line to assure that the conclusions drawn in the initial analysis remained valid and that no new hazardous materials of concern were being transported in proximity to the facility ([CPS, 2002](#)).

The COL phase for the EGC ESP Site will require a new analysis of the hazards associated with the Gilman Line that is specific to the control room location of the EGC ESP Facility, includes consideration of the specific control room ventilation system design, and incorporates current (at time of COL preparation) analytical methodology for dispersion and transport of airborne hazardous materials. Periodic review of hazardous material types and quantities being transported will also be required, presumably at the same or similar frequency to those currently being performed in support of the CPS Facility operation.

#### **2.2.3.1.4 Fires**

No external fire hazard can threaten facilities located at the EGC ESP Site, since, aside from those materials stored at CPS, no chemical plants or oil storage facilities are located near the site. Forest or brush fires pose negligible danger due to the minimal vegetation remaining from previous site preparation activities.

#### **2.2.3.1.5 Collisions with Intake Structure**

The EGC ESP Site is not located near a large navigable waterway. There is no potential for a large ship or a barge to have an impact on the intake structure. The CPS USAR concluded that since only small recreational boats are operated near the site, collisions of watercraft were not capable of interrupting intake structure function ([CPS, 2002](#)). The ESP Intake Structure would have similar performance and structural characteristics such that it would not be affected by potential impact from recreational watercraft.

#### **2.2.3.1.6 Liquid Spills**

The CPS USAR concluded that there was no potential for an accidental release of oil or other liquids which may be drawn into the intake structure and/or cooling water systems, or

which may otherwise affect the safety of such structures supporting that facility (CPS, 2002). No additional sources of such a hazard are evident for the EGC ESP Site and the CPS USAR conclusion is deemed appropriate for the EGC ESP Site.

### **2.2.3.2 Effects of Design Basis Events**

The only design basis accidents identified in [Section 2.2.3.1](#), relate to material releases at Van Horn-DeWitt and from the Gilman Rail Line resulting in toxic vapor concentrations as discussed in [Section 2.2.3.1.3](#). Analyses will be required at the COL stage to evaluate the potential for material releases at Van Horn-DeWitt and from the Gilman Rail Line resulting in toxic vapor concentrations in a control room located at the ESP Site. These analyses will be dependent on the specific control room location and control room ventilation system design.

All other potential accidents involving explosions, flammable vapor clouds, fires, collisions with intake structures, and liquid spills do not pose a threat to the EGC ESP Facility.

## 2.3 Meteorology

### 2.3.1 Regional Climatology

This section provides a description of the general climate of the EGC ESP Site, as well as the regional meteorological conditions used as a basis for design and operating conditions. A climatological summary of normal and extreme values of several meteorological parameters is presented for the first-order National Weather Service Stations in Peoria, Illinois and Springfield, Illinois. Further information regarding regional climatology was derived from pertinent documents, which are referenced in the text.

#### 2.3.1.1 General Climate

The EGC ESP Site is located near the geographical center of Illinois, approximately 55 mi southeast of the National Weather Service Station in Peoria, and 49 mi east-northeast of the National Weather Service Station in Springfield, Illinois. Both of these stations are considered to be “first-order” weather observing stations because they are fully instrumented and record a complete range of meteorological parameters. Additionally, the observations are recorded continuously, either by automated instruments or by human observer for the 24 hour period, midnight to midnight.

General climatological data for the region surrounding the site area was obtained from several sources of information that contain statistical summaries of historical meteorological data for the region. The climatic data from the Peoria and Springfield observing stations are considered to be representative of the climate at the site. This is due to the relatively close proximity of these two stations to the site as well as similarities of terrain and vegetation features in the area. With the exception of a few low hills in the extreme southern and northwest portions of the state, the terrain throughout Illinois is considered to be flat to gently rolling, with vegetation consisting predominantly of croplands, interspersed with only modest amounts of deciduous forestation. The references that were used to characterize the climatology of the region include *Climates of the States, Third Edition* (Gale Research Company, 1985); *Weather of U.S. Cities, Fourth Edition* (Gale Research Company, 1992b); and *The Weather Almanac, Sixth Edition* (Gale Research Company, 1992a).

The climate of central Illinois is typically continental, with cold winters, warm summers, and frequent short-period fluctuations in temperature, humidity, cloudiness, and wind direction. The great variability in central Illinois climate is due to its location in a confluence zone, particularly during the cooler months, between different air masses. The air masses which affect central Illinois typically include maritime tropical air, which originates in the Gulf of Mexico; continental tropical air, which originates in Mexico and the southern Rockies; Pacific air, which originates in Mexico and eastern North Pacific Ocean; and continental polar and continental arctic air, which originates in Canada. As these air masses migrate from their source regions, they may undergo substantial modification in their characteristics. Monthly streamline analyses of resultant surface winds suggest that air reaching central Illinois most frequently originates over the Gulf of Mexico from April through August, over the southeastern U.S. from September through November, and over both the Pacific Ocean and the Gulf of Mexico from December through March (Bryson, 1966).

The major factors controlling the frequency and variation of weather types in central Illinois are distinctly different during two separate periods of the year. During the fall, winter, and spring months, the frequency and variation of weather types is determined by the movement of synoptic-scale storm systems, which commonly follow paths along a major confluence zone between air masses, and is usually oriented from southwest to northeast through the region. The confluence zone normally shifts in latitude during this period, ranging in position from the central states to the U.S.-Canadian border. The average frequency of passage of storm systems along this zone is about once every five to eight days. The storm systems are most frequent during the winter and spring months, causing a maximum of cloudiness during these seasons. Winter is characterized by alternating periods of steady precipitation (rain, freezing rain, sleet, or snow) and periods of clear, crisp, and cold weather. Springtime precipitation is primarily showery in nature. The frequent passage of storm systems, presence of high winds aloft, and frequent occurrence of unstable conditions caused by the close proximity of warm, moist air masses to cold, dry air masses result in a relatively high frequency of thunderstorms during this period. These thunderstorms, on occasion, are the source of hail, damaging winds, and tornadoes. Although synoptic-scale storm systems also occur during the fall months, their frequency of occurrence is less than in winter or spring. Periods of pleasant, dry weather characterize the fall season, but ends rather abruptly with the returning storminess that usually begins in November.

In contrast, weather during the summer months is characterized by weaker storm systems, which tend to pass to the north of Illinois. A major confluence zone is not present in the region, and the region's weather is characterized by much sunshine interspersed with thunderstorm situations. Showers and thunderstorms are usually of the air mass-type, although occasional outbreaks of cold air bring precipitation and weather typical of that associated with the fronts and storm systems of the spring months.

When southeast and easterly winds are present in central Illinois, they usually bring mild and wet weather. Southerly winds are warm and showery, westerly winds are dry with moderate temperatures, and winds from the northwest and north are cool and dry.

Table 2.3-1 presents a summary of historical climatological observations from the Peoria and Springfield meteorological observing stations.

### 2.3.1.2 Regional Meteorological Conditions for Design and Operating Basis

#### 2.3.1.2.1 Thunderstorms, Hail, and Lightning

Thunderstorms occurred on an average of 48 days per year in Peoria (1955-1990) and in Springfield (1959-1990) (Gale Research Company, 1992b). Approximately 41 percent of the annual precipitation in the region is estimated to fall during thunderstorms (Changnon, 1957). Thunderstorms occur most frequently during the months of June and July; each with eight days per month in Peoria, and eight and nine days per month, respectively, in Springfield. Peoria and Springfield average five or more thunderstorm days per month throughout the season from April through September. Both stations average two or less thunderstorm days per month from November through February (Gale Research Company, 1992b). A thunderstorm day is normally recorded only if thunder is heard and the observation is independent of whether or not rain and/or lightning are observed concurrent with the thunder (AMS, 1970).

A severe thunderstorm is defined by the National Severe Storms Forecast Center (NSSFC) of the National Weather Service as a thunderstorm that possesses one or more of the following characteristics (USDOC, 1969):

- Winds of 50 knots or more;
- Hail 0.75 in or more in diameter; or
- Cumulonimbus cloud favorable to tornado formation.

The above referenced report by the NSSFC provides values for the total number of hail reports 0.75 in or greater, winds of 50 knots or greater, and the number of tornadoes for the period 1955-1967 by 1° squares (latitude by longitude). The report shows that during this 13 year period, the 1° square containing the site had 15 hailstorms producing hail 0.75 in in diameter or greater, 26 occurrences of winds of 50 knots or greater, and 42 tornadoes.

At least one day of hail is observed per year over approximately 90 percent of Illinois, with the average number of hail days at a point varying from one to four (Huff and Changnon, 1959). Considerable year-to-year variation in the number of hail days is seen to occur; annual extremes at a point vary from no hail in certain years to as many as 14 hail days in other years. About 80 percent of the hail days occur from March through August with spring (March through May) being the primary period of occurrence. In the EGC ESP Site region, Peoria and Springfield average approximately 22 hail days per 10 year period, with about 55 percent of all hail days occurring in the spring (Huff and Changnon, 1959). The maximum number of hail days in a year for Peoria and Springfield is seven (1927, 1950, 1954) and eight (1975), respectively (Changnon, 1995). Total hailstorm life at a point averages about 7 minutes, with maximum storm life reported as generally not over 20 minutes for Illinois (Changnon, 1957).

The frequency of lightning flashes per thunderstorm day over a specific area can be estimated by using Equation 2.3-1, taking into account the distance of the location from the equator (Marshall, 1971):

$$N = (0.1 + 0.35 \sin \varnothing) (0.40 \pm 0.20) \quad \text{Equation 2.3-1}$$

Where: N = Number of flashes to earth per thunderstorm day per km<sup>2</sup>

$\varnothing$  = Geographical latitude

For the EGC ESP Site, which is located at approximately 40° north latitude, the frequency of lightning flashes (N) ranges from 0.065 to 0.195 flashes per thunderstorm day per km<sup>2</sup>. The value 0.195 is used as the most conservative estimate of lightning frequency in the calculations that follow.

Taking the annual average number of thunderstorm days in the site region as 48 (in Peoria and Springfield), the mean frequency of lightning flashes per km<sup>2</sup> per year is 9.4 as calculated below:

$$\frac{0.195 \text{ flashes}}{\text{(thunderstorm day) (km}^2\text{)}} \times \frac{48 \text{ thunderstorm days}}{\text{year}} = \frac{9.4 \text{ flashes}}{\text{(km}^2\text{) (year)}}$$

The area of the CPS Site is approximately 14,000 ac. Hence, the expected frequency of lightning flashes at the site per year is 533, as calculated below:

$$\frac{9.4 \text{ flashes}}{(\text{km}^2) (\text{year})} \times 56.7 \text{ km}^2 = \frac{533 \text{ flashes}}{\text{year}}$$

The exclusion area for the EGC ESP Facility at the EGC ESP Site has a radius of 3,362 ft. Hence, the expected frequency of lightning flashes in the exclusion area per year is 31, as calculated below:

$$\frac{9.4 \text{ flashes}}{(\text{km}^2) (\text{year})} \times 3.3 \text{ km}^2 = \frac{31 \text{ flashes}}{\text{year}}$$

### 2.3.1.2.2 Tornadoes and Severe Winds

Illinois ranks eighth in the U.S. in average annual number of tornadoes, based on the period-of-record 1953-1989 ([Gale Research Company, 1992b](#)). During the period 1950 to 2002, the average number of tornadoes per year that have occurred in Illinois is 30 ([NOAA, 2002a](#)). For this same period of record, Illinois tornado statistics based on storm intensity are summarized in [Table 2.3-2 \(NOAA, 2002b\)](#). It is important to note that the wind speeds associated with the storm intensities (referenced in the Fujita Tornado Scale) listed in [Table 2.3-2](#) are estimates and have never been verified by actual measurement. The scale is based on estimated winds associated with the amount of damage observed after the storm event.

For DeWitt and the immediately adjacent surrounding counties, the number of tornadoes reported for the same period is summarized in [Table 2.3-3](#).

Approximately 65 percent of Illinois tornadoes have occurred during the months of March through June, with the highest statewide probability of a tornado occurrence being in April. Tornadoes can occur at any hour of the day, but are most common during the afternoon and evening hours. About 50 percent of Illinois tornadoes travel from the southwest to northeast. Slightly over 80 percent exhibit directions of movement toward the northeast through east. Fewer than 2 percent move from a direction with an easterly component ([Wilson and Changnon, 1971](#)).

[Figure 2.3-1](#) illustrates the total number of tornadoes recorded during the period (1916-1969) for each county in Illinois. This figure was obtained from the CPS USAR, and it illustrates that 36 tornadoes originated during the 54 year period in the five-county surrounding area and including the EGC ESP Site (specifically DeWitt, McLean, Logan, Macon, and Piatt counties). Three of these tornadoes were recorded in DeWitt County during the 54 year period. For the period 1950 - 2002, 11 tornadoes were recorded in DeWitt County and 188 tornadoes recorded in the 5-county area. In spite of the fact that there was a significant increase in the number of recorded tornadoes in the area for 1950 - 2002 period when compared to the 1916 - 1969 period, there is no reason to believe that the existence of such a large increase actually occurred. Based on a statistical analysis of tornado occurrences in the United States over a 70 year period, [Fujita \(1987\)](#) concluded that the indicated increase in tornado occurrences was a result of increased reporting efficiency and confirmation skill, and that F0 and F1 class tornadoes were typically overlooked during the early data-collection years. Additionally, research conducted by [Grazulis \(1993\)](#) concluded that the

increase in urbanization over the past 50 years has effectively resulted in an increase in the number of reported tornadoes, if for no other reason than there are more targets destroyed or damaged by a tornado in an urban area than in a rural area. As a result, there is a higher frequency of reported incidents in urban areas than in rural areas.

The likelihood of a given point being struck by a tornado can be calculated by using a method developed by H.C.S. Thom (Thom, 1963). Thom presents a map of the continental U.S. showing the mean annual frequency of occurrence of tornadoes for each 1° square (latitude by longitude) for the period of 1953-1962. For the 1° square (3,634 mi<sup>2</sup> in area) containing the EGC ESP Site, Thom computed an annual average of 1.9 tornadoes. Assuming 2.82 mi<sup>2</sup> is the average tornado path area, the mean probability of a tornado occurring at any point within the 1° square containing the site area in any given year, is calculated to be 0.0015. This converts to a mean recurrence interval of 670 years. Using the same annual frequency, but an average area of tornado coverage of 3.5 mi<sup>2</sup> (Wilson and Changnon, 1971), the mean probability of a tornado occurrence is 0.0018. More recent data containing tornado frequencies for the period 1955-1967 indicate an annual tornado frequency of 3.2 for the 1° square containing the site (USDOC, 1969). This frequency, in conjunction with Wilson and Changnon's average path area of 3.5 mi<sup>2</sup>, results in an estimated mean tornado probability of 0.0031, with a corresponding mean return period of 325 years.

The annual tornado probability (for a tornado of any intensity) in the EGC ESP Site area is therefore best expressed as being in the range of 0.0015 to 0.0031, with a mean tornado return period of 325 to 670 years. Based on the observed occurrences of worst case tornadoes in Illinois (F4 and F5 on the Fujita Scale), an estimate of worst case tornadic events at the EGC ESP Site area can be made. The distribution of tornadoes in Illinois by intensity, as shown in Table 2.3-3 during the period 1950 – 2002, indicates that there were 43 occurrences of F4 and F5 tornadoes out of a total of 1716 tornadoes (2.51 percent). Applying this percentage to the range of annual tornado probabilities for the Site area, the probability of occurrence of a worst tornado is therefore 0.000038 – 0.000078.

Design basis tornado parameters have traditionally been based on Regulatory Guide 1.76 (USNRC, 1974a) and WASH-1300 (USNRC, 1974b). WASH-1300 states that the probability of occurrence of a tornado that exceeds the design-basis tornado should be on the order of 1.0E-7 per year per nuclear power plant and Regulatory Guide 1.76 delineates maximum wind speeds of 240 to 360 mph depending on the region of the US in which the site is located. More recent evaluations have resulted in recommendations for reduced design basis tornado wind conditions. ANSI/ANS 2.3 (ANSI, 1983) recommends a maximum tornado wind speed of 260 mph and a tornado recurrence interval of 1.0E-6 years; however, this standard has not been endorsed by the USNRC. However, in SECY-93-087 (USNRC, 1993), the USNRC staff endorsed/recommended use of a maximum tornado wind speed of 483 km/hr (300 mph) in the design of evolutionary and passive advanced light water reactors (ALWRs) for sites east of the Rocky Mountains. The Commission's subsequent Staff Requirements Memo (SRM) approved the staff's position (USNRC, 1993a). It is important to note that this recommendation did not include and was not based on a specific recurrence interval.

While SECY-93-087 was addressing ALWR issues, the determination of a design basis tornado for a specific area of the United States is not design specific, but is location specific.

In other words, for a given geographic location, a tornado with specific properties is related to an acceptable mean recurrence interval. This conclusion is effectively unrelated to the reactor type. Because the EGC ESP Site is east of the Rocky Mountains, the design basis tornado parameters identified in SECY-93-087 are applicable to the site. Further, the maximum wind speed of 300 mph (for sites east of the Rocky Mountains) and other associated parameters have already been evaluated and accepted by the NRC staff as an appropriate design basis tornado (USNRC, 1994).

The SECY-93-087 recommendation was based on an NRC staff and contractor re-evaluation of tornado data as provided in NUREG/CR-4461 (USNRC, 1986). This study was based on a tornado data tape prepared by the National Severe Storm Forecast Center with 30 years of data including the data for approximately 30,000 tornadoes that occurred during the period of 1954 through 1983. Based on discussions between the contractor and the USNRC staff, wind speed values associated with a tornado having a mean recurrence interval of  $1.0E-7$  per year were estimated to be about 322 km/yr (200 mph) for states west of the Rocky Mountains, and 482 km/yr (300 mph) for states east of the Rocky Mountains. Subsequent discussions with EPRI culminated in eliminating the recurrence interval as a requirement for the design basis tornado (USNRC, 1993 and USNRC, 1994a). Further, it was the USNRC staff position that this recommendation was based on the best available information (USNRC, 1992). An EPRI letter (EPRI, 1992) identified its understanding of the USNRC staff agreement to use this design basis tornado criteria "for design certification *and siting* of evolutionary and passive ALWR designs" (emphasis added). The USNRC acknowledged this understanding in SECY-93-087 by referencing the EPRI letter and stating "EPRI agreed with the staff's position to use a 482 km/hr (300 mph) maximum tornado wind speed and to consider other site-specific hazards in the COL *or early site permit*" (emphasis added). Thus, this tornado criteria is considered to be the site-specific hazard for use in early site permit proceedings.

Other characteristics associated with a maximum wind speed of 300 mph are as identified in the previous USNRC staff position (USNRC, 1988, Table II) for a wind speed of 300 mph, i.e., rotational speed of 240 mph, maximum translational speed of 60 mph, radius of maximum rotational speed of 150 ft, pressure drop of 2.0 psi, and rate of pressure drop of 1.2 psi/sec (USNRC, 1994).

Since actual measurements of site-specific tornado parameters is not practical, the site characteristics for tornado parameters have historically been based on the best available information (which has generally been reflected in the USNRC guidance for the design basis tornado, i.e., Regulatory Guide 1.76). Also, because actual site measurements have not been taken (due to the impracticality), there is no known actual site hazard. Further, NUREG/CR-4461 represents better available information than Regulatory Guide 1.76, and the latest USNRC position on design basis tornados is based on the information in NUREG/CR-4461. Therefore, the EGC ESP Facility site characteristic tornado has been chosen consistent with the SECY-93-087 position, as approved by the Commission and based on the NUREG/CR-4461 information.

Thus, the following site characteristic tornado parameters are established for the EGC ESP Facility ([Table 1.4-1 Section 1.6](#)):

- Rotational velocity = 240 mph
- Maximum translational velocity = 60 mph
- Maximum wind speed = 300 mph
- Radius of maximum rotational velocity = 150 ft
- Pressure drop = 2.0 psi
- Rate of pressure drop = 1.2 psi/sec

These parameters are believed to be relatively consistent with expected conditions associated with potential worst-case tornadoes, namely the F4/F5 class of tornadoes.

A site characteristic wind velocity of 75 mph is established for the EGC ESP Site based on the peak wind speed observed at either Peoria or Springfield, IL as identified in [Table 2.3-1](#). An importance factor of 1.11 is applied to this wind speed in the design of safety related structures.

#### **2.3.1.2.3 Heavy Snow and Severe Glaze Storms**

Severe winter storms, which usually produce snowfall in excess of 6 in and are often accompanied by glaze, are responsible for more damage in Illinois than any other form of severe weather including hail, tornadoes, or lightning ([Changnon, 1969](#)). These storms occur on an average of five times per year in the state. The estimated probability of one or more severe winter storms occurring in a given year is virtually 100 percent, while the estimated probability for three or more severe winter storms occurring in Illinois in a year is 87 percent. A typical storm has a median point duration of 14.2 hours. Point durations have ranged from 2 hours to 48 hours during the 61 year period-of-record from 1900 to 1960, which is used in the severe winter storm statistical analyses ([Changnon, 1969](#)). Data on the average areal extent of severe winter storms in Illinois show that they deposit at least 4 in of snow over 15,050 mi<sup>2</sup>. Central Illinois (including the EGC ESP Site) had 107 occurrences of a 6 in snow or glaze damage area during the years from 1900-1960. About 42 of those storms deposited more than 6 in of snowfall in DeWitt County ([Changnon, 1969](#)).

In the Springfield area, the maximum-recorded 24 hour snowfall is 15.0 in, and the maximum monthly snowfall is 24.4 in, both of which occurred in February of 1900. On the average, heavy snows of 4 to 6 in have occurred one to two times per year ([Changnon, 1969](#)).

The 2 day and 7 day maximum snowfall values for selected recurrence intervals in the EGC ESP Site area are as follows (Changnon, 1969):

	<u>2-yr</u>	<u>5-yr</u>	<u>10-yr</u>	<u>20-yr</u>	<u>30-yr</u>	<u>50-yr</u>
2-day:	7.0	8.6	10.2	12.1	13.4	15.2
7-day:	7.6	10.1	12.8	16.3	18.7	22.0

Sleet or freezing rain occurs during the colder months of the year when rain falls through a shallow layer of cold air with a temperature below 32°F from an overlying warm layer of temperature above 32°F. The rain becomes supercooled as it descends through the cold air. If it cools enough to freeze in the air, it descends to the ground as sleet; otherwise, it freezes upon contact with the ground or other objects, causing glaze.

In Illinois, severe glaze storms occur on an average of about three times every 2 years. Statewide statistics indicate that during the 61 year period from 1900-1960, there were 92 recorded glaze storms defined either by the occurrence of glaze damage or by occurrence of glaze over at least 10 percent of Illinois. These 92 glaze storms represent 30 percent of the total winter storms in the period. The greatest number of glaze storms in 1 year is six (1951); in 2 years, nine (1950-1951); in 3 years, ten (1950-1952); and in 5 years, fifteen (1948-1952). In an analysis of these 92 glaze storms, Changnon determined that in 66 storms, the heaviest glaze disappeared within 2 days; in 11 storms, 3 to 5 days; in eight storms, 6 to 8 days; in four storms, 9 to 11 days; and in three storms, 12 to 15 days. Fifteen days was the maximum persistence of glaze (1969). Within the central third of Illinois, 11 localized areas received damaging glaze in an average 10 year period; the EGC ESP Site area averages slightly over 5 days of glaze per year (Changnon, 1969).

Ice measurements recorded in some of the most severe Illinois glaze storms are shown in Table 2.3-4. The listing reveals that severe glaze storms depositing ice of moderate to large radial thickness may occur in any part of Illinois. An average of one storm every 3 years will produce glaze ice 0.75 in or thicker on wires (Changnon, 1969).

Strong winds during and after a glaze storm greatly increase the amount of damage to trees and power lines. In studying wind effects on glaze-loaded wires, the Association of American Railroads (AAR, 1955) concluded that maximum wind gusts were not as significant (harmful) a measure of wind damage as were speeds sustained over 5 minute periods (1955). Moderate wind speeds (10-24 mph) occurring after glaze storms are most prevalent. Wind speeds of 25 mph or higher are not unusual; however, there have been 5 minute winds in excess of 40 mph with a glaze thickness of 0.25 in or more (Changnon, 1969). Table 2.3-5 presents specific glaze thickness data for the five fastest 5 minute speeds and the speeds with the five greatest measured glazed thicknesses for 148 glaze storms throughout the country during the period from 1926-1937. Although these data were collected from various locations throughout the U.S., they are considered applicable design values for locations in Illinois.

Section 2.3.1.2 of Regulatory Guide 1.70 (USNRC, 1978) suggests that applicants provide site vicinity estimates of the weight of the 100 year return period snowpack and the weight of the 48 hour Probable Maximum Winter Precipitation (PMP) for use in estimating the weight

of snow and ice on the roofs of safety-related structures. The 100 year return period snowpack, as obtained from the American Society of Civil Engineers (ASCE) building code requirements (ASCE, 2000), is 22 pounds per square foot (psf), which corresponds to approximately 22 in of snowpack. The 48 hour winter PMP for the EGC ESP Site area as previously estimated in the CPS USAR is 79 psf, which corresponds to 152 inches of fresh snow, or 15.2 inches of equivalent water.

The combined 100 year return snowpack and the estimated winter PMP is 101 psf, which is an extremely conservative and highly unlikely snow/ice roof loading for a structure in Illinois. A more realistic, and still conservative, snow load site characteristic for the EGC ESP Site is established based on the snow and ice loads from historical winter maximum precipitation events in conjunction with a 100 year recurrence interval antecedent snow pack. The weight of the accumulation of winter precipitation from a single storm is 13 psf. This is based on the assumption that the worst-case storm event would be consistent with the maximum monthly snowfall observed in the Springfield/Peoria area over the past 100 years. The maximum-recorded monthly snowfall in the area is 24.7 inches (Peoria, January 1979) and 24.4 inches (Springfield, February 1900). This translates to the equivalent of about 2.5 inches of precipitable water and is assumed to be representative of a worst-case storm event during the winter months. Thus, a conservative estimate of the accumulated weight of snow and ice on the roof of each safety-related structure after a worst-case winter storm event is established as the site characteristic of 35 psf (22 psf + 13 psf).

#### 2.3.1.2.4 Ultimate Heat Sink Design Parameters

Mechanical draft cooling towers will be used to provide the Ultimate Heat Sink for the EGC ESP Facility if the selected reactor type does not use passive cooling methods for the safety class cooling function. The cooling water system associated with any required Ultimate Heat Sink, as defined in Regulatory Guide 1.27, is referred to as the Essential Service Water (ESW) System in this document. The controlling meteorological parameter for a Essential Service Water mechanical draft cooling tower is the wet bulb temperature. The design wet bulb temperature based on the wet bulb temperature that is exceeded less than 1% of the time which is 77.2°F. The maximum wet bulb temperature recorded was 84.7°F and will produce a cold ESW water temperature of 94.7°F with a 10 degree approach in the cooling tower. This cold water temperature is less than the 95°F value given in [Table 1.4-1, Section 3.2.1](#). Wet bulb design temperatures are based on the maximum values for data from Springfield and Peoria, Ill weather data for the period 1961 to 1990. ESW cooling tower approaches greater than 10 degrees would be used for reactor plants designed for a cooling water inlet temperature greater than 95°F.

Modern cooling towers have almost no drift losses and this is not considered to be a critical design parameter. Site wind velocities and direction will be considered in designing the mechanical draft cooling towers to both minimize any recirculation of the air discharge from the tower and to provide adequate tower capacity with any expected recirculation. [Figures 2.3-2 through 2.3-15](#) provide the wind direction data that will be used for the design of the cooling tower.

The UHS cooling towers will be designed structurally for the tornado wind conditions given in [section 2.3.1.2.2](#).

### 2.3.1.2.5 Inversions and High Air Pollution Potential

Weather records from many U.S. weather stations have been analyzed by [Hosler \(1961\)](#) and [Holzworth \(1972\)](#) with the objective of characterizing atmospheric dispersion potential. The seasonal frequencies of inversions based below 500 ft for the general area of the EGC ESP Site are shown in [Table 2.3-6](#).

Since central Illinois has a primarily continental climate, inversion frequencies are expected to be closely related to the diurnal cycle. The less frequent occurrence of storms in summer and early fall is expected to produce a larger frequency of nights with short-duration inversion conditions.

Holzworth's data give estimates of the average depth of vigorous vertical mixing, which gives an indication of the vertical depth of atmosphere available for mixing and dispersion of effluents. For the EGC ESP Site region, the seasonal values of the mean daily mixing depths are given by Holzworth and shown in [Table 2.3-7](#). In general, when daytime (maximum) mixing depths are shallow (low inversion heights), pollution potential is considered to be greatest.

Holzworth has also presented statistics on the frequency of episodes of high air pollution potential, defined as a combination of low mixing depth and light winds. Holzworth's data indicate that during the 5 year period of 1960-1964, the region, including the EGC ESP Site, did not experience any episodes of two days or longer with mixing depths less than 500 m and winds less than 2 m/sec. There were two such episodes with winds remaining less than 4 m per second. For mixing heights less than 1,000 m and winds less than 4 m/sec, there were about nine episodes in the 5 year period that lasted two days or more. However, there were no episodes lasting five days or more. Holzworth's data indicates that central Illinois is in a relatively favorable dispersion regime in that a relatively low frequency of extended periods of high air pollution potential is expected ([Holzworth, 1972](#)).

## 2.3.2 Local Meteorology

Local meteorological conditions are characterized by data obtained from an on-site meteorological monitoring system that was installed and began operation at the CPS Site on April 13, 1972. The location of the on-site monitoring system is approximately 3,200 ft south-southeast of the CPS containment structure and approximately 1,800 ft south-southeast of the center of the EGC ESP Site. Based on its proximity to the ESP site, the meteorological parameters that are monitored by the CPS monitoring station are representative of the EGC ESP Site and are therefore appropriate for use in characterizing local meteorological conditions for use in this report. Local meteorological monitoring results and summaries of the parameters monitored by the on-site system are contained in this section. A detailed description of the physical characteristics of the on-site meteorological monitoring system is provided in [Section 2.3.3](#).

Two periods of record were used to characterize the local meteorological conditions representative of the EGC ESP Site, namely 1972 - 1977 (pre-CPS construction) and 2000 - 2002 (post-CPS construction). The specific dates for each of these periods have been described elsewhere in this report. The newer data from the period 2000 - 2002 should not be considered to be better, substantially more accurate, or more representative of the ESP Site than the data from the period 1972 - 1977. Rather, the newer data supplements the

original data used in the original and updated CPS documentation. Furthermore, it has been effectively demonstrated in the EGC ESP Environmental Report that the effects of changes to the site attributable to the construction and operation of the CPS Facility (including Clinton Lake) are not significant enough to affect meteorological parameters. In the subsections that follow, a comparison of pre- and post-construction winds conditions is described, with the conclusion that differences between the two data periods is consistent with expectations. No comparisons were made for temperature, relative humidity, wet bulb, or dew point temperature since these parameters compared well with long term measurements from Peoria and Springfield.

### 2.3.2.1 Normal and Extreme Values of Meteorological Parameters

#### 2.3.2.1.1 Wind Summaries

Detailed wind records are available from the CPS meteorological monitoring system for two periods of record, namely 1972-1977 and 2000-2002. Monthly and long-term average wind roses were constructed from wind speed and direction measurements made at the 10-m (33-ft) level of the on-site meteorological tower. A composite wind rose for the period 1972 - 1977 is presented in [Figure 2.3-2](#), and the composite monthly average wind roses for the same period are shown in [Figure 2.3-3](#) through [Figure 2.3-14](#). A composite wind rose for the period 2000 - 2002 is presented in [Figure 2.3-15](#). Seasonal variations are evident from the monthly data for the 1972-1977 period of record. Winds from the south-southeast through west-northwest sectors tend to dominate in most months. Winter months show generally higher wind speeds, fewer calms, and more west-northwest winds than do the summer months. A visual comparison of the composite wind roses for the two periods of record illustrates that the wind speed and direction characteristics of the Site area did not change substantially before (1972 - 1977) and after (2000 - 2002) construction of the CPS Facility. The two data periods are similar in their overall characteristics in that they exhibit a predominance of winds from the northwest through the southwest and south-southeast sectors. The most notable differences include a slight increase in occurrence of winds from the northeast sector in the 2000 - 2002 data period (7% versus a <5% occurrence in the 1972 - 1977 data). There is also an apparent increase in some direction sectors (of less than approximately 1% per sector) in the frequency of occurrence of wind speeds greater than 8 m/s in the 2000 - 2002 period. However, [Table 2.3-8](#) illustrates that, for all sectors combined, there is a general shift towards lower wind speeds in the more recent data. These types of differences are consistent with what can be expected when comparing wind roses and statistical data summaries for periods in the mid-western U.S. Furthermore, such variations should be somewhat more noticeable in the shorter 32 month 2000 - 2002 data period as a result of year-to-year variations that may otherwise be averaged out over a longer 5 year period.

For the 1972-1977 period of record, there were two occurrences of persistence of wind direction for 33 hours (the longest persistence observed). These occurred in two sectors, the south-southwest and the northeast.

#### 2.3.2.1.2 Temperatures

Temperatures at the CPS meteorological monitoring site are measured at the 10 and 60 m level of the tower. For the 1972-1977 period of record, the average daily temperature was 50.9°F (10.5°C). The absolute maximum temperature was 95.4°F (35.2°C), and the absolute

minimum temperature was -19.8°F (-28.8°C). The 1972-1977 period of record and composite monthly summaries of the on-site temperature data are presented in [Table 2.3-9](#) through [Table 2.3-11](#). These data are believed to be representative of the site area and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

### **2.3.2.1.3 Atmospheric Moisture**

#### **2.3.2.1.3.1 Relative Humidity**

The relative humidity for a given moisture content of the air is inversely proportional to the temperature cycle. Maximum relative humidity usually occurs during the early morning hours, and minimum relative humidity is typically observed in the mid-afternoon. For the annual cycle, the lowest humidities occur in mid-spring; the winter months experience the highest. [Table 2.3-12](#) presents a summary of relative humidity at the 10 m level for the CPS during the period from 1972-1977. These data are believed to be representative of the site area, and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

#### **2.3.2.1.3.2 Wet Bulb**

The wet bulb temperature is not as strong a function of the ambient temperature as the relative humidity. In addition, it is used for evaporative cooling system modeling studies. The wet bulb temperature is defined to be the temperature that an air parcel may be cooled by evaporating water into it at constant pressure until it is saturated. All latent heat utilized in the process is supplied by the air parcel. Summaries of 10 m wet bulb temperatures are presented in [Table 2.3-13](#) for the period from 1972-1977. These values were calculated from the dew point and ambient temperatures, assuming a constant standard sea level pressure of 1,013.25 mbar. These data are believed to be representative of the site area and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

#### **2.3.2.1.3.3 Dew Point Temperature**

Dew point temperature is a measure of absolute humidity in the air. It is the temperature to which air must be cooled to reach saturation/condensation, assuming pressure and water vapor content remain constant. Summaries of composite monthly and period of record 10 m dew point measurements are presented in [Table 2.3-14](#) through [Table 2.3-16](#) for the period from 1972-1977. These data are believed to be representative of the site area and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

#### **2.3.2.1.3.4 Precipitation**

The average yearly precipitation for the 1972-1977 period of record for the EGC ESP Site is 25.47 in. Period of record and composite monthly precipitation data appear in [Table 2.3-17](#). The months of March and June are the wettest; the months of December, January, and February are the driest. These data are believed to be representative of the site area and have been previously shown to be consistent with regional observations from Peoria and Springfield, Illinois when compared to long-term periods of record at those locations.

### 2.3.2.1.3.5 Fog

Fog is an aggregate of minute water droplets suspended in the atmosphere near the surface of the earth. According to international definition, fog reduces visibility to less than 0.62 mi. According to U.S. observing practice, ground fog is a fog that hides less than 60 percent of the sky and does not extend to the base of any clouds that may lie above it. Ice fog is fog composed of suspended particles of ice. It usually occurs in high latitudes in calm, clear weather at temperatures below -20°F and increases in frequency as temperature decreases (AMS, 1970).

Since local data are not available to assess the fog statistics at the EGC ESP Site, data are presented for nearby Springfield and Peoria, Illinois. Fog is a very local phenomenon; thus, this data should be considered only as regional estimates. The average number of days during which heavy fog (visibility less than 0.25 mi) was observed is presented in [Table 2.3-18](#) for the 23 year period 1949 - 1971.

The yearly average number of fog days for this reporting period was 18.5 days in Springfield and 20 days in Peoria, with the highest occurrence of fog being in the winter months in both locations.

[Tables 2.3-19](#) and [2.3-20](#) also summarize the frequency of occurrence, number of hours, and persistence of all fog for Peoria and Springfield, respectively. These summaries were obtained from the CPS USAR (CPS, 2002) and were originally prepared by processing the digital data tapes for these NWS observing stations. Fog extracted from these tapes included any of the fogs coded as either "fog," "ground fog," or "ice fog," which occurred in column 132, "obstruction to vision," on the Airways Surface Observations tapes.

The percentage of the total observations during which fog was reported for Peoria and Springfield is given in the first column of [Tables 2.3-19](#) and [2.3-20](#). The hour and the percentage of observations for that hour of the maximum and minimum fog occurrence are given in the next four columns.

Peoria shows a higher frequency of fog in all months. The long-term annual average percent of hourly observations with any intensity of fog for Peoria and Springfield are 11.3 percent and 9.1 percent, respectively. The occurrence of prolonged periods of fog is also greater for Peoria. Although information on fog is generally a very local phenomenon, the expected occurrences at the EGC ESP Site should be within the range represented by these two stations.

A less detailed summary of fog occurrence in Peoria and Springfield available for a 40 year reporting period spanning 1951 - 1990 ([Gale Research Company, 1992a](#)), indicates that the average occurrence of fog is 21 times per year in Peoria and 17 times per year in Springfield.

The observations of fog in Peoria and Springfield, at approximately 20 - 21 days of occurrence per year, can be considered to be a "baseline" occurrence. This is because they do not account for any occurrences of fog associated with the presence of Clinton Lake or the once-through cooling system used by the CPS. During winter months, cold air passing over the relatively warmer water surface of Clinton Lake can become saturated with respect to water vapor. When sufficient evaporated water vapor condenses into droplets, steam fog occurs. The characteristics of such steam fog will vary with the water temperature, the distance traveled over the water, the low-level ambient air temperature, relative humidity,

vertical and horizontal stability, and the transporting wind speed.

In addition to the regional observations of fog obtained from the Springfield and Peoria airports, the impacts of fog associated with the presence of the Clinton Lake and the once-through cooling were previously addressed and documented in Section 2.3.2.2.2, of the CPS USAR (CPS, 2002). An analytical model was used that accounted for the processes of evaporation, condensation, and diffusion downwind. A description of the model that was used was provided in Attachment A2.3 (Analytical Fog Model) of the USAR. The modeling analysis focused on a number of areas surrounding the CPS Facility, including roadways and areas of population. The steam fog prediction model was used to calculate the occurrence of restricted visibility caused by steam fog in each of the specified areas of interest. This process was repeated for each month to account for the monthly difference in water temperature. The results were documented in several hundred maps showing the concentration of water vapor and water droplets for Clinton Lake and adjacent areas. The maps produced by the computer fog model illustrated the horizontal extent of visible water vapor plumes that were predicted to occur with a given wind direction for a specified combination of air temperature and relative humidity. The analyses of these maps as described in the USAR concluded that the maximum extent of reduced visibility beyond Clinton Lake from the lake steam fog would generally be confined to the area that is south of Clinton Lake and east of the town of Lane. Although, steam fog was predicted to occasionally drift over U.S. 54 where it passes near the northern edge of Clinton Lake. The steam fog analysis also concluded that there was no significant probability of lake steam fog extending to the towns of DeWitt or Lane. In addition, the remaining sections of roads around Clinton Lake were not affected significantly by the predicted lake steam fog. In general, the steam fog analysis presented in the USAR concluded that the maximum horizontal extent of steam fog from Clinton Lake would be 1 mi or less. The extent of extremely dense steam fog would be limited to the area immediately adjacent to Clinton Lake, and, in particular, the shallow water discharge flume and the point of discharge to the lake.

#### **2.3.2.1.3.6 Atmospheric Stability**

For estimates of average dispersion over extended periods, the joint probability of occurrence of wind speed, wind direction, and atmospheric stability must be known. These probabilities, or frequencies, have been generated from on-site data using the vertical temperature gradient and the variability of the horizontal wind to estimate atmospheric stability in accordance with Regulatory Guide 1.23. Joint frequency distributions of wind speed, wind direction, and atmospheric stability measured at the site are provided in [Table 2.3-21](#) through [Table 2.3-28](#) for the 1972-1977 period of record. Joint frequency distributions for the 2000-2002 period of record are provided in [Table 2.3-29](#) through [Table 2.3-36](#).

[Table 2.3-37](#) summarizes the percent frequencies of occurrence for each stability class (determined on the basis of vertical temperature gradient) recorded at the EGC ESP Site. The upper part of the table summarizes the 1972-1977 period of record, and the lower part summarizes the 2000-2002 period of record.

For the 1972-1977 period of record, the combination of E stability and calm winds (< 0.3 mps) occurred 0.06 percent of the time, F and calm conditions occurred 0.06 percent of the time, and G and calm conditions occurred 0.12 percent of the time. For the 2000-2002 period

of record, only 9 hours of calm winds occurred out of 21,430 hours of valid observations and 1,937 hours of missing data (see [Table 2.3-29](#) through [Table 2.3-36](#)).

### 2.3.2.2 Potential Influence of the Plant and Its Facilities on Local Meteorology

The construction and operation of the EGC ESP Facility will have the potential to influence the local micrometeorology of the area in the immediate vicinity of the CPS Facility. This may occur as a result of minor changes to the topography resulting from the construction of additional buildings and supporting infrastructure, and the use of natural and/or mechanical draft cooling towers for system heat rejection to the atmosphere. The minor changes in local topography are not expected to have a significant impact on diffusion characteristics in the area except in the immediate vicinity of the buildings themselves. The use of natural and/or mechanical draft cooling towers for system heat rejection will result in visible moisture plumes from the cooling towers during certain atmospheric conditions. The amount of condensation of evaporated water vapor, and thus, the formation of a visible plume, will be greatest during winter months when ambient air temperatures are cool and the air is moist.

Icing caused by the freezing of condensed water vapor from cooling tower plumes could affect the vertical surfaces (such as buildings and equipment) and horizontal surfaces (such as roadways) in the immediate vicinity of the cooling towers; however, these impacts can be expected to occur only at on-site locations (for example, on EGC ESP or CPS plant property). Except in very cold, dry, and stable atmospheric conditions, fogging and icing conditions in the cooling tower plume is expected to remain primarily on site.

#### 2.3.2.2.1 Topographical Description

[Figure 2.3-16](#) is a topographic map of the area within 5 mi of the site. [Figure 2.3-17](#) shows topographic cross sections in each of the 16 primary compass directions radiating from the site. The crosshatched sections represent the areas associated with Clinton Lake. The EGC ESP Facility will be located at an elevation of approximately 735 ft above msl. Within the 5 mi radius, no land elevation is above 760 ft above msl or below 640 ft above msl. Most of this modest relief is due to the shallow valleys surrounding the North Fork of Salt Creek and Salt Creek. These valleys form the boundaries of the CPS cooling lake (Clinton Lake). The surface of Clinton Lake is approximately 690 ft above msl. Thus, a large portion of the topographical relief in the immediate area is filled by Clinton Lake.

The terrain in central Illinois is relatively flat and differences in elevation should have no significant influence on the general climate. However, the low hills and shallow river valleys that do exist could exert a small effect upon nocturnal wind drainage patterns and fog frequency under certain atmospheric conditions.

In the immediate vicinity of the site, the 4,895 ac Clinton Lake represents a discontinuity in the ground surface over which diffusing gases can travel. Clinton Lake presents a smoother surface than does the land over which the air parcels will travel and, for both east and west winds, there will be up to a maximum of approximately 6,000 ft (1.1 mi) of upwind/downwind fetch that could potentially have an effect on diffusion downwind of the site. Under certain atmospheric conditions, this could reduce the surface- or mechanically-induced turbulence, and thus, the resulting diffusion of any pollutants released from the facility. At the same time however, reduced frictional effects would allow

for an increase in wind speed, thus, to some effect mitigating the effects of decreased diffusion due to turbulence. In view of the relatively short distances across Clinton Lake for releases from the plant under most wind directions, no adjustments in the diffusion calculations are proposed to account for the reduction in surface roughness caused by Clinton Lake.

Since Clinton Lake is currently used as a heat sink for the existing CPS reactor, a more potentially significant impact of Clinton Lake is the warm surface that it can present to the atmosphere which, at times, can be significantly warmer than the surrounding ground and air. Under these conditions, this increase in surface temperature could cause the layer of air in contact with Clinton Lake to achieve a neutral or unstable lapse rate in the vertical, especially when thermally stable conditions prevail over the land. Under these conditions, a release from a ground-level source would undergo some additional vertical diffusion over Clinton Lake than would be computed (using a stable delta-T based stability category) from the meteorological tower. However, due to the relatively small dimensions of Clinton Lake and its orientation with respect to the EGC ESP Facility, no adjustments are proposed to the diffusion calculations. Not accounting for any additional dispersion effects attributable to lake temperature effects should add to the conservative nature of the routine and accidental release diffusion estimates that are described in detail later in this section.

The natural topography of the area surrounding the site is considered to be rural in nature and is not expected to significantly affect the diffusion estimates.

#### **2.3.2.2.2 Fogging and Icing Effects Attributable to Cooling Tower Operation**

As discussed in [Section 2.3.2.2.2](#), the operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere. Depending on the type of cooling system(s) used to dissipate this heat, the rejected heat will be manifested in the form of thermal and/or vapor plumes on and around the site.

Quantification of these ambient impacts will necessarily require a more in depth assessment once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted at or before a later licensing stage.

##### **2.3.2.2.1 Qualitative Assessment of Water Vapor Plumes**

[Table 2.3-38](#) provides a qualitative assessment of the nature and extent of water vapor plumes that can be expected to occur as a result of the operation of the EGC ESP Facility.

##### **2.3.2.2.2 Quantitative Assessment of Heat Dissipation Effects on the Atmosphere**

The operation of the EGC ESP Facility will result in significant heat dissipation to the atmosphere. Depending on the type of cooling system(s) that will be used to dissipate heat from the facility, the rejected heat will be manifested in the form of thermal and/or vapor plumes from one or more locations at the site. For wet cooling processes, resulting water vapor plumes will have the potential to result in a variety of physical or aesthetic impacts. The extent of these impacts will depend primarily on the prevailing meteorological conditions, the type of cooling tower selected (mechanical or natural draft), cooling water quality, and plant load. For dry cooling processes, dry thermal plumes are not normally expected to result in significant environmental or other impacts.

The scope of this evaluation includes a qualitative assessment of potential impacts attributable to wet cooling processes, specifically mechanical and natural draft cooling towers. The ambient impacts that are expected to be of most concern as a result of the use of these wet cooling systems include the following:

- Length and frequency of occurrence of visible plumes;
- Frequency of occurrence and spatial extent of ground level fogging and icing in the immediate vicinity of the cooling towers;
- Solids deposition (cooling tower drift droplet deposition);
- Cloud formation, cloud shadowing, and additional precipitation attributable to vapor formation downwind of wet cooling towers; and
- Interaction of the vapor plume with existing pollution sources in the area, including the potential for wet deposition effects.

Wet cooling systems that utilize mechanical or natural draft cooling towers use evaporative cooling to transfer heat from the process to the atmosphere. Within a wet cooling tower, hot process water is sprayed in at the top of the tower, and cooled by evaporation. Large amounts of water can be lost by evaporation. Depending on the meteorological conditions, wet cooling systems can produce visible plumes of varying densities and lengths, at on- and off-site locations.

Dry cooling systems transfer heat to the atmosphere by pumping hot process water through a large heat exchanger or radiator, over which ambient air is passed to transfer heat from the process water to the air. This is a closed non-contact process, thus, no water is lost to evaporation, and there is no visible plume. The temperature of the ambient air passing through the system is increased during the cooling process, and the warm air rises naturally and dissipates into the local atmosphere, typically with no visible effects. Dry cooling is less efficient than wet cooling; therefore, dry cooling systems tend to be much larger and more costly than wet cooling systems.

Hybrid wet/dry cooling systems are a combination of the wet and dry cooling methods. The extent and length of visible plumes that will result from a wet/dry cooling process will necessarily depend on the proportional mix of wet and dry cooling, as well as the meteorological conditions present at the time of operation.

[Table 2.3-38](#) provides a qualitative assessment of the nature and extent of water vapor plumes that can be expected to occur as a result of the operation of the EGC ESP Facility, depending on the type of cooling system that is ultimately selected for use at the facility.

A quantitative assessment of the potential impacts of heat dissipation to the atmosphere requires the use of mathematical and/or empirical models to simulate cooling tower operation under a variety of meteorological conditions. Models are available that will predict the frequency of occurrence of visible plumes, fogging, icing, and drift droplet deposition as a result of wet cooling tower operation. The EGC ESP Facility will be located on property that is currently owned by CPS, and the distances to the CPS property boundaries are relatively large and necessarily restricted from public access. Because of the relative proximity of the EGC ESP Site to restricted areas and property boundaries, the most

significant impacts attributable to the operation of the cooling towers (i.e., visible plumes, fogging/icing, and drift deposition impacts) are expected to be limited primarily to on-site locations. Inasmuch as the nearest public roadway is more than 0.5 mi in any direction, fogging and icing impacts are not expected to significantly impact any public roadway. Additionally, there is no agricultural or public land use in the immediate vicinity of the ESP Site, so deposition effects are not expected to be a significant concern. In terms of potential interaction with conventional fossil fueled emission sources, the proposed facility will only be installing standby and auxiliary power systems that will be used for emergency and backup purposes. As such, their use will be very limited and, for the most part, only during periods when the EGC ESP Facility is not operational. Occasionally, during cold weather conditions, moisture plumes from the cooling towers may be visible from some off-site locations, depending on wind direction and other meteorological parameters.

Quantification of these ambient impacts will necessarily require a more in depth assessment once the facility's cooling system configuration and design parameters have been determined. This analysis will be conducted during or before a later licensing stage.

### 2.3.2.3 Local Meteorological Conditions for Design and Operating Bases

Design and operating bases, such as, tornado parameters, ice glaze thickness, and winter probable maximum precipitation are statistics that, by definition and necessity, are based upon long-term regional records. While data collected at the on-site meteorological monitoring system can be considered representative of long-term site meteorology, long-term regional data are most appropriate for use as conservative estimates of climatological extremes. Therefore, the design and operating basis conditions were based upon regional meteorological data, as described in [Section 2.3.1.2](#).

### 2.3.3 On-Site Meteorological Measurements Program

On-site meteorological monitoring began at the site of the CPS on April 13, 1972. The on-site meteorological monitoring system, including details on the location, instrumentation, and data reduction protocols, has previously been described in detail in Section 2 of the USAR ([CPS, 2002](#)), Section 6 of the CPS Construction Phase Environmental Report ([CPS, 1973](#)), and Section 6 of the CPS Operating License Stage Environmental Report ([CPS, 1982](#)). Data from the CPS meteorological monitoring system, as described and documented in these reports, have previously been used in the preparation of the USAR and the Construction and Operating License Environmental Reports for the 5 year period that spans April 13, 1972 through April 30, 1977. This data was also previously used in the assessment of the radiological impacts associated with routine CPS operation (for example, routine radiological releases), as well as the impacts of potential accidental releases that could occur during CPS operation.

The CPS meteorological monitoring tower is located approximately 3,200 ft south-southeast of the CPS containment structure, and approximately 1,800 ft south-southeast of the center of the EGC ESP Facility (see [Figure 2.3-18](#)). Based on its proximity to the ESP site, the meteorological parameters that are monitored by the CPS monitoring station are representative of the EGC ESP Site and are therefore appropriate for use in characterizing local meteorological conditions for use in this report. This monitoring system will also be used as an operational system once the EGC ESP Facility becomes operational. Local meteorological monitoring results and summaries of the parameters monitored by the on-

site system are contained in this section. During the 5 year period of record that was reported in the CPS Construction and Operating ERs and the USAR, the meteorological system monitored the following parameters (also summarized in Table 6.1-5 of the CPS Construction Phase ER) (CPS, 1973):

<u>Tower Level</u>	<u>Parameters Measured</u>
Ground:	Precipitation
10 m:	Wind speed and direction Ambient air temperature Dew Point
60 m:	Wind speed and direction Ambient air temperature (for computing Delta-T with 10 m temp) Delta-T Dew Point

Data that is currently available from the CPS on-site meteorological monitoring system is obtained from the same tower system and at the same levels above ground as the original installation described above. It is noted that some of the original monitoring equipment (sensors, data recorders, electronic data loggers, remote interrogation equipment) have undergone routine replacement, repair, and upgrade since the original installation. Additionally, certain changes in the method of data reduction have been made since the original installation date, with a transition to a more electronic-based system. However, the basic monitoring system hardware that has been in use at the CPS from April of 1972 through October of 2002 is essentially the same, or very similar to, what was originally installed in 1972. The meteorological monitoring system has been demonstrated throughout this period to be compliant with applicable requirements of Regulatory Guide 1.23, (USNRC, 1972). It is noted that the CPS USAR identifies various NRC authorized exceptions for this instrumentation.

Since CPS began operation in 1987, annual reports have been prepared and submitted to the USNRC. The reports contain annual summaries of joint frequency distributions of wind speed, direction, and atmospheric stability of the meteorological data collected by the CPS on-site meteorological monitoring system.

Two different periods of meteorological record have been utilized and referenced, as follows:

04/13/72-04/30/77:	The data from this period of record is representative of the EGC ESP Site prior to construction of the CPS (including the filling of Clinton Lake) and were used in the original construction and operating license environmental reports and the USAR for the CPS. Analyses of this data included joint frequency distributions of wind speed, direction, and atmospheric stability, as well as short- and long-term analyses of accidental and routine radiological releases from the CPS.
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01/01/00–8/31/02: The data from this period of record were used to characterize current site-specific meteorological conditions. They were also used to assess the impacts of long-term routine radiological releases from the EGC ESP Facility using operational software utilized by the CPS personnel.

### **2.3.3.1 Instrumentation: 1972 – 1977 Period of Operation**

The on-site instrumented meteorological tower was installed and placed in operation at the CPS on April 13, 1972. The original tower was 199 ft high, with the base at an elevation of approximately 735 ft above msl. Wind and temperature instrumentation were located at the 10 m and 60 m levels on the tower, and precipitation measurements were made at ground level. The tower was located approximately 3,200 ft south-southeast of the CPS containment structure (see [Figure 2.3-18](#)).

#### **2.3.3.1.1 Wind Systems**

Lower level (10 m) wind speeds were recorded by a staggered six-cup anemometer assembly and a transmitter with a starting speed of approximately 0.5 mph or about 0.22 m/sec. Wind direction was measured with a direction vane and a wind direction transmitter with a turning threshold of 0.7 mph at 10°. Wind direction and speed were simultaneously recorded.

Upper level (60 m) winds were measured using a six-bladed aerovane, which had a starting speed of approximately 1.7 mph and a stalling speed of approximately 0.8 mph. Wind speeds and directions were simultaneously recorded.

#### **2.3.3.1.2 Temperature Systems**

The ambient temperature, delta-T and dew point were measured on a multi-channel recorder. One channel of the recorder was used to print a reference value of zero volts, from which the temperature traces were calibrated. The temperature and delta-T sensors were installed in aspirated shields on the tower. The dew point sensors were installed on the tower in protective weatherhoods.

#### **2.3.3.1.3 Precipitation Systems**

A heated tipping bucket rain/snow gauge was installed near the tower to measure liquid precipitation at the CPS monitoring station. The gauge measured liquid precipitation in 0.01 in step increments (tip of the bucket), and the results transmitted electronically to a recording device.

#### **2.3.3.1.4 Equipment Calibration and Data Reduction**

The equipment was checked and calibrated prior to installation. A contract vendor was engaged by CPS to service and maintain the CPS meteorological system in compliance with Regulatory Guide 1.23. Every two months, recorded air temperatures were checked against values obtained on the tower with ASTM precision thermometers. On-tower ice bath checks were performed on the temperature systems semi-annually. Dew point sensors were calibrated against values obtained with a Bendix Psychron. Wind systems were checked for

normal operation in accordance with manufacturer's recommendations.

Meteorological parameters recorded on strip chart recorders were reviewed for possible equipment system or component failures prior to processing the data. The hourly data values, the average value for the 30 minutes preceding the hour, were determined directly from the strip charts. This value was manually transferred to a punched card by means of a semi-automatic analog-to-digital transcriber. This device transferred an operator controlled chart coordinate to a punched card. The cards were checked by computer for errors from one hour to the next, and for logical values. After the checks were verified, a punched card was prepared that contained the date, hour, and hourly values for the parameters measured by the system. These cards were used to form the database for the between 1972-1977.

Values for the standard deviation of wind direction were extracted from the strip charts. For each averaging period, the representative magnitude of the wind direction variability was determined. By assuming that the wind direction has a normal distribution, one-sixth of this range was assumed to be equivalent to the standard deviation of the wind direction. During periods of low wind speeds, only wind direction fluctuations that occurred with a valid wind speed were used. This procedure was intended to prevent the inclusion of "square wave" data that could occur during periods of calm or very low wind speeds.

### **2.3.3.2 Instrumentation: 2000 – 2002 Period of Operation**

The on-site instrumented meteorological tower that was installed and placed in operation at the CPS on April 13, 1972 has remained in operation at the same location since its original installation. During the course of operation, various electronic components and sensors have been replaced with equivalent or upgraded components as a matter of routine maintenance and repair. Wind and temperature instrumentation are still located at the 10 m and 60 m levels on the tower, and precipitation measurements are still made at the ground level. The tower is located approximately 3,200 ft south-southeast of the CPS containment structure (see [Figure 2.3-18](#)).

#### **2.3.3.2.1 Wind Systems**

The 10 m and 60 m level wind directions and speeds were measured by a combined cup and vane sensor. The anemometer cups were positioned directly above the azimuth vane so that data may be obtained from a single point in space. Three 4.5 in diameter conical aluminum cups sensed the wind speed, and were linked directly to a LED-photocell transducer. Wind direction was obtained with a single blade aluminum tail vane and incorporates a nose-damping vane with static balance. Vane movement was transferred by a one-to-one gear and idler shaft into the main housing, where a connection is made to the azimuth transducer. The azimuth transducer was a 360° potentiometer whose output signal is interpreted as a 540° signal by the transducer electronics. The wind speed sensor had a starting threshold of 0.75 mph, a response distance of 18 ft (63 percent recovery), and a range to 100 mph. The wind direction sensor had a starting threshold of 0.75 mph, a delay distance of 4 ft (50° recovery), a damping ratio of 0.5 to 0.6, and a range of 360° (540° output from electronics). Wind speed and direction were recorded on continuous strip chart recorders, which were located in the CPS main control room. In addition to recording the data on strip chart recorders, wind parameters were continuously fed to a microprocessor, which is part of the radiation monitoring system that processes and records meteorological information.

Backup meteorological monitoring instrumentation consists of separate wind direction and wind speed sensors installed at the 10 m level on the CPS microwave tower, the location of which is shown in [Figure 2.3-18](#). The anemometer and the wind direction sensors are both mounted on the same plane. Three 2 in diameter conical molded polycarbonate cups sense wind speed and are linked directly to a photo-chopper assembly that produces a variable-frequency square wave that is directly proportional to the wind speed. Wind direction is sensed with a single-bladed aluminum tail vane. Vane movement is transferred by a high precision shaft and bearing assembly to a low-torque resolver. The resolver rotor is supplied with a precision 1.0 kHz signal from the resolver driver circuit. The two resolver-stator outputs are combined by the resolver output circuit to produce a single 1.0 kHz signal, which has a constant amplitude but whose phase varies. If the resolver rotor signal is used as a fixed reference, then the phase of the combined stator signal lags the rotor signal by an amount that is directly proportional to the rotor shaft clockwise rotation. The wind speed sensor has a threshold of 1.0 mph, a distance constant of 5 ft, an accuracy of  $\pm 0.1$  percent, and a calibrated range to 100 mph. The wind direction sensor has a threshold of 0.7 mph, a distance constant of 3.7 ft, a damping ratio of 0.4 at  $10^\circ$  initial angle of attack, and a range of  $360^\circ$ .

#### 2.3.3.2 Temperature Systems

Ambient temperatures were sensed by an aspirated dual temperature sensor at the 60 m level and an aspirated dual temperature sensor at the 10 m level. One half of the dual sensor at each elevation was used for ambient temperature, and the other half of each sensor was used to provide a differential temperature between the 10 m and 60 m elevation. Aspirated shielded housing was installed, which was designed to provide a high heat transfer from the ambient air to the sensing element. At the same time, it afforded maximum protection from incoming short-wave solar radiation and outgoing long-wave radiation. The aspirated airflow was approximately 15 ft/sec. Each temperature element within the dual sensor was comprised of a dual thermistor and resistor network. Combined with a temperature signal-conditioning module, the circuit provided a linear voltage with respect to the air temperature. The range of temperature measurement was from  $-22^\circ\text{F}$  to  $+110^\circ\text{F}$ . The range of the delta-T measurement was from  $-5.4^\circ\text{F}$  to  $+12.6^\circ\text{F}$ .

#### 2.3.3.3 Dew Point Systems

Lower level (10 m) dew point temperatures were measured with an aspirated dew point sensor. Aspirated shielded housing was used to provide a high heat transfer from the ambient air to the sensing element. At the same time, it afforded maximum protection from incoming short-wave solar radiation and outgoing long-wave radiation. The dew point was determined by a lithium chloride dew point sensor consisting of bifilar wire electrodes wound on a cloth sleeve that covers a hollow bobbin. The electrodes are not interconnected, but depend on conductivity of the atmospherically moistened lithium chloride for current flow. As the moisture content in the air increases, the lithium chloride absorbs water vapor and becomes conductive. Current then begins to flow between the electrodes and heats the bobbin. Some of the moisture is evaporated until an equilibrium temperature is reached on the bobbin. The equilibrium bobbin temperature is, thus, related to the dew point temperature of the air. A thermistor sensor is mounted inside the bobbin to measure cavity temperature, which is converted to actual dew point temperature by the transmuter circuit

card. The cavity temperature is higher than the actual dew point temperature, but this factor is taken into account by the transmitter circuit card. The range of the dew point sensor is -22°F to +110°F.

#### **2.3.3.2.4 Precipitation Systems**

Precipitation was and continues to be measured by using a tipping bucket rain gauge. The gauge is heated and can be used to measure both rainfall and snowfall. The gauge is mounted near the tower, but clear of any rain-shadow effects from either the tower or the instrument shed. Data was recorded on a multi-point chart recorder in the main control room. An electronic transmitter card increments a 4-mA to 20-mA signal corresponding to 0.01 in steps. Full scale corresponds to 1 in of rainfall.

#### **2.3.3.2.5 Maintenance and Calibration**

Emergency maintenance and calibration was performed by a contract vendor, with routine maintenance performed by CPS technicians. Data recovery goals were in excess of 90 percent for all parameters. Semi-annual equipment calibrations were performed by trained technicians. Ice baths were used to check both ambient temperature sensors. The lithium chloride dew cell was checked against calibrated material and test equipment. Wind speed and wind direction sensors were checked for normal operation according to vendor specifications.

#### **2.3.3.2.6 Data Reduction**

The meteorological parameters measured were transmitted to the CPS control building via a dedicated telephone line. The signals are received and converted to 4-mA to 20-mA signals, and fed individually to a microprocessor and chart recorders. The microprocessor is part of the CPS radiation monitoring system. This system calculates and stores 10 minute averages of the meteorological parameters.

#### **2.3.3.2.7 Control Room Monitoring**

Meteorological data was recorded on a panel in the CPS Facility main control room. Additionally, 10 minute averages are available on the radiation monitoring system cathode ray tube (CRT) terminal in the technical support center (TSC).

The main control room wind recorders were dual 5 in, continuous strip, 3 in per hour chart recorders. They continuously recorded wind direction and speed at the 10 m and 60 m level. A multi-point recorder recorded 10 m and 60 m temperature, delta-T, precipitation, and 10 m dew point.

### **2.3.4 Short-Term Diffusion Estimates**

#### **2.3.4.1 Objective**

Conservative estimates of the local atmospheric dilution factors ( $\text{Chi}/Q$ ) for the EGC ESP Facility are available from two sources of information:

- $\text{Chi}/Q$  analyses (including 5 and 50 percent probability levels) that are presented in the Updated Safety Analysis Report (USAR) for the CPS Facility (CPS, 2002) are described in [Section 2.3.4.2](#).

- Chi/Q estimates using the PAVAN Computer code (USNRC, 1982) and the on-site meteorological data from the period 2000 – 2002 are described in Section 2.3.4.3.

### 2.3.4.2 Chi/Q Estimates From the CPS USAR

The short-term Chi/Q analyses presented in the CPS USAR were prepared for the CPS EAB (defined to be 975 m from the release point in all sectors) as well as the LPZ (defined to be 4,018 m from the release point in all directions). Calculations were made for sliding time period windows of 1, 8, 16, 72, and 624 hours using on-site meteorological data obtained from the CPS meteorological monitoring system during the April 4, 1972 through April 30, 1977 meteorological monitoring period. Calculations of the short-term ground-level atmospheric dilution factors for the CPS Facility were performed using Gaussian plume diffusion models for a continuously emitting ground-level source in accordance with guidance provided in Regulatory Guide 1.145 (USNRC, 1983). Hourly centerline Chi/Q values were computed from concurrent hourly mean values of wind speed, wind direction and variability, and Pasquill stability class of the on-site meteorological data. The wind speed at the 10 m level was used in the diffusion estimates for the ground-level release. The Pasquill stability class was determined from the measured vertical temperature difference and the variation of horizontal wind direction, according to Regulatory Guide 1.23 (USNRC, 1972). Calms were assigned a wind speed value equal to the starting speed of the wind vane (0.7 mph). Cumulative frequency distributions were prepared to determine the Chi/Q values that are exceeded no more than 5 percent and 50 percent of the time.

The short-term diffusion estimates that were made for the CPS Facility are representative of short-term releases from the EGC ESP Facility, based on the following assumptions:

- The EAB for the EGC ESP Facility is defined to be 1,025 m, which compares with the EAB that was defined for CPS of 975 m. Since the EAB in the USAR analysis for CPS is smaller than the EAB for the EGC ESP Facility by 50 m, the results will be slightly more conservative (higher) than if the larger EAB were used in the analysis. Since the accidental release modeling was performed as a ground-level release, the predicted concentrations decrease with increasing distance from the source.
- The Low Population Zone (LPZ) distance for the EGC ESP Facility of 4,018 m is the same as the LPZ used in the CPS Facility USAR analysis.
- The meteorological data and characteristics used in the original analysis are still representative of current site conditions.

Gaussian plume diffusion models for ground-level concentration were used to describe the downwind spread of effluents (CPS, 2002). A continuous ground-level release of effluents at a constant emission rate was assumed in the diffusion estimates. Total reflection of the plume at ground level was assumed in the diffusion estimates (for instance, no deposition or reaction at the surface). Hourly Chi/Q values were calculated by using the following equations:

$$\text{Chi/Q} = 1 / (u_{10} \pi \sigma_y \sigma_z) \quad \text{Equation 2.3-2}$$

$$\text{Chi/Q} = 1 / [u_{10} (\pi \sigma_y \sigma_z + A/2)] \quad \text{Equation 2.3-3}$$

$$\text{Chi/Q} = 1 / [u_{10} (3 \pi \sigma_y \sigma_z)] \quad \text{Equation 2.3-4}$$

Where:  $\text{Chi}/Q$  = Relative centerline concentration ( $\text{sec}/\text{m}^3$ ) at ground level.

$$\pi = 3.14159$$

$u_{10}$  = Wind speed (m/sec) at 10 meters above the ground.

$\Sigma_y$  = Lateral plume spread (m), a function of atmospheric stability, wind speed, and downwind distance from the point of release. For distances to 800 meters,  $\Sigma_y = M\sigma_y$  where  $M$  is a function of atmospheric stability and wind speed. For distances greater than 800 meters,  $\Sigma_y = (M-1)\sigma_{y800m} + \sigma_y$ .

$\sigma_y$  = Lateral plume spread as a function of atmospheric stability and distance.

$\sigma_z$  = Vertical plume spread as a function of atmospheric stability and distance.

$A$  = Smallest vertical plane, cross-sectional area of the building from which the effluent is released ( $A=2,069 \text{ m}^2$ ).

For neutral to stable conditions with wind speeds less than 6 m/sec, Equation 2.3-3 and Equation 2.3-4 were calculated and compared, and the higher  $\text{Chi}/Q$  was selected. This higher value was compared to the  $\text{Chi}/Q$  resulting from Equation 2.3-2 and the lower was selected. This was done in accordance with Regulatory Guide 1.145 (USNRC, 1983). For other stability and/or wind speed conditions,  $\text{Chi}/Q$  was selected as the higher value from Equation 2.3-3 and Equation 2.3-4.

From these hourly  $\text{Chi}/Q$  values, cumulative frequency distributions were prepared from the mean values of sliding time windows of 1, 2, 8, 16, 72, and 624 hours. These intervals correspond to time periods of 0-1 hour, 0-2 hours, 0-8 hours, 8-24 hours, 1-4 days, and 4-30 days. For each time period used, the mean centerline  $\text{Chi}/Q$  value in each sector was computed. The results of these analyses are presented in Table 2.3-39 through Table 2.3-50.

### 2.3.4.3 Chi/Q Estimates Using the PAVAN Computer Code and On-Site Data

The PAVAN computer code (USNRC, 1982), was used to calculate short-term accident  $\text{Chi}/Q$  values attributable to potential accidental releases from the EGC ESP Facility. Values were determined in accordance with USNRC Regulatory Guide 1.145 (USNRC, 1983) for the 0.5 percent maximum sector  $\text{Chi}/Q$  and the 5 percent direction independent value. In addition, 50 percent direction independent values were determined for use in the environmental report evaluations. The model was run for a two cases using 2 years and 8 months of on-site meteorological data from the period 2000 – 2002, a description of which is provided above. The following two cases were evaluated:

Case 1: CSP Site distances used in CPS USAR (EAB = 975 m, LPZ = 4,018 m)

Case 2: EGC ESP Site distance (EAB = 1025 m, LPZ = 4,018 m)

In addition, Case 2 was evaluated with and without building wake effects.

These two cases were modeled to facilitate an evaluation and comparison of the  $\text{Chi}/Q$  calculations with those presented in the CPS USAR, as well as to examine the relative significance of building wake effects on the calculations.

Input to the PAVAN model consisted of the following:

Meteorological Data: Joint frequency distribution of wind speed, wind

direction, atmospheric stability, 16 standard azimuthal sectors, period of record 1/1/00 – 8/31/02 (Tables 2.3-29 through 2.3-36)

Wind Sensor Height:	10 m
Delta-T Heights:	10 – 60 m
No. Wind Speed Categories:	6
Minimum Building Cross Section:	2,069 m <sup>2</sup> (equivalent to CPS containment structure)
Containment Height:	76.1 m
Release Height:	10.0 m (ground level default height)

The release points and receptor locations in this analysis are defined as the EGC ESP Site EAB (1,025 m) and LPZ (4,018 m).

Short-term Chi/Q analyses were performed using the PAVAN model. The results of the PAVAN modeling analysis are summarized in [Table 2.3-51](#) and [2.3-52](#). [Table 2.3-51](#) summarizes in a matrix format the results of the modeling analysis for the two cases discussed above. Maximum sector Chi/Q's from the PAVAN modeling analysis are compared with the maximum sector Chi/Q's in the current CPS USAR. It is noted that the PAVAN results for the EGC ESP Site distances reflect the limiting values based on the 0.5 percent maximum sector Chi/Q. The values from the CPS USAR reflect the 5 percent maximum sector. A review of the results summarized in the table leads to the following conclusions:

- A comparison of the CPS USAR and the PAVAN Chi/Q's for the CPS 975 m EAB distance indicates that the results are similar, with the PAVAN model results being only moderately greater for all averaging periods. Differences are attributed to the different models used, as well as differences in the meteorology used in each analysis (1972 – 1977 for the USAR analysis and 2000 – 2002 for the PAVAN analysis).
- A comparison of the CPS USAR and the PAVAN Chi/Q's for the 4,018 m LPZ distance indicates that the results are similar, with the PAVAN model results being only moderately greater for all averaging periods. Differences are attributed to the different models used, as well as differences in the meteorology used in each analysis (1972 – 1977 for the USAR analysis and 2000 – 2002 for the PAVAN analysis).
- A comparison of the Case 2 results both with and without building wake effects illustrates that building wake effects have very little influence on Chi/Q's, particularly for very short averaging periods. This conclusion is the same for both the EAB distance of 1,025 m and the LPZ distance of 4,018 m. Since the results obtained without building wakes tend to be slightly higher at both distances (for averaging periods greater than 2 hours), these values are used for any further ESP evaluations or analyses.

#### 2.3.4.4 Chi/Q Estimates for Short-Term Diffusion Calculations

Although the results of the Chi/Q analyses discussed above have been demonstrated to compare favorably with one another, the results of the analysis using the PAVAN model and the meteorological data for the period 2000 – 2002 are moderately higher for some

scenarios. Since this is a more conservative estimate of the Chi/Q's, the PAVAN values listed on [Table 2.3-51](#) without building wake are established as the site characteristic 5% probability short-term diffusion values ([Table 1.4-1, Section 9.1](#)).

## 2.3.5 Long-Term Diffusion Estimates

### 2.3.5.1 Objective

Estimates of long-term atmospheric dilution factors (Chi/Q) and relative deposition (D/Q) were made using a straight-line Gaussian model, consistent with the requirements of Regulatory Guides 1.111 ([USNRC, 1977](#)) and 1.109 ([USNRC, 1976](#)). The objective was to calculate Chi/Q and D/Q values at the following locations in each of the 16 primary directions, including:

- Nearest Property Boundary
- Exclusion Area Boundary
- Nearest Milk Cow
- Nearest Milk Goat
- Nearest Garden
- Nearest Meat Animal
- Nearest Residence
- Distances of 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, 8.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0, 45.0, and 47.5 mi from the EGC ESP Facility.

[Section 2.3.5.2](#), provides additional information on the results of long-term Chi/Q estimates for the EGC ESP Facility.

### 2.3.5.2 Calculations

The calculations were made using the MIDAS<sup>®</sup> suite of software programs that is licensed and installed at the CPS Facility. Program XDCALC from the Midas software package calculates hourly centerline values of Chi/Q and D/Q and accumulates those values over any specified time period less than 32,760 hours.

The calculations of Chi/Q and D/Q were made by program XDCALC using hourly on-site meteorological data. Hourly meteorological data was obtained using the 15 min observation period that ended on each hour. The program was used to estimate centerline Chi /Qs and D/Qs for a ground-level release, with an assumed height of release of 10 m. The 10 m release height is consistent with the height at which wind speed and direction are measured on the CPS meteorological tower, as well as with USNRC guidance for the modeling of ground-level releases. Assumptions used in the analysis are summarized below:

- Meteorological Data Source - CPS on-site meteorological tower
- Period of Record - 1/1/2000 - 08/31/2002

- Wind Reference Level - 10 m
- Stability Calculation - Delta-Temperature (10 and 60 m tower levels)
- Release Type - Ground level
- Release Height - 10 m
- Building Wake Effects - Included

The results of the long-term diffusion modeling analysis are contained in [Table 2.3-53](#) to represent undepleted Chi/Q calculations from the EGC ESP Facility. [Table 2.3-54](#) represents Chi/Q calculations that account for deposition effects. [Table 2.3-55](#) contains estimates that include radioactive decay with an overall half-life of 2.26 days for short-lived noble gases. [Table 2.3-56](#) contains estimates that also include an 8 day half-life for all iodines released to the atmosphere.

Based on the above analysis, a value of  $2.04\text{E-}06$  sec/m<sup>3</sup> is established at the site characteristic value for the maximum average annual atmospheric dispersion factor at the EAB in any given sector (i.e., NNE sector, refer to [Table 2.3-53](#)).

## 2.4 Hydrologic Engineering

### 2.4.1 Hydrologic Description

#### 2.4.1.1 Site and Facilities

The EGC ESP Site is located six mi east of the city of Clinton, DeWitt County in central Illinois. Clinton Lake was formed, for the existing CPS Facility, by the construction of an earthen dam across Salt Creek, 1,200 ft downstream from the confluence of the North Fork of Salt Creek with Salt Creek (see [Figure 2.4-1](#)). The site is about 3.5 mi northeast of the dam, located between the two fingers of the lake, at a grade elevation of about 735 ft above msl. The drainage area at the dam site is 296 mi<sup>2</sup>.

Clinton Lake was designed to provide cooling water to the CPS Facility and remove the design heat load from the circulating water before the water circulates back into the station. The CPS Facility intakes water through the circulating water screen house located on the North Fork of Salt Creek finger. The circulating water is discharged into the Salt Creek finger through a 3.4 mi long (18,040 ft) discharge flume, as shown in [Figure 2.4-1](#).

The dam structure has a length of 3,040 ft, with a 3:1 (horizontal to vertical) slope on both the upstream and downstream faces. The top of the dam is at an elevation of 711.8 ft above msl (about 21.8 ft above the normal pool elevation), with a width of 22 ft and 10 in at the top. The maximum height of the dam is 65 ft above the creek bed. Riprap is provided on the upstream slope of the dam for protection against wind-wave erosion and lake drawdown effects. The downstream slope is seeded and the toe of the dam is provided with riprap for erosion protection ([CPS, 1982](#)).

The dam includes three flow components: 1) a concrete service spillway with an ogee-shaped crest on the west abutment of the dam to pass floods; 2) an auxiliary spillway on the east abutment of the dam to pass floods greater than the 100 yr flood; and 3) a lake outlet structure near the west abutment to provide a minimum downstream release of 5 cfs ([CPS, 1982](#)). The plan of the dam and appurtenances is shown in [Figure 2.4-2](#).

The lake elevation area capacity curves are shown in [Figure 2.4-3](#). The lake normal pool elevation is 690 ft above msl, with a surface area of 4,895 ac (7.65 mi<sup>2</sup>, 2.6 percent of the drainage area), and a storage capacity of 74,200 ac-ft at the normal pool elevation ([CPS, 2002](#)).

#### 2.4.1.2 Hydrosphere

The site, including Clinton Lake, is near the confluence of the Salt Creek and the North Fork of Salt Creek, about 56 mi east of where Salt Creek joins the Sangamon River. Clinton Lake was formed by construction of an earthen dam 1,200 ft downstream from the confluence of the North Fork of Salt Creek with Salt Creek. The Salt Creek and North Fork of Salt Creek fingers extend 14 mi and 8 mi, respectively, upstream from the dam.

The general hydrologic features in the Sangamon River Basin and their relation to the dam site are shown in [Figure 2.4-4](#).

Salt Creek, in central Illinois, lies within the Sangamon River Basin, which drains into the Illinois River about 10 mi upstream from Beardstown, Illinois (about 75 mi west of the site). The Sangamon River has a length of 200 mi and a drainage area of 5,400 mi<sup>2</sup> (CPS, 1982).

Salt Creek, the principal tributary of the Sangamon River, has its headwaters 15 mi east of Bloomington in McClean County, and flows in a southwesterly direction into DeWitt County. Thereafter, it pursues a westerly course through Logan County and into Mason and Menard counties to join the Sangamon River, 8 mi east of Oakford. The length of Salt Creek is 92 mi, and the total drainage area is 1,860 mi<sup>2</sup>. The maximum relief in the basin between the mouth and the high point on the drainage divide, near LeRoy, is 440 ft (CPS, 1982).

Salt Creek flows through rolling country for 40 mi with a fall of 300 ft. Channel slope varies from over 10 ft/mi in the upper reaches, to less than 3 ft/mi near the Town of Rowell. At Clinton Lake, the channel slope is about 5 ft/mi. Downstream from Rowell, Salt Creek flows sluggishly through prairies to its confluence with the Sangamon River. Channel slope in the lower reach of Salt Creek is less than 2 ft/mi. The drainage area of Salt Creek to the Clinton Lake Dam is 296 mi<sup>2</sup> (CPS, 1982).

The cross section of the Salt Creek valley is typically u-shaped with a channel width of 20 ft to 80 ft and a channel depth of 4 ft to 12 ft. The streambed is on relatively thick sand and gravel alluvium underlain by glacial till and deep bedrock formations. Beneath the dam, the bedrock is about 300 ft below the creek bed (CPS, 1982).

The main tributaries of Salt Creek include North Fork of Salt Creek, Lake Fork, Deer Creek, Kickapoo Creek, Tenmile Creek and Sugar Creek (CPS, 1982). The length, drainage area, maximum relief between the mouth and the high point of the drainage divide, and average annual runoff for the Salt Creek tributaries are provided in Table 2.4-1.

There are currently no existing reservoirs or dams upstream or downstream from Clinton Lake that could affect the availability of water to Clinton Lake (CPS, 1982).

A USGS gauging station on Salt Creek is located near Rowell, 12 mi downstream from the Clinton Lake Dam. The drainage area at the gauging station is 335 mi<sup>2</sup>. The station maintains records dating back to October of 1942.

Table 2.4-2 presents the mean monthly runoff, rainfall, and natural lake evaporation data for the Salt Creek basin at the Rowell gauging station, following construction of the Clinton Lake Dam (1978 to 2000) (USGS, 2002). The average discharge of Salt Creek for this 21 yr period is 295 cfs, or about 12 in. of runoff per yr. March has the highest average monthly runoff, amounting to 1.99 in over the drainage area, or 578 cfs. September has the lowest runoff, amounting to 0.21 in, or 63 cfs. A maximum discharge of 7,810 cfs was recorded on April 13, 1994. The lowest mean daily flow was 3.7 cfs, observed on September 8, 1988. The runoff to rainfall ratio for the post-dam conditions is approximately 30 percent (i.e., approximately 30 percent of the rainfall drains out of the basin).

The discharge data for post-dam conditions (after 1978) at Rowell gauging station are shown in Table 2.4-3. There are no existing river control structures located upstream or downstream of the dam site that can affect the safety of the lake and EGC ESP Facility structures or the availability of water supply.

There are no communities either upstream or downstream of the Clinton Lake Dam that draw water from Salt Creek for public water supply. There are no known surface water users of the Sangamon River within 50 river mi downstream from the plant site. The closest surface water user for drinking purposes is in Alton, Illinois on the Mississippi River, 242 river mi downstream from the EGC ESP Site. Within 25 mi of the EGC ESP Site Bloomington (35,000 population) draws water from the Mackinaw River Watershed to the north, and Decatur (95,000 population) draws water from the Sangamon River Watershed to the south.

There is a population of 308,000 in the counties that lie within a 50 mi radius of the facility that use surface water from a public water supply other than Salt Creek. Public water supplies draw about 75 million gallons of water per day from surface waters. There are no private surface water withdrawals for domestic water supply or for agricultural purposes. There are 10 million gallons of private surface water withdrawn for commercial purposes, and 30 million gallons withdrawn for industrial purposes.

## 2.4.2 Floods

### 2.4.2.1 Flood History

The review of post-dam conditions indicates that the lake is significantly attenuating flood flows in Salt Creek. There are no discharges over 10,000 cfs recorded at the Rowell gauging station after construction of the Clinton Lake Dam (USGS, 2002).

Flood frequency for the Rowell gauging station were analyzed based on the 22 years of records from January of 1978 to September of 2000. Figure 2.4-5 shows the peak flood frequency curve for Salt Creek at the gauging station under post-dam conditions. The peak flow for various recurrence intervals at the gauging station and at the dam site are also shown in Table 2.4-4. The discharges at the dam site were derived using the drainage area ratio.

At the gauging station, the mean annual flood for post-dam conditions is 3,600 cfs (recurrence interval of 2.33 yrs). The maximum post-dam discharge of 7,810 cfs (April of 1994) has a recurrence interval of about 25 yrs (USGS, 2002).

As a result of the dam the 10 yr recurrence interval flood flow at the Rowell Gauging Station is reduced from 11,400 cfs to 6,200 cfs. The 100 yr recurrence flood flow is reduced from 29,900 cfs to 10,400 cfs (see Table 2.4-4).

### 2.4.2.2 Flood Design Considerations

The hydrologic analyses and hydraulic design for the dam and the lake are based on a probable maximum flood (PMF) condition with a standard project flood (SPF) as an antecedent flood. This design basis is in accordance with the recommendations given by the USNRC Regulatory Guide 1.59 (1977). The PMF is an estimated flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions, and it can reasonably occur in the region. The SPF is estimated to be equal to 50 percent of the PMF. The maximum water level in Clinton Lake at the dam site was determined by routing the antecedent SPF, occurring three days prior to the PMF, and the PMF through the lake

using the U.S. Army Hydrologic Engineering Center computer program, "Spillway Rating and Flood Routing" (USACOE, 1966a).

At the dam site, the PMF water surface elevation in the Clinton Lake is 708.8 ft above msl. The top of the dam is at an elevation of 711.8 ft above msl. A minimum freeboard of 3 ft from the PMF water level was provided in order to determine the elevation at the top of the dam. This provides for protection against overtopping of the dam by the PMF and wave action. The maximum wave run-up elevation at the dam, due to sustained 40 mph wind acting on the PMF water level, is 711 ft above msl.

A concrete service spillway designed to pass floods is located on the west abutment of the dam. The lake water level for a 100 yr flood is at an elevation of 697 ft above msl. The ungated service spillway with an ogee-shaped crest has a semicircular plan, with a crest length of 175 ft and a crest elevation of 690 ft above msl. The height of the concrete ogee is 10 ft. Water passing over the ogee section will discharge through an 80 ft wide concrete chute into a stilling basin, where the energy of flow is dissipated. Riprap is provided downstream from the stilling basin for erosion protection. A discharge channel was excavated to convey the water to the main channel of Salt Creek (CPS, 1982).

An auxiliary spillway is provided on the east abutment of the dam to pass floods up to and including the PMF. The auxiliary spillway is open-cut, with a crest length of 1,200 ft and a crest elevation of 700 ft above msl. The dam crest or control section is 25 ft wide asphalt concrete with riprap provided on the upstream and downstream sides. A 6 ft deep rock trench is provided as a downstream cut-off. This varies in distance from the crest, from 150 ft on the far end to 300 ft near the dam. This rock trench protects the spillway crest against erosion on the discharge channel. The spillway approach channel is excavated to an elevation that varies from 690 ft to 695 ft above msl, and the discharge channel is excavated to an elevation of 695 ft above msl. Both of the channels are vegetated (CPS, 1982).

All safety related structures at the EGC ESP Facility will either be outside the flood elevation or designed to withstand the effects of flooding.

### 2.4.2.3 Effects of Local Intense Precipitation

The effects of local intense precipitation on the drainage areas surrounding the EGC ESP Site were evaluated on the basis of 24 hour probable maximum precipitation (PMP) estimates for "Zone 7" from the U.S. Weather Bureau (USWB) Hydrometeorological Report No. 33, as summarized in Table 2.4-5 (U.S. Weather Bureau, 1956). This information has previously been used and summarized in the CPS USAR (CPS, 2002). A review of historical rainfall records from the National Weather Service (NWS) Cooperative Observer Station No. 111743 in Clinton, IL (Midwestern Regional Climate Center, 2002b) for the period 1910 to 2002 indicates that there have been no significant changes in storm activity (based on either 24 hour or annual precipitation records) since the information was developed for use in the CPS USAR. More specifically, the six highest 24 hour rainfall totals prior to the construction of the Clinton Lake Dam ranged from 3.33 to 6.25 in, with a single 24 hour event totaling 14.25 in 1961. After the dam was constructed, the six highest 24 hour rainfall events ranged from 3.54 to 5.28 in. Annual average rainfall before and after dam construction was 38.3 and 38.9 in, respectively. Inasmuch as the methodology for estimating PMP is based on a simple scaling to increase observed storm rainfall amounts to reflect localized heavy rainfall

associated with higher atmospheric moisture levels, the PMP's presented in [Table 2.4-5](#) are still considered to be representative of the ESP site area. The July and August PMP's from [Table 2.4-5](#) are seen to be the all-season high values (31.2 in), and this value is used as the basis for estimating PMP's for other time periods.

The 48 hour PMP estimates (in 6 hour increments) are summarized in [Table 2.4-6](#), with an estimated cumulative 48 hour PMP for the site area of 33.6 in and a maximum probable 6 hr rainfall of 24.48 in. The estimated maximum probable 6 hour rainfall distribution is further divided into twelve 0.5 hour periods using a procedure described by [Chow \(1964\)](#), as shown in [Table 2.4-7](#). Distributions of estimated PMP at 5 to 20 minute intervals are shown in [Figure 2.4-6](#). The 48 hour PMP for the site area is assumed to form the design basis for flood protection for the ESP Facility.

In north central Illinois approximately 70 percent of the annual snowfall occurs in December, January, and February ([Illinois State Water Survey, 1966](#)). November, March, and April are normally the only other months when measurable snowfall occurs. Among these 6 winter months, the largest value for the monthly 24 hr PMP is in November and equals 14.9 in for a 200 mi<sup>2</sup> area ([Table 2.4-5](#)). The corresponding 24 hour and 48 hour PMP estimates for the site area (<10 mi<sup>2</sup>) are 16.99 and 20.71 in, respectively. The winter PMP intensity-duration curve (based on 5 minute estimates) was obtained in a manner similar to the summer PMP estimates and is shown in [Figure 2.4-6](#).

The maximum rainfall rate site characteristic for the EGC ESP Site is derived from [Figure 2.4-6 \(CPS, 2002\)](#). The values are established as 13.5 in/hr (4.3 in/5 min) where the five min to the 1 hr PMP ratio is 0.32 as found in National Weather Service Publication HMR No. 52 ([USDOC, 1982](#)). (The local PMP values will be used to evaluate the local site flooding based on site grading and drainage design at the COL stage.

### 2.4.3 Probable Maximum Flood on Streams and Rivers

The probable maximum flood is an estimated flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The analyses in the following sections are based on the information contained in the CPS USAR ([CPS, 2002](#)) and as noted therein were performed in accordance [USNRC Regulatory Guide 1.59](#).

The floodwater surface elevations in the lake were determined by routing the floods through the lake using the Spillway Rating and Flood Routing (SPRAT) computer program ([USACOE, 1966a](#)). The 100 yr flood level in the lake at the dam site is at an elevation of 697 ft. The routed peak outflow through the service spillway is 11,610 cfs. Based on the flood frequency analysis, the 100 yr flood flow at the dam site, based on records before the dam was built (that is, before November 1977), was estimated to be 26,400 cfs. As shown by the analysis of the post-dam, however, the attenuation effect of the lake will reduce the expected magnitude of the flood flows downstream from the dam. The PMF level with an antecedent standard project flood is at an elevation of 708.8 ft above msl at the dam and 708.9 ft above msl at the plant sites.

The flooding effects on the headwater area of the cooling lake were determined by backwater computations using the computer program, "Water Surface Profiles" ([USACOE, 1968](#)). [Figure 2.4-7](#) and [Figure 2.4-8](#) depict the water surface profiles of the 100 yr flood and

the PMF under natural conditions for Salt Creek and the North Fork of Salt Creek, respectively. The Illinois Central Railroad depicted on [Figure 2.4-8](#) was procured by the Canadian National Railroad.

For Salt Creek, the backwater effect of a 100 yr flood in the lake terminates at the Iron Bridge, approximately 76,000 ft or 14.5 mi upstream from the dam and 1.5 mi southwest of Farmer City. The backwater effect of the PMF in the lake terminates at the US Hwy 150 Bridge, approximately 86,400 ft or 16.4 mi upstream from the dam and in Farmer City. For the North Fork of Salt Creek, the backwater effect of a 100 yr flood in the lake terminates at 39,000 ft or 7.5 mi upstream from the dam. The backwater effect of the PMF in the lake terminates at approximately 47,500 ft or 9.0 mi upstream from the dam ([CPS, 1982](#)).

The 100 yr flood level was a criterion used in the property acquisition for the lake area. There is no increase in flooding outside of the lake area property acquisition. The CPS is at a grade elevation of 736 ft above msl and the EGC ESP Facility will be at grade elevation 735 ft. Neither location will be affected by floods in the lake.

The impoundment of Salt Creek and the North Fork of the Salt Creek to form Clinton Lake has altered natural flood levels. [Figure 2.4-9](#) depicts the post-dam construction normal lake level, 100 yr and PMF flood areas, and the CPS and ESP plant sites. No CPS Facility structures were built in the pre-construction 100 yr flood prone area, except for the dam that was built across Salt Creek to create Clinton Lake. Likewise, with the exception of new intake structure for the EGC ESP Facility, structures will not be built in this flood prone area. Several structures have been built along the edges of the post-construction flood prone area (with Clinton Lake in place). These include the intake and discharge structures, modified highway bridges, a marina, and seven boat ramps. Construction of these structures is complete, and their presence will not cause any alteration in flood levels. To date, flood flows downstream of the Clinton Lake Dam have been lower than pre-construction flood flows.

The above analysis remains valid since the hydrologic characteristics of the watershed are essentially unchanged from those used above. Population levels in the area from the time of the analysis are actually down slightly indicating that there has been no significant watershed development that would affect the watershed hydrologic characteristics. Review of precipitation values from 1978 through 2001 indicates essentially the same average annual precipitation values as those recorded prior to dam construction. There will be a slight increase in the watershed impervious surfaces due to construction of the EGC ESP Facility and a slight decrease in lake water volume due to forced evaporation as the lake water is cycled through the EGC ESP Facility. These values are offsetting, however, in any case neither is significant in terms of affecting the analysis.

#### **2.4.3.1 Probable Maximum Precipitation**

As reported in the CPS USAR ([CPS, 2002](#)), the seasonal variation of PMP over the 296 square mi drainage area of Salt Creek was obtained from the US Weather Bureau Hydrometeorological Report No. 33, "Seasonal Variation of the Probable Maximum Precipitation East of 105th Meridian for Areas from 10 to 1000 Square Miles and Durations of 6, 12, 24, and 48 Hours," ([USWB, 1956](#)). Monthly and all-season depth-duration data for the basin are given in [Table 2.4-8](#) ([USWB, 1961](#)). The precipitation for the summer month of

August is the most critical and is equal to the all-season value. The design PMP for each 6 hour duration is shown in [Table 2.4-9 \(USWB, 1961\)](#).

The 48 hour PMP of 25.2 in that was used in developing the PMF hydrograph was assumed to be distributed uniformly over the entire 296 mi<sup>2</sup> area in accordance with the areal correction factor given in Hydrometeorological Report No. 33 ([U.S. Weather Bureau, 1956](#)). No spatial distribution of this precipitation was considered since the drainage area is relatively small and the approach suggested in Hydrometeorological Report No. 33 is appropriate. The distribution of the 48 hour PMP into smaller time intervals was based on the procedure given in U.S. Army Corps of Engineers Civil Engineering Bulletin No. 52-8, EM1110-2-1411, "Standard Project Flood Determinations" ([U.S. Army Corps of Engineers, 1952](#)). There are two 24 hour rainfall periods, arranged as per the procedure described in [U.S. Weather Bureau \(1961\)](#). Each of the two 24 hour rainfall periods is subdivided into four 6 hour periods. The sequence of the PMP is shown in [Table 2.4-10](#). A standard project storm (SPS) with precipitation equal to 50 percent of the PMP is considered to occur 3 days prior to the PMP as the antecedent storm in accordance with the recommendations given in [Regulatory Guide 1.59](#). The procedures to develop the floods and flood routing are discussed in [Sections 2.4.3.4 and 2.4.3.5](#).

The maximum potential snow accumulation was studied and estimated to correspond to a weight of 35 psf, which would be attributable to the 100 yr snowpack of 22 psf ([ASCE, 2000](#)) plus the snow accumulated from the worst-case 100 yr storm event (13 psf), as described in [Section 2.3.1.2.3](#) and is established as the EGC ESP Site characteristic value.

A review of historical rainfall records from 1910–2002 obtained from the National Weather Service (NWS) Cooperative Observer Station No. 111743 in Clinton, IL ([Midwest Regional Climate Center, 2002b](#)) indicates that there have been no significant changes in storm activity (based on either 24 hour or annual precipitation records) in the area since 1910. Inasmuch as the methodology for estimating PMP is based on a simple scaling to increase observed storm rainfall to reflect localized heavy rainfall associated with higher atmospheric moisture levels, the PMPs presented in [Tables 2.4-11 and 2.4-12](#) are considered to be representative of the ESP site area.

### 2.4.3.2 Precipitation Losses

The topography of the Salt Creek basin is gentle to moderate. Using the soil maps published by the University of Illinois Agricultural Experiment Station, about 90 percent of the drainage area is found to be associated with Flanagan silt loam, Drummer clay loam, and Huntsville loam; the rest is Sawmill clay loam. The first three types of soils mentioned belong to hydrologic soil group B based on the U.S. Soil Conservation Service soil grouping ([UIAES, 1960](#) and [UIAES, 1967](#)). The initial loss depends upon antecedent moisture condition, in addition to other factors. From the data furnished by the U.S. Army Corps of Engineers ([USACOE, 1970](#)), the initial loss is taken as 1.5 in for the antecedent SPS and zero for the PMP.

Infiltration rates vary throughout the storm period from a high rate at the beginning, to a relatively low and uniform rate as the precipitation continues. Infiltration also depends on antecedent field moisture conditions, slope, soil type, vegetation, etc. Based upon the data furnished by the U.S. Army Corps of Engineers ([USACOE, 1970](#)), the infiltration rate is

assumed to be a constant equal to 0.1 in/hr. The above values of initial loss and infiltration rate were used in calculating the rainfall excess for both the antecedent SPS and PMP. It is conservatively assumed that the initial loss is applicable only to the antecedent SPS and the infiltration is applied to both. Tables 2.4-11 and 2.4-12 show the rainfall excess values for the PMP and antecedent SPS, respectively, for a 48 hour period. A review of this information indicates that, since soil characteristics of Salt Creek basin would not have changed appreciably since the 1970s, it is still considered to be representative of the CPS and EGC ESP Site areas.

### 2.4.3.3 Runoff and Stream Course Models

The unit hydrograph for Salt Creek at the gauging station near Rowell was derived from storm data recorded in 1943 and 1944. It is presented in the publication, "Unit Hydrographs in Illinois," by W. D. Mitchell (IDOW, 1948). In the same publication, a synthetic method of deriving a unit hydrograph was developed. This method is applied in constructing the unit hydrographs. Figure 2.4-10 shows the synthetically developed unit hydrograph for Salt Creek at the dam site under natural river conditions compared with the Rowell Station unit hydrograph adjusted by direct ratio of drainage areas at the dam site and the gauging station. Figure 2.4-11 shows the unit hydrographs derived from the subbasin drainage areas above the dam site (IDOW, 1948). The total drainage area at the dam site is relatively small. There are no existing or proposed reservoirs upstream of Clinton Lake. Flood hydrographs were developed for headwater areas and other subareas in the drainage basin that drain directly into the lake. Flood routing through the proposed cooling lake was done using a "storage indication" routing procedure. The U.S. Army Corps of Engineers' Hydrologic Engineering Center computer program 22-j2-L210, "Spillway Rating and Flood Routing" (USACOE, 1966a), was used in the computations.

A storage indication routing procedure is appropriate in this case because of the large depth of the lake (average 25 ft depth during floods).

This was further substantiated by the results of the backwater calculations. Under PMF conditions, the average slope of the lake surface was seen to be only about 0.06 ft/mi. The spillway rating curves are given in Figure 2.4-12. Initial pool level was taken at elevation 690.0 ft above msl for flood routing. This is the normal lake level and also the crest elevation of the service spillway. Elevation 690.0 ft above msl was taken for the starting pool elevation because uncontrolled service spillway restores the pool to that elevation within a relatively short period following a major flood.

- Runoff Model

Synthetic unit hydrographs were developed for subareas of Salt Creek and North Fork upstream of the dam site. The unit hydrographs were derived by using the information from Illinois Division of Waterways (IDOW, 1948). Lag times have been computed according to the associated subareas.

- Computation of Lag

An appropriate postulated relationship for Illinois streams is expressed by the formula:  $t = 1.05 A^{0.60}$ , (IDOW, 1948) in which  $A$  = drainage area in  $\text{mi}^2$  and  $t$  = lag in hour.

The variation of maximum ordinate of synthetic unit hydrograph obtained by using the

above formula for drainage areas upstream of the Rowell Gauging Station is only within 3 percent of the maximum ordinate of the unit hydrograph derived from observed flood hydrographs (IDOW, 1948).

- Duration of Unit Hydrographs

Ideal duration varies from one basin to another depending upon several characteristics of the basin; the most important is the size. For small subareas, durations of 1/2 hour and 1 hour were selected. Then, by using the S-curve hydrograph method, 2 hour unit hydrographs were obtained.

- Ratio of Duration to Lag

This ratio determines which type of synthetic unit hydrograph should be used. Altogether nine forms for different basin sizes and ratio of duration to lag are given. (IDOW, 1948).

- Unit Hydrograph Ordinates

The unit hydrograph ordinates were computed using the following procedure given in IDOW, 1948.

$$q_s = \frac{A \times nd}{0.03719} \quad \text{Equation 2.4-1}$$

Where  $q_s$  = total cfs-intervals

$A$  = drainage area in square mi

$nd$  = average number of points in a 24 hour period.

Actual ordinates of unit hydrographs equal  $q_s$  times value of distribution graph (given in nine associated forms). All the pertinent information regarding the area, time lag, etc. of subareas of Salt Creek and North Fork along with the total area upstream of the dam site is given in Table 2.4-13. For the lake area (8 mi<sup>2</sup>), a hydrograph ordinate corresponding to 1 in of runoff has been computed for a 2 hour duration.

- Routing Coefficients

Channel routing procedure has not been used. Instead, flood hydrographs were developed for headwater areas and local areas that drain directly into the lake. Time lags between flood hydrographs of subareas have been computed based upon celerity of flood waves. The average depth of the lake during flood passage is about 25 ft. The distance from the dam site to the headwater area of Salt Creek is 14.2 mi (about 75,000 ft).

- Celerity

The celerity of flood wave in fps is given by the formula:

$$C = (gy)^{1/2} \quad \text{Equation 2.4-2}$$

Where  $C$  = celerity in fps  
 $g$  = acceleration due to gravity, and  
 $y$  = average depth of water in ft.

For an average water depth of 25 ft, the celerity is about 28 fps. The time lag for the flood wave to travel a distance of 75,000 ft is about 1 hour. The flood hydrographs at the dam site are obtained by adding the hydrographs of the subareas taking into consideration the time lag. The spillway flood routing was done using the U.S. Army Corps of Engineers computer program SPRAT for determining the flood elevations over the spillway.

As previously discussed, the hydrologic characteristics of the EGC ESP Site remain unchanged from the original CPS analysis (CPS, 2002). Therefore, the above analysis remains valid for the EGC ESP Facility.

#### 2.4.3.4 Probable Maximum Flood (PMF) Flow

The peak PMF flow of Salt Creek under natural river conditions is 112,927 cfs. The peak probable maximum flood flow into the lake is 175,615 cfs.

There are no existing or proposed dams on Salt Creek upstream and downstream of the CPS station site that will affect the water level at the station site, except the cooling lake dam for CPS. The cooling lake dam is designed to withstand the effects of a PMF and a coincident reservoir wind-wave action. Spillways with uncontrolled crests are provided to pass floods. The dam and the spillways are protected against erosion due to wind-wave action and flood flows (CPS, 2002).

As previously discussed, there is no significant change in the watershed hydrology and precipitation for the EGC ESP Site from the values used in the original CPS analysis. Therefore, the above conclusions remain valid for the EGC ESP Facility.

#### 2.4.3.5 Water Level Determinations

The hydrologic analyses and hydraulic design for the dam and the lake are based on a PMF condition with an SPF as an antecedent flood. This design basis is in accordance with the recommendations given by the USNRC Regulatory Guide 1.59 (USNRC, 1977). The PMF is an estimated flood that may be expected from the most severe combination of critical meteorological and hydrologic conditions, and it can reasonably occur in the region. The SPF is estimated to be equal to 50 percent of the PMF. The maximum water level in Clinton Lake at the dam site was determined by routing the antecedent SPF, occurring three days prior to the PMF, and the PMF through the lake using the U.S. Army Hydrologic Engineering Center computer program, "SPRAT" (USACOE, 1966a).

At the dam, the PMF water surface elevation in the Clinton Lake is 708.8 ft above msl. The top of the dam is at an elevation of 711.8 ft above msl. A minimum freeboard of 3 ft from the PMF water level was provided in order to determine the elevation at the top of the dam. This provides for protection against overtopping of the dam by the PMF and wave action. The maximum wave run-up elevation at the dam, due to sustained 40 mph wind acting on the PMF water level, is 711 ft above msl (CPS, 2002).

The maximum water level at the site was determined by making backwater calculations

from the dam site to the CPS Site along the North Fork finger of the lake, a distance of about 3.5 mi. The backwater computations were made using the U.S. Army (HEC) computer program, "Water Surface Profiles" (USACOE, 1968), with a starting elevation of 708.8 ft above msl, which is the maximum water level at the dam during PMF.

There is no gauging station upstream of the dam site. The nearest stream gauging station on Salt Creek is near Rowell, 12 mi downstream from the dam site. Historical flood levels at the Rowell Gauging Station were reconstituted using the slope area method. The roughness coefficients (n-values) used in backwater computations were verified by trying coefficients ranging from 0.020 to 0.040 for the main channel and from 0.035 to 0.068 for the floodplain. The values obtained for the roughness coefficients that best fit the historical flood stage are 0.030 and 0.050 for the main channel and floodplain, respectively. These coefficients were assumed to be applicable to the cooling lake PMF backwater computations. The creation of the cooling lake raises the stage considerably; therefore, the roughness coefficients used are more than appropriate. Furthermore, the lake clearing substantially reduced the side channel roughness, which made the choice of these roughness coefficients to be sufficiently conservative. The values used for Manning's coefficient of roughness are 0.03 and 0.05 for the main channel and the floodplain, respectively. The backwater computations resulted in a maximum water level elevation of 708.9 ft above msl at the site (CPS, 2002).

Since the EGC ESP Facility is located essentially at the same location as the CPS, the maximum water level of approximately 708.9 ft above msl remains applicable. The EGC ESP Facility grade elevation is 735 ft above msl, which is well above this level. Thus, the site characteristic for the maximum flood water level is established at 26.1 ft below grade (Table 1.4-1, Section 1.4.1).

#### 2.4.3.6 Coincident Wind Wave Activity

The significant (33.33 percent) and maximum (1 percent) wave effects of a coincident 40 mph winds were superimposed on the PMF water level at the site. The wave runups were calculated based on deepwater and nonbreaking wave conditions with an effective fetch of 0.8 mi, a water depth of 40.5 ft, and the waves acting on a smooth 3:1 (horizontal to vertical) ground slope. The estimated wave runups are 2.95 ft and 4.85 ft for the significant waves and maximum (1 percent) waves, respectively. Superimposing the wave runup values on the probable maximum flood level at the station site resulted in a wave runup elevation of 711.95 ft above msl for significant waves and elevation of 713.8 ft above msl for maximum (1 percent) waves (USACOE, 1966b and USACOE, 1962). The pressure distribution due to the waves is a combination of hydrostatic and hydrodynamic components and the exposed safety-related structures are designed to withstand these effects.

The maximum runup elevation at the dam for significant waves was calculated by superimposing the significant wave effects of a coincident 40 mph wind on the probable maximum flood water level at the dam site. The calculations are based on an effective fetch of 0.9 mi, a windtide fetch of 4 mi, a water depth of 58 ft, and an upstream slope of the dam of 3:1 (horizontal to vertical) with riprap. The wave runup obtained is 2.2 ft, resulting in a significant wave runup elevation of 711.0 ft above msl at the dam site. The top of dam is at elevation 711.8 ft above msl.

## 2.4.4 Potential Dam Failures, Seismically Induced

There are no existing dams upstream or downstream of the cooling lake which can affect the EGC ESP Site safety-related facilities or the availability of the cooling water supply. Furthermore, a postulated failure of the cooling lake dam will not result in the loss of water from the UHS pond as discussed in [Section 2.4.8.1.5](#).

## 2.4.5 Probable Maximum Surge and Seiche Flooding

There is no large body of water near the site where significant storm surges and seiche formations can occur. The size of Clinton Lake is not large enough to develop surge and seiche conditions that are more critical than the PMF condition ([CPS, 2002](#)).

## 2.4.6 Probable Maximum Tsunami Flooding

The site will not be subjected to the effects of tsunami flooding because the site is not adjacent to a coastal area ([CPS, 2002](#)).

## 2.4.7 Ice Effects

The recording station on Salt Creek near Rowell is the only gauging station within the Salt Creek drainage basin. It has maintained a continuous streamflow record since October 1942. The records show intermittent ice effects during the winter months. Most of the recorded ice effects are minor in terms of the stage-discharge relationship, except for the ice jam that occurred on February 11, 1959. The maximum gauge height caused by this ice jam was 24.84 ft with a peak discharge of 7,500 cfs. The datum of gauge is elevation 610 ft above msl. Based on the ice-free stage-discharge relationship, the gauge height corresponding to a discharge of 7500 cfs is 22.14 ft ([SWSUS, 1959](#)). The ice jam effect raised the flood level by 2.7 ft. The streamflow records also show that the maximum-recorded ice jam effects were less than the maximum flood stage and discharge values observed during the period of record. The effects of ice formation and the probable maximum winter flood on the lake water level would be less than that of the probable maximum summer flood. [Table 2.4-8](#) shows that the PMP for a duration of 48 hours for the month of August (25.2 in) is greater than that for the month of February (13.8 in) by 11.4 in.

The average thickness of sheet-ice that could form in the lake area is estimated to be 10 in, without considering the increase in lake water temperature due to station operation. The calculation is based on the empirical method developed by Assur ([Chow, 1964](#)), using a coefficient of snow cover of 0.85 and a value of 115 for the accumulated degree-days since freeze-up obtained from the average temperature data of Decatur, Urbana, and Springfield ([USWB, 1964](#)).

The inlet to the CPS screen house is at elevation 670 ft above msl, 5 ft below the design water level of the ultimate heat sink, giving a water depth of 12.3 ft for station operation during lake low water level conditions. The occurrence of an estimated ice thickness of 10 in in the intake area when the water level is at elevation 675 ft above msl would not block the flow into the CPS screen house. The availability of CPS station cooling water will not be affected by ice formation in the screen house area. Ice formation or ice jams causing low flow conditions in the streams would not affect the performance of the ultimate heat sink due to its submerged condition. The ultimate heat sink is full and will be maintained ([CPS, 2002](#)).

The only EGC ESP Facility structure exposed to the effect of ice on Clinton Lake is the new intake structure. The new intake structure will be similar to the existing CPS intake structure except it will be considerably smaller. It is planned to draw water from the same bottom elevation as the CPS intake structure. The separation between the surface ice and the bottom intake is significant. Ice jams at bridge crossings are not an issue because of the low velocity situations at the two impoundment crossings at Route 48 across the Salt Creek stream valley and Route 54 across the north Branch stream valley. Upstream and downstream ice jams will not impact ESP Facility operations.

## 2.4.8 Cooling Water Canals and Reservoirs

### 2.4.8.1 Cooling Lake

The cooling lake that was constructed for the CPS Facility will be used as a source of raw water for the EGC ESP Facility. The lake has a normal pool elevation of 690 ft above msl with a surface area of 4,895 ac and a volume of 74,200 ac ft. A new intake structure will be added next to the existing screen house to supply water to the EGC ESP Facility. The location of the new intake structure is shown on [Figure 2.4-13](#). The EGC ESP Facility will utilize cooling tower(s) for the normal and possibly safety-related cooling functions. The supply of make-up water to replace evaporation and cooling tower blowdown losses from the tower(s) will be taken from the existing lake.

The capacity of the lake was evaluated with a design drought condition for a 100 yr recurrence interval. The evaluation of drought effects on the cooling lake for the CPS is discussed in [Section 2.4.11](#). A lake drawdown analysis will be performed at the design stage, using the cooling tower make-up water requirements for the selected reactor plant, to determine if load reductions or a wet/dry cooling tower will be used for the EGC ESP Facility to reduce the cooling tower make-up requirements to match the raw water supply capacity of the lake under drought conditions. A wet/dry tower or power reduction program will be used for the EGC ESP Facility, if necessary, to assure that the lake will be maintained at or above elevation 677 ft above msl during a 100 yr drought.

#### 2.4.8.1.1 Cooling Lake Dam

There are no changes to the dam for the EGC ESP Facility. The following description of the dam is based on the existing CPS dam.

The plan of the cooling lake dam, spillways and outlet works is shown in [Figure 2.4-2](#). The cooling lake dam is a homogeneous earth fill dam with a maximum height of 65 ft above the creek bed and a length of 3,040 ft. The top of the dam is at elevation 711.8 ft above msl. A freeboard of 3 ft is provided to prevent overtopping of the dam by the PMF and significant wave runoff.

Both the upstream and downstream face of the dam has a side slope of 3:1 (horizontal to vertical). The upstream face is provided with an 18 in thick riprap laid on two 9 in layers of graded filter materials for protection against wind wave erosion and lake drawdown effects. The riprap is designed for 50 mph wind on lake normal pool. The downstream face is provided with seeded topsoil for protection against the erosive effect of rain falling over the dam. An 18 in thick riprap laid on two 9 in layers of graded filler materials is provided at the toe of the dam for erosion protection against tailwater effects. The riprap is designed for

50 mph wind on 100 yr tailwater flood level.

A cutoff into the Illinoian till and provision of a sand drainage blanket are made for seepage control under the dam and in the abutments.

The probable maximum flood elevation is 708.8 ft above msl and the maximum wave runup elevation is 711.95 ft above msl. The top of the dam is at elevation 711.8 ft above msl. The time duration over which overtopping by wave action would occur is only 2.5 hours. Any overtopping that would occur would be in the form of spray because the wave runs up the upstream slope and the water would be lifted into the air, thus creating a fine spray. Since most of the runup would be contained by the dam, only about 0.15 ft of the runup would be overtopping in the form of spray. The downstream slope is well protected with grass against gully erosion due to rain and, hence, any overtopping that might occur for a period of only 2.5 hours would not cause any significant damage to the downstream slope of the dam.

#### 2.4.8.1.2 Service Spillway

There are no changes to the operation and construction of the service spillway for the EGC ESP Facility. The following description of the service spillway is based on the existing CPS spillway.

A service spillway is provided to pass a design flood of 100 yr frequency with a floodwater surface elevation of 697 ft above msl in the lake. It is located on the west abutment of the dam mainly due to favorable soil conditions. The service spillway is an uncontrolled concrete ogee type, semicircular in plan, with a crest length of 175 ft and a crest elevation of 690 ft above msl. The height of the concrete ogee is 10 ft. From the ogee section, the water will discharge through an 80 ft wide concrete chute and into a stilling basin. A discharge channel is excavated to convey the water from the stilling basin to the main channel of Salt Creek.

The location of the service spillway is shown in [Figure 2.4-2](#). The total length of the spillway from the face of the ogee section to the end of the stilling basin is 603 ft above msl.

The peak discharge through the spillway for the 100 yr flood is 11,450 cfs. The velocity on the spillway crest is 12.9 fps and the water surface elevation downstream of the ogee is 687.6 ft above msl. The peak discharge through the spillway for the PMF is 33,200 cfs with a floodwater surface elevation of 708.8 ft above msl at the crest. The velocity on the crest is 18.2 fps and the water surface elevation downstream of the ogee is 696.5 ft above msl. The spillway-rating curve is shown in [Figure 2.4-12](#).

The chute section is designed considering the natural ground profile and the economics of the structure. It consists of a sloping channel of two different slopes (0.824 percent and 2.98 percent) and an inclined drop with a slope of 2.5:1 (horizontal to vertical), terminating into a horizontal stilling basin. An under drainage system is provided to reduce the uplift conditions. It consists of graded gravel and sand materials with perforated pipes and weep holes located at selected points along the chute.

The horizontal stilling basin is designed on the basis of the U.S. Bureau of Reclamation practices ([USDOL, 1973](#)). The tailwater elevations for the 100 yr flood and the PMF are 660 ft above msl and 678 ft above msl, respectively.

Riprap is provided downstream of the stilling basin for a distance of 80 ft as protection against erosion. The rip rap is 2 ft thick laid on 1 foot thick gravel filter materials. The rip rap can withstand a maximum velocity of 10 fps.

The top of the retaining walls in the chute section is provided with a minimum freeboard of 1 ft above the PMF water surface profile. The top of the retaining walls for the stilling basin is provided with a freeboard of 4.5 ft above the standard project flood level. The backfill and graded area adjacent to the stilling basin are provided with riprap and seeded topsoil for erosion protection.

The 100 yr flood level in the lake is the basis for determining the auxiliary spillway crest elevation. The auxiliary spillway is designed to function only during floods greater than the 100 yr flood. The crest of the auxiliary spillway is set at elevation 700 ft above msl for the 100 yr flood flow to discharge entirely through the service spillway.

#### **2.4.8.1.3 Auxiliary Spillway**

There are no changes to the operation and construction of the auxiliary spillway for the EGC ESP Facility. The following description of the auxiliary spillway is based on the existing CPS auxiliary spillway.

The auxiliary (emergency) spillway is located east of the dam. The location is chosen on the basis of obtaining a better approach condition. The auxiliary spillway is designed to pass floods more severe than the 100 yr flood and up to and including the PMF. The spillway provides protection to the dam against overtopping. The spillway is an open-cut type with a crest length of 1,200 ft and a crest elevation of 700 ft above msl. The floodwater will be discharged back into the main channel of Salt Creek between the dam and the Illinois State Route 10 bridge. The location of the auxiliary spillway is shown in [Figure 2.4-2](#).

The peak discharge through the auxiliary spillway during the PMF conditions is 102,800 cfs with a corresponding water level in the lake of elevation 708.8 ft above msl. The maximum velocity at the crest is 14 fps. The crest control section consists of 9 in thick asphalt concrete laid on 16 in of compacted aggregate materials. The width of the asphalt concrete crest is 25 ft. Concrete cutoffs and riprap is provided upstream and downstream of the asphalt concrete crest to protect the crest against scouring. A 6 ft deep rock trench is provided at the end of the downstream riprap that varies in distance from the crest from 150 ft at the far end to 300 ft at the area near the dam.

The approach channel is excavated to elevations varying from 690 ft above msl to 695 ft above msl. The length of the approach channel is 1,510 ft along the centerline of the spillway. The bottom of the discharge channel is elevation 695 ft above msl. The length of the discharge channel is 2,120 ft along the centerline of the spillway. The channels are provided with an erosion resistant soil with Bermuda grass cover that can withstand a velocity of 8 fps. Erosion control measures on the auxiliary spillway are provided for the safety of the dam and the spillway structure during extreme flood conditions.

#### **2.4.8.1.4 Outlet Works**

There are no changes to the operation and construction of the outlet works for the EGC ESP Facility. The following description of the outlet works is based on the existing CPS.

The lake outlet works is located on the west abutment of the dam, 160 ft east of the service spillway. The location of the outlet works is shown in [Figure 2.4-2](#). The lake outlet works is provided primarily to release a minimum flow of 5 cfs to the creek downstream of the dam to satisfy commitments documented in the CPS Final Environmental Statement ([USNRC, 1982](#)). The discharge from the lake outlet works at normal pool elevation, with all the gates fully opened, is 170 cfs.

The plan, section, and details of the lake outlet works are shown in [Figure 2.4-2](#). The lake outlet works consists of a submerged concrete intake structure of the drop inlet type, a 36 in diameter precast, prestressed concrete entrance pipe, a wet well type concrete control house with three cast iron sluice gates at different levels, and a 48 in diameter precast, prestressed concrete outlet pipe terminating at the spillway stilling basin.

The crest of the intake structure is at elevation 668 ft above msl with an inlet diameter of 84 in, transitioning into a 36 in diameter vertical section (throat). The inlet is provided with a trash rack and a vortex breaker. A provision for placing stop logs is made at the inlet of the entrance pipe for inspection or maintenance of the control gates.

The three cast iron sluice gates at the control house regulate the downstream releases of water from the lake. Two gates are 12 in by 12 in size with the centerline of one gate at elevation 686 ft above msl and the other centerline at elevation 684 ft above msl, and one gate 24 in by 36 in size located at the bottom of the control house at elevation 650.88 ft above msl. The upper 12 in by 12 in gate remains open during normal operating conditions. When the lake level falls to elevation 687 ft above msl, the lower 12 in by 12 in gate is opened. The bottom 24 in by 36 in gate is opened when the lake level falls to elevation 685 ft above msl. The gates are manually operated from the top of the control house. Locking devices are provided for the gates to prevent unauthorized personnel from operating the gates. A 15 ft wide concrete bridge is provided for access from the top of the dam to the control house.

The 48 in outlet pipes are located below a good natural soil formation and are provided with concrete anti-seep collars to prevent seepage problems in the body of the dam. The outlet pipe discharges the water into the stilling basin of the service spillway where the energy of flow is dissipated. The discharge channel downstream of the stilling basin conveys the flow to the main channel of Salt Creek.

#### **2.4.8.1.5 Flow Through the Ultimate Heat Sink (UHS) Pond**

The EGC ESP Facility will use the existing UHS submerged pond as the supply source for makeup water to any required safety-related cooling tower(s) if Clinton Lake is not available. The makeup water will be supplied from the new intake structure located next to the existing screen house. The UHS pond capacity has been evaluated as sufficient volume to provide shutdown cooling for the existing CPS and makeup water to the EGC ESP Facility safety-related cooling tower(s) for 30 days.

There are no changes to the flow path through the UHS Pond as a result of the EGC ESP Facility. The following description of the UHS pond is based on the existing CPS UHS pond.

The ultimate heat sink is a submerged pond formed by the construction of a submerged dam across the North Fork channel. The submerged dam is located 1 mi west of the CPS screen house. The location of the ultimate heat sink is shown in [Figures 1.2-3 and 2.4-9](#). [Figure 2.4-14](#) shows the plan of the ultimate heat sink. The cross sections through the ultimate heat sink, submerged dam, and baffle dike are shown in [Figure 2.4-15](#).

The top of the submerged dam is at elevation 675 ft above msl with a width of 30 ft and a length of 2350 ft. The dam consists of homogeneous compacted backfill materials with a side slope of 5:1 (horizontal to vertical) on both faces of the dam. The excavation for foundation of the dam is extended to the Illinoian till. A 2 ft thick compacted soil-cement is provided at the top and side slopes of the dam and extends into a horizontal apron downstream of the toe of the dam. The toe is at elevation 670.3 ft above msl. A random fill is provided to elevation 673.5 ft above msl at the end of the soil-cement apron to a distance of 290 ft from the centerline of the dam. The random fill is placed in areas where the existing grade is lower than elevation 673.5 ft above msl to create a stilling pool downstream of the dam. The baffle dike consists of homogeneous compacted backfill materials with a 30 ft width at the top and a side slope of 5:1 (horizontal to vertical) on both faces of the dike. The top of the baffle dike is at elevation 676 ft above msl and is provided with a 3ft thick compacted soil-cement. The bottom of the dike is founded on the Illinoian till. The length of the baffle dike is 3,300 ft.

The area of the ultimate heat sink at the design water surface elevation of 675 ft above msl is 158 ac with a total volume of 1,067 ac-ft.

The velocities over the submerged dam were analyzed for flow conditions resulting from a sudden breach in the main dam. The breach was conservatively assumed to occur at the time of the PMF with the lake water level at elevation 708.8 ft above msl. An instantaneous breach 100 ft wide and extending down to the Salt Creek bed was postulated.

The ultimate heat sink and the lake area downstream of the submerged dam were analyzed to evaluate the flow conditions due to the breach. The conventional level pool reservoir routing method was used. This method is based on the premise that the inflow volume minus the outflow volume equals the change in storage. The inflow volume is the flow through a control section, which is the constriction due to a railroad bridge upstream of the ultimate heat sink. The water surface elevations upstream and downstream of the submerged dam were determined from the flood routing calculations. Based on the water surface elevations and the corresponding flow over the submerged dam, the maximum velocities at the crest and at the toe of the dam were calculated. The maximum velocities obtained are 3.8 and 11.8 fps at the crest and at the toe of the submerged dam, respectively, occurring 43 hours after the main dam breach. Correspondingly, a maximum velocity of 1.2 fps on the face of the baffle dike is obtained. The maximum velocity on the baffle dike is lower than the maximum velocity at the crest of the submerged dam because the induced flow is primarily parallel to the baffle dike.

The velocities over the submerged dam and baffle dike were also analyzed with the occurrence of a PMF on the North Fork when the lake level is at the 100 yr drought water surface elevation of 682.3 ft above msl. The maximum velocities obtained over the submerged dam and baffle dike are 2.1 and 2.6 fps, respectively.

The compacted soil-cement provided over the surface of submerged dam and baffle dike will protect these structures against the erosive effect of the velocities and flow conditions due to the postulated dam breach and the occurrence of a probable maximum flood on North Fork coincident with the 100 yr drought lake water level of elevation 682.3 ft above msl.

### 2.4.8.2 Station Discharge Flume

The existing CPS discharge flume will be used to receive discharges from the EGC ESP Facility and convey them to the lake. [Figure 2.4-13](#) indicates the approximate discharge point. The existing discharge flume is designed for a maximum flow of 3057 cfs. Since the design was for two CPS units, the current flow to the flume from the CPS is less than 50 percent of the design capacity.

There are no changes to the operation and construction of the station discharge flume for the EGC ESP Facility. The following description of the station discharge flume is based on the existing CPS flume.

The discharge flume is provided to convey the plant discharge from the CPS circulating water pipe discharge structure into the Salt Creek finger of the lake. The flume is located east of the plant area and runs due east toward the lake. The location of the flume provides an effective cooling surface area of 3650 ac in the lake. [Figure 1.2-3](#) shows the location of the flume. The discharge flume is designed for a maximum flow of 3057 cfs with a nonscouring velocity of 1.5 fps. The flume has a bottom width of 120 ft and a side slope of 3:1 (horizontal to vertical). The total length of the flume is 3.4 mi (18,040 ft). A minimum freeboard of 3.8 ft is provided in the flume. A 6 in thick crushed stone layer is provided on the side slopes of the flume for protection against erosion due to wind wave action in the flume. Riprap is provided on the lakeside of the embankment fills for protection against erosion due to wind wave action in the lake.

Drop structures of the baffled apron type are provided at two locations along the flume to adapt the flume design to ground topography and to prevent scouring in the flume during station operations at design drought conditions in the lake. The two-drop structures have the same width of 70 ft; the first one is designed for a drop of 18 ft, and the second is designed for a drop of 26 ft. Provisions against erosion are provided at the end of both structures.

### 2.4.9 Channel Diversions

There is no historical evidence of channel diversion of Salt Creek and North Fork of Salt Creek upstream of the dam site. The dam site is located on the upper reaches of Salt Creek, 28 mi from its source. The topographic characteristics and geological features of the drainage basin indicate that there is no possibility for the occurrence of a landslide that will cut off the streamflow into the lake. The history of ice jam formation discussed in [Section 2.4.7](#), Ice Effects, did not show evidence of flow diversion during winter months.

### 2.4.10 Flooding Protection Requirements

The flooding effects of a PMF on Salt Creek and a local PMP on the plant area are the design bases for flood protection. The considerations for selecting the PMF on Salt Creek as the design flood are discussed in [Section 2.4.2.2](#), Flood Design Considerations. The effects of the

PMF and a coincident wind wave activity on the lake at the site are discussed in [Section 2.4.3](#), Probable Maximum Flood on Streams and Rivers.

The maximum (1 percent) wave runup elevation at the station site is 713.8 ft above msl, produced by a sustained 40 mph overland wind acting on the PMF still water elevation of 708.9 ft above msl. The approximate grade elevation for the EGC ESP Facility of 735 ft above msl is approximately 21 ft above the maximum wave runup level and 26 ft above the PMF water level. The safety-related facilities in the station area would not be affected by the PMF conditions in the lake. The only EGC ESP Facility structure that would be affected by the PMF is the intake structure, which will be designed for flood protection of the safety-related equipment located in the intake structure.

Wind-wave forces caused by a sustained 48 mph overland wind coincident with the PMF pool and 67 mph overland wind coincident with normal pool will be considered in the design of the EGC ESP Facility intake structure. Both breaking and non-breaking wave forces will be considered. The flooding effects of the local PMP are design related and will be addressed at the COL stage.

## 2.4.11 Low Water Considerations

### 2.4.11.1 Low Flow in Salt Creek

A design drought with a recurrence interval of 100 yrs was used in the determination of the minimum water level in the cooling lake for the CPS. Factors considered in the evaluation include runoff, evaporation, and forced evaporation.

A drawdown analysis of Clinton Lake, for the original Clinton Power Station, was made for two 991 MWe units operating at a 70 percent load factor, starting at a normal pool elevation of 690 ft above msl, using a minimum reservoir release of 5 cfs and assuming a seepage loss of 0.5 percent of the lake capacity per month. The original Clinton Power Station drawdown analysis was used to evaluate the capability of Clinton Lake to provide cooling tower makeup water for the EGC ESP Facility and the cooling water requirements for CPS. The forced evaporation rate (evaporation loss due to heat rejection from CPS) was corrected as follows for use in the EGC ESP evaluation:

- Divided by 2 since only one of the two units originally planned was constructed.
- Divided by 0.7 to conservatively adjust the evaporation for a 100 percent load factor.
- Multiplied by 1.20 to conservatively adjust for the additional heat load due to power uprate of CPS.

The drawdown evaluation performed for the EGC ESP Facility determined that the quantity of water available for cooling tower makeup based on a 50 yr drought is 15,808 gpm and the quantity available with a 100 yr drought is 10,222 gpm. The available water quantities maintain the lake level at or above the CPS minimum lake elevation of 677 ft above msl with both the CPS and the EGC ESP Facility in operation.

The available water quantity, for the EGC ESP Facility is sufficient to provide the Cooling Tower Makeup requirements, using evaporative (wet) cooling, for some of the reactors under consideration, for both the non-safety turbine plant cooling and the safety related

cooling systems. The bounding Reactor plant cooling system makeup demand would require the use of a wet-/dry-type cooling tower for the turbine plant cooling systems to reduce the evaporation rate or load reductions, so that the demand does not exceed the available water supply from Clinton Lake. The bounding cooling tower makeup water requirements, for evaporative losses in the tower, are shown on [Table 2.4-14](#) for a 100 percent evaporative (wet) tower and for a wet/dry tower with approximately 70 percent of the cooling achieved in the dry surface. The cooling tower makeup water requirements in [Table 1.4-1](#) consist of the quantity of water required to replace both the evaporative and blowdown losses from the tower. Since the blowdown water from the tower is returned to Clinton Lake it does not represent a demand for additional water from the lake. The other water usage listed in [Table 1.4-1](#) and supplied from the lake is (Potable/Sanitary, Demineralized water and Fire Service) are essentially returned to the lake as liquid waste discharges to the CPS discharge flume and do not result in a loss of lake water.

#### **2.4.11.2 Low Water Resulting From Surges, Seiches, or Tsunami**

Surges, seiches, or tsunami conditions are not possible to occur and affect low water conditions in the lake and the CPS UHS pond because there is no large body of water near the site.

#### **2.4.11.3 Historical Low Water**

The effect of drought on lake levels has been evaluated to determine if operation of the existing CPS Plant can be sustained during dry periods (CPS, 2002). A minimum safe lake level is established at elevation of 677 ft above msl. Lake levels below this would require plant shutdown to avoid loss of the safe plant cooling capacity. Two 5 yr duration droughts were established based on historical climatic conditions. The 50 yr and 100 yr droughts were selected for the evaluation.

The drawdown analysis accounted for lake inflows generated from direct rainfall and storm water runoff, normal evaporation, forced evaporation due to plant cooling and increased lake water temperature, ground seepage losses of 0.5 percent per month of the lake volume, minimum 5 cfs discharge at the dam to sustain the receiving stream, and dam overflow discharges. The drought analysis was completed based on the existing uprated CPS of one 1,138.5-megawatts electric (MWe) boiling water reactor (BWR) operating at 100 percent of its rated capacity.

The results of the lake level evaluation during drought established minimum lake levels for the 50 yr and 100 yr droughts of elevation 685 ft above msl and elevation 681.4 ft above msl, respectively. Both minimum lake levels are well above the minimum safe lake level of elevation 677 ft above msl. A discussion of lake levels and cooling system impacts based on both the existing CPS and proposed EGC ESP Facility operation is presented in Chapter 5 of the EGC ESP Environmental Report.

#### **2.4.11.4 Future Controls**

Based on inquiries made with state and federal regulatory agencies, there are no future plans to use Salt Creek water upstream of the cooling lake. Any future use of Salt Creek water upstream of the site would not affect the availability of shutdown cooling water supply due to the submerged condition of the UHS pond.

#### 2.4.11.5 Plant Requirements

The estimated station water requirements for cooling tower make-up and other plant water uses are shown in [Table 2.4-14](#). The water required for the EGC ESP Facility will be supplied from a new intake structure located next to the existing CPS intake structure. The new intake structure will use Clinton Lake as a supply source and will have the capability to take water from the existing submerged UHS pond as an alternate source of make-up water to the safety-related Essential Service Water (ESW) cooling tower(s) for shutdown and to maintain cooling for a period of at least 30 days.

The common intake structure for raw water requirements for the EGC ESP Facility is described in [Sections 3.2.1.3](#) and [3.2.2.3](#). The location of the Exelon ESP intake structure is shown on [Figure 2.4-13](#). The intake structure will house the traveling screens, fire pumps, cooling tower make-up pumps, and safety-related cooling tower make-up pumps. The make-up water pumps for the safety-related cooling tower(s) will be designed to operate with a suction water elevation at least 1 foot below the lowest level that the existing CPS UHS pond could attain after 30 days of operation without makeup to the UHS pond. The normal plant heat sink and UHS systems for the EGC ESP Facility are discussed in [Sections 3.2.1.1](#) and [3.2.2.1](#).

The minimum operating condition lake water level is elevation 677 ft above msl. The EGC ESP Facility make-up water pumps will be designed for an operating level equal to or less than this minimum water level. In the event of a severe drought that will reduce the lake water level to elevation 677 ft above msl, station shutdown operation will be followed. The design water level for the safety-related make-up water pumps and the CPS UHS pond are not affected by drought conditions in the lake.

The ESW system flow rate is 26,125 gpm for normal operation and 52,250 gpm for shutdown based on the bounding reactor plant. The ESW cooling tower makeup water requirements range from 350 gpm to 1,400 gpm.

The Ultimate Heat Sink cooling function for the EGC ESP Facility is provided by the Essential Service Water Cooling Tower(s). The cooling tower(s) require makeup from Lake Clinton to replace the water lost due to the evaporative cooling process that takes place in the tower(s). The make up water requirements range from 250 gpm during normal operation up to a maximum of 700 gpm during a normal shutdown. The total makeup water requirements for post accident shutdown and cooldown for a 30 day period are approximately 2,860,000 cubic feet (21,392,800 gallons) which is a average makeup requirement of approximately 495.2 gpm over the 30 day period.

#### 2.4.11.6 Heat Sink Dependability Requirements

Clinton Lake is the source of make-up water to the EGC ESP Facility during normal and emergency operation. The design considerations and description of the lake and the main dam are discussed in [Section 2.4.8](#). In the unlikely event of a failure of the main dam and complete loss of the cooling lake, the existing submerged CPS UHS pond will supply the make-up water to the safety-related cooling tower(s) for emergency station operation.

The existing CPS UHS pond is a submerged pond within Clinton Lake formed by the construction of a submerged dam across the North Fork channel. The existing CPS UHS pond is adjacent to the EGC ESP Facility intake structure where the make-up water pumps

for the Essential Service Water (ESW) safety-related cooling tower(s), if required, will be located. The return (cold) water temperature from the safety related cooling tower(s) is a maximum of 94.7 °F based on a 10°F approach and a maximum wet bulb temperature of 84.7 °F. The blowdown from the safety-related cooling tower(s) is discharged to the existing discharge flume for the CPS Facility and no credit has been taken for the return of blowdown to the CPS UHS pond in determining its capability to supply water to the EGC ESP Facility.

The CPS UHS pond has sufficient water volume and cooling capability for shutdown operation of the CPS Facility and make-up water for the EGC ESP Facility for shutdown operation for a period of at least 30 days and beyond, if necessary, without requiring makeup water. The current design basis, description and analysis of the UHS pond for the CPS Facility is provided in section 9.2.5 of the CPS USAR. The plan of the CPS UHS pond is shown in EGC ESP SSAR [Figure 2.4-14](#). [Figure 2.4-15](#) shows the cross sections through the UHS pond, submerged dam, and submerged baffle dike

The capacity of the CPS UHS pond will be sufficient for providing make-up to the ESW cooling tower(s) for the safe shutdown of the EGC ESP Facility and to provide safe shutdown cooling for the CPS Facility. A reduction in the allowable accumulated sediment volume in the CPS UHS pond may be required to provide adequate additional capacity make-up to the EGC ESP Facility ESW cooling tower(s).

The amount of makeup water required to the EGC ESP Facility safety related Ultimate Heat Sink cooling tower(s) for a 30 day period was determined based on the reactor plant with the bounding Ultimate Heat Sink heat load for shutdown. The amount of water that will be evaporated to provide post accident shutdown cooling is 2,860,000 ft<sup>3</sup> of water. This water quantity was conservatively increased by 1/3 to provide an allowance for blowdown to limit the concentration of impurities in the cooling tower basin to four times the concentration in the Lake. This number is conservative since it would be expected that blowdown would be terminated during an accident and that normal operation would be at a higher concentration ratio than the assumed ratio of four.

The original design of the Ultimate Heat Sink pond for the CPS was based on the heat load from the shutdown of one unit under LOCA and one unit under LOOP with a total integrated heat load of  $180,455 \times 10^6$  btu for 30 days. The heat load for the single CPS unit constructed, with Power Uprate, is  $99,973 \times 10^6$  btu for 30 days under LOCA or LOOP conditions. This value is approximately 55 percent of the CPS UHS Pond design heat load and indicates considerable margin is available. The design analysis for the original CPS UHS pond were reviewed and it was determined that the withdrawal of water to provide makeup to the Exelon ESP facility would have only a small effect on heat transfer from the CPS UHS pond and is insignificant when the actual CPS heat load, which is 55 percent of the design heat load, is considered.

The EGC ESP Facility does not use the existing CPS UHS Pond for heat removal but does use it for a source of makeup water for the EGC ESP UHS cooling tower(s) if Clinton Lake is not available to provide the makeup water.

Reliability of the CPS UHS to provide a supply of water during drought conditions is further enhanced by the CPS UHS pond location with respect to the adjacent groundwater

table. Since the CPS UHS pond is normally submerged in the cooling lake and the normal pool elevation sets the base level for the adjacent groundwater during low flow or loss of the main dam, water stored in the upstream alluviums would replenish water in the CPS UHS pond. The Salt Creek water shed would also provide a source of water for long term cooling following a loss of the Clinton Lake dam. The watershed can supply 400 gpm at the minimum mean daily flow from [Table 2.4-3](#) and 16,150 gpm at the lowest mean monthly flow. The required makeup flow to the EGC ESP Facility UHS cooling tower(s) during normal operation is 250 gpm and would bound the requirements after plant shutdown is achieved.

The CPS UHS pond is monitored for sediment accumulation periodically and after a major flood passes through the cooling lake ([CPS, 2002](#)). After the EGC ESP Facility is constructed, the allowable sedimentation accumulation in the CPS UHS pond may be decreased. For example, an allowable post-1991 dredging sedimentation accumulation of approximately 118 ac-ft would continue to support the largest anticipated additional capacity requirements.

#### **2.4.12 Dispersion, Dilution, and Travel Times of Accidental Releases of Liquid Effluents in Surface Waters**

As discussed in [Section 2.4.13.3](#), it is extremely unlikely that the effluents can move out of the buildings containing radioactive liquids due to high groundwater elevation. In addition, tanks located outside of structures potentially containing radioactive fluids will have positive means to collect and prevent uncontrolled releases such as dikes and collection basins. Therefore, it is extremely unlikely for the effluents to reach a surface water body.

The locations of surface water users are discussed in [Section 2.4.1.2](#). There are no known surface water users of Salt Creek or Sangamon River within 50 river mi downstream from the plant site. The closest surface water user for drinking purposes is in Alton, Illinois on the Mississippi River, 242 river mi downstream from the EGC ESP Site.

#### **2.4.13 Groundwater**

##### **2.4.13.1 Description and On-Site Use**

###### **2.4.13.1.1 On-Site Use**

Groundwater with high methane content was obtained from a test well during the site planning for the CPS Facility; therefore, the CPS Facility's water requirements have been met using surface water sources (Clinton Lake) rather than from groundwater wells. The test well was located approximately 1 mi south of the site ([CPS, 1982](#)). Based on the presence of methane in the groundwater and the availability of water from Clinton Lake, groundwater will not be used for operations of the EGC ESP Facility.

###### **2.4.13.1.2 Regional Hydrogeologic Systems**

Unconsolidated deposits of Quaternary-age glacial drift and stream alluvium overlie thick sequences of Paleozoic sedimentary rock throughout most of Illinois. Bedrock aquifers within 50 mi of the EGC ESP Site are shown in [Figure 2.4-16](#). The description and characteristics of the geologic and hydrogeologic systems in the vicinity of the site are

summarized in [Table 2.4-15](#).

The aquifer systems within 50 mi of the site are found in the following geologic environments, in descending order ([CPS, 2002](#)).

- Alluvial deposits along streams;
- Glacial drift including layers and lenses of sand and gravel within and between the various tills;
- Glacial outwash (Kansan Stage) in buried bedrock valleys;
- Bedrock of Pennsylvanian-age, consisting of shale, siltstone, limestone, sandstone, underclay, and coal;
- Bedrock of Silurian-age, Devonian-age, and Mississippian-age, predominantly dolomites and limestones; and
- Bedrock of Cambrian-Ordovician-age, consisting of a sequence of limestone, dolomites, and sandstones.

According to the USEPA, none of the aquifers occurring within a 50 mi radius of the site have been designated as “sole source” aquifers ([USEPA, 2002](#)).

Groundwater supplies are obtained chiefly from the glacial outwash in the buried bedrock valleys and shallower unconsolidated deposits. In addition, they are obtained, to a minor extent, from the upper 100 ft of the Pennsylvanian rock sequence beneath the glacial drift. In DeWitt County, the lower bedrock aquifers are not typically used for water supply because adequate supplies for municipal, agricultural, and domestic requirements are more easily obtained from the shallower bedrock or the overlying unconsolidated materials. Poor water quality in the deeper aquifers is also typical in this region ([CPS, 2002](#)).

The various aquifer systems are described in the following sections ([CPS, 2002](#)).

Alluvial deposits, consisting of varying amounts of clay, silt, sand, and gravel occur in the valleys of many streams in the regional area. The alluvium may be used for groundwater supply in those areas, where thick, permeable sand and gravel deposits are present. Such deposits commonly occur along larger streams having established floodplains, such as Salt Creek and North Fork of Salt Creek. Alluvial aquifers are not used extensively in the regional area because the floodplain areas have undergone only minor development.

The public water supply for Heyworth, in McLean County, is obtained from alluvial deposits along Kickapoo Creek. Pumping tests show the aquifer at this location to be capable of supplying over 200 gpm per well.

With the exception of the surficial alluvium in present stream valleys, the regional area is underlain by a thick sequence of silts of eolian and lacustrine origin, tills, and outwash. This sequence of Wisconsinian-aged, Illinoian-aged, and Kansan-aged deposits are collectively referred to as glacial drift. The total thickness of these deposits varies from less than 50 ft to approximately 400 ft, and averages 200 ft. The silts are often clayey and may contain fine sand. The tills are composed of heterogeneous mixtures of clay, silts, sand, and gravel, but consist predominantly of clayey silts or silty clays. Lenses, and thin discontinuous layers of

silt, sand, or gravel are common between and within the tills. Outwash deposits consist of sand and gravel with varying amounts of silt or clay.

Availability of groundwater from the unconsolidated material is governed by the occurrence of permeable sand and gravel deposits within the glacial drift and recharge sources. Sand and gravel deposits may occur above or below the individual tills, as lenses within the tills, or as relatively continuous deposits in bedrock valleys.

The Wisconsinan formations are generally composed of fine-grained sediments with only shallow and very localized deposits of sand and gravel. Thus, they are poor sources of groundwater.

Widespread lenses of sand and gravel intercalated in the Illinoian drift are capable of supplying small to moderate amounts of groundwater. Sand and gravel deposits in the Kansan-aged drift occur primarily as outwash deposits in buried bedrock valleys. The axes of the bedrock valleys in central Illinois are shown in [Figure 2.4-17](#). Specifically important to this area are the Mahomet and Mackinaw bedrock valleys, which are filled with sand and gravel ([USGS, 1995a](#)). Deposits filling the valley include the widespread Mahomet Sand Member, and are as much as 200 ft thick ([Kempton et. al, 1991](#)). With hydraulic conductivities as high as  $2.0E-04$  cm/sec (570 ft/day), a gradient of 0.0002 ft/ft, and an assumed porosity of 0.25, average linear groundwater velocities in this material are estimated at 0.45 ft/day. Aquifers associated with the Mahomet Bedrock Valley and the ancient Mississippi Bedrock Valley are the only highly productive, nonalluvial sand and gravel aquifers in southern Illinois. Forty municipalities and water districts obtained groundwater from these aquifers as of 1991. The largest groundwater withdrawals from the valley aquifer occur in the Champaign-Urbana area, averaging 17 mgd ([Kempton et. al, 1991](#)).

Groundwater in the Illinoian and Kansan deposits occur under artesian conditions, whereas, in the Wisconsinan deposits, water table conditions generally prevail (see [Figure 2.4-18](#)). Wells in the outwash near the margins of the bedrock valleys may produce as much as 500 gpm. Wells located in the center of the valleys might yield substantially higher quantities of groundwater on a sustained basis given proper well construction and management. Most wells in this area do not produce from this deep outwash because adequate supplies for domestic, agricultural, and most municipal purposes may be developed from the shallow alluvium along stream courses or from small permeable lenses in the upper glacial drift materials ([CPS, 2002](#)).

Groundwater in the glacial drift is derived from precipitation, underflow through bedrock and bedrock valleys, and induced infiltration from streambeds. Recharge to the sand and gravel deposits occurs primarily by vertical leakage of infiltrating precipitation, the rate of which is controlled by the vertical permeability of the relatively impermeable tills, the thickness of the tills (confining beds), and the head differential between the source of recharge and the receiving aquifer. Vertical permeability for till with some sand and gravel averages 0.02 gallons per day per square foot (gpd/ft<sup>2</sup>). The recharge rate for sand and gravel aquifers overlain by thick glacial drift consisting largely of till is estimated to be 115,000 gpd/mi<sup>2</sup>. The recharge rate for the Kansan glacial deposits is estimated to be 107,000 gpd/mi<sup>2</sup> ([CPS, 1982](#)).

Groundwater in the glacial drift aquifers is discharged to streams that intersect the aquifers (base flow), to the underlying glacial drift, to the Pennsylvanian bedrock, and to pumping wells. Groundwater base flow for the upper portion of the Salt Creek drainage basin, calculated from hydrologic data collected at the Rowell Gauging Station, averages 0.36 cfs/mi<sup>2</sup> for years that have near-normal precipitation. Groundwater base flow averages 0.13 cfs/mi<sup>2</sup> for years that have below-normal precipitation and 0.58 cfs/mi<sup>2</sup> for years that have above-normal precipitation. In alluvial deposits, bank storage accounts for much of the variability in observed values of groundwater runoff between years of below-normal and above-normal precipitation (CPS, 2002).

Bedrock aquifers within the 50 mi radius of the site are shown in Figure 2.4-16. Most of the glacial drift in the study area is underlain by Pennsylvanian bedrock that consists largely of shale and siltstone interbedded with limestone, sandstone, underclay, and coal. Small amounts of groundwater may be obtained from wells penetrating beds of sandstone, creviced limestone, and fractured shale and coal. Recharge to the Pennsylvanian bedrock occurs by vertical leakage from the overlying glacial drift. Groundwater in the bedrock is under artesian conditions and is discharged to lower bedrock formations or to the glacial drift in those areas where the potentiometric surface of the Pennsylvanian aquifers is higher than that of the drift aquifers. Most wells in the Pennsylvanian bedrock extend less than 100 ft below the bedrock surface because the formations become tighter and mineralization of the groundwater increases with depth. Bedrock is used as a source of domestic water supply in the regional area only where conditions are unfavorable for the development of drift aquifers. The USGS reports that yield of wells in the Pennsylvanian aquifers range from less than 1 to about 100 gpm, with an average well yield of about 10 gpm (USGS, 1995a). Fresh groundwater withdrawals from these aquifers during 1985 accounted for less than 4 percent of the total withdrawals in Illinois.

Bedrock aquifers of the Mississippian-age or Silurian-Devonian-age occur beneath the unconsolidated deposits in the northeast portion of the study area (Figure 2.4-16). Mississippian rocks that are aquifers are generally comprised of thick-bedded limestone and sandstone. However, these aquifers are typically used for water supply when they are less than 200 ft below land surface, and when more water can be obtained from them than from the overlying surficial aquifer system. Water is typically under confined conditions where the water-yielding zones lie beneath clay or shale beds. Recharge to the Mississippian aquifers occurs primarily by water that percolates downward through the unconsolidated materials and the Pennsylvanian bedrock, if present. Reported well yields range from 1 gpm to 100 gpm, with an average of about 10 gpm. Fresh groundwater withdrawals from the Mississippian aquifers during 1985 were less than 3 percent of the total groundwater withdrawn in Illinois (USGS, 1995a).

Dolomites and limestone of Silurian-Devonian-age also constitute some of the aquifers in the northeast portion of the study area (see Figure 2.4-16). The aquifer portion of the rock lies beneath the upper Devonian shale, Mississippian rocks, or Quaternary deposits. This aquifer generally contains freshwater where the aquifer is between land surface and about 500 ft below the land surface. The base of freshwater coincides approximately with the base of the aquifer. Underlying Ordovician shale impedes the downward movement of freshwater. Groundwater is generally under confined conditions and moves through fractures, bedding planes, and solution cavities. Probable well yields in the study area,

where this aquifer is used, range from less than 250 gpm to 500 gpm. In 1985, withdrawals from the Silurian-Devonian aquifer account for about 15 percent of the total groundwater withdrawn in Illinois (USGS, 1995a).

#### 2.4.13.1.3 Site Hydrogeologic Systems

The hydrogeologic systems in the site area consist of alluvial deposits along Salt Creek and North Fork of Salt Creek, glacial drift, glacial outwash in the buried Mahomet Bedrock Valley, and Pennsylvanian-age bedrock. General occurrence and characteristics of yield, recharge, and discharge of these systems are discussed in the previous section. The data presented in this section are mainly based upon site investigations conducted for the CPS Facility and are summarized in the CPS USAR (CPS, 2002). In July and August 2002, a limited geological investigation was conducted within the proposed area of the plant to confirm that the underlying subsurface conditions are consistent with those presented in the CPS USAR.

Alluvial deposits (Henry Formation) were encountered in the vicinity of the UHS for the CPS Facility consisting of fine-grained floodplain deposits overlying coarse-grained outwash. Illinoian till (Glasford Formation) underlies the alluvial deposits. The floodplain deposits are commonly silt with some fine sand and clay, whereas the outwash deposits are sand and gravel with varying amounts of silt or clay. The total thickness of the alluvial deposits varies from 6 ft to 48 ft in the UHS borings, and it averages about 18.5 ft. Floodplain deposits range to a maximum thickness of 23 ft and averages about 9 ft. Outwash deposits range to a maximum of 41 ft thick and averages about 9 ft thick; the thickest outwash deposits are located over an apparent terrace on the north side of the valley. Outwash deposits were observed to be continuous in the foundation excavation for the UHS dam. The base of the outwash that was observed in the borings ranges in elevation from 650.5 ft above msl to 678.3 ft above msl, with the most frequently reported base elevations in the interval between 657 ft above msl and 667 ft above msl. Permeability tests were not performed in the UHS borings. However, based upon the results of particle-size analyses for samples from the borings, the permeability of the outwash deposits is approximately  $10^{-3}$  to  $10^{-2}$  cm/sec (2.8 to 28 ft/day). There were no known domestic or farm supply wells in the alluvial deposits in the CPS Facility's UHS area (CPS, 2002).

The CPS Facility excavation exposed the sequence of glacial drift consisting of the Wisconsinan-age Richland Loess, Wedron Formation, and Robein Silt; and the Illinoian-age Glasford Formation. Based on the CPS Facility's borings, the elevation of the top of the Illinoian deposits averaged 698 ft above msl. Fifteen deep borings in the CPS Facility and UHS areas encountered lacustrine deposits and Kansan-age till beneath the Illinoian drift at an average elevation of 572 ft above msl. The total thickness of the glacial drift in the CPS Facility area varies from 230 ft to 250 ft and averages about 237 ft (CPS, 2002). The lithologies of these stratigraphic units are summarized in Table 2.4-15.

Several discontinuous sand lenses, ranging in thickness from several in to 22 ft, were encountered by the CPS Site borings between an elevation of 650 ft above msl and 730 ft above msl. The CPS Facility excavation that extended to an elevation of about 680 ft above msl penetrated some of these lenses. The majority of the sand deposits encountered are discontinuous pockets or lenses. The one exception is a nearly continuous layer of fine sand near the top of the Wedron Formation. Sand is reported at the same position in most of the

borings around the plant except those within the triangular area formed by the UHS baffle dike abutment, the screen house, and the southwest corner of the excavation. In general, the base of the sand layer slopes from an elevation of 723 ft above msl at the western limit of the excavation to an elevation of 716 ft above msl on the slope above the cooling lake. In borings, between the excavation and the cooling lake, the thickness of the sand layer varies from 2.0 ft to 16.5 ft. The remainder of the sand deposits encountered occurred as discontinuous seams and localized pockets within the tills of the Wedron and Glasford Formations (CPS, 2002).

Four additional soil borings were advanced in July and August 2002, within the footprint for EGC ESP Facility. These borings confirm that the general stratigraphic sequence depicted in Figure 2.4-18 continues south of the CPS Facility. Two of these borings extend into the Pennsylvanian bedrock. In these borings, unconsolidated deposits encountered include the Richland Loess, the Wedron Formation (Wisconsinan glacial till and outwash), the Robien Silt (Interglacial Zone), the Glasford Formation (Illinoian glacial till and outwash), lacustrine deposits, the Banner Formation (pre-Illinoian glacial till and outwash), and pre-Illinoian alluvial deposits. The continuous fine sand deposit noted in previous site borings near the top of the Wedron Formation apparently continues south of the CPS Facility, tapering out to the southeast. The top of the Glasford Formation drops toward the south, to an average elevation of 678 ft above msl in the four additional borings. Lacustrine deposits were encountered below the Glasford Formation at elevations (566 ft above msl and 574 ft above msl) consistent with previous site borings. Pre-Illinoian alluvial deposits, consisting of interbedded silts, clays, sands, and gravels, were encountered above the top of the bedrock.

The additional borings indicate that the bedrock surface dips to the south of the CPS Facility, from west to east. The top of bedrock was encountered at elevations of 446 ft above msl and 448 ft above msl in these borings, approximately 35 ft lower than at previous site borings to the north and west. This bedrock valley is filled with pre-Illinoian alluvial deposits. The upper 20 ft to 30 ft of bedrock was cored, and consists of interbedded shale, limestone, and siltstone. A 1 ft thick layer of coal was encountered in one coring.

### 2.4.13.2 Sources

#### 2.4.13.2.1 Present and Future Groundwater Use

Public water supplies in the regional area are derived mainly from groundwater sources. The ISGS GIS database was used to identify water supply and water wells within a 15 mi radius of the site (ISGS, 2002). These wells are shown in Figure 2.4-19.

The CPS USAR reported that within 15 mi of the site, approximately 65 percent of the total public groundwater supplies are pumped from the Mahomet Bedrock Valley aquifer. Except for the alluvial wells at Heyworth, the remaining public water supplies are pumped from wells in the Wisconsinan, Illinoian, and Kansan glacial deposits. Bedrock wells are not used in any of the public water supply systems within 15 mi of the site (CPS, 2002).

The database, maintained by the ISGS, identifies approximately 179 water wells and 18 water test holes within 5 mi of the site. Approximately 40 percent of the records, for many of these wells, were filed before 1980 and a substantial number may no longer be in use. The available data indicate that the depths of the water wells and water test holes range

from 36 ft to 413 ft below ground surface. Four wells with depths greater than 400 ft, 12 water wells, and two additional water test holes are owned by Clinton Power Station and occur within a 5 mi radius of the site (ISGS, 2002). The USAR identifies a small test well located about one mile south of the CPS site, 120 feet southeast of the CPS test well, that will be used as a water supply well for the village of DeWitt (see Figure 2.4-20). The well is about 340 feet deep and the produces water from the sand and gravel deposits of the buried Mahomet Bedrock Valley at a depth of 300 to 340 ft (CPS 2002).

Most of the domestic wells are less than 150 ft deep and produce from sand lenses in the upper glacial tills rather than from the deeper Mahomet Bedrock Valley aquifer. Production exceeded 10 gpm in only a few cases. With the exception of wells used by tenant farmers or for monitoring, wells on the site property were abandoned and sealed in accordance with applicable state requirements during plant construction (CPS, 2002).

The area within 15 mi of the site includes most of DeWitt County and portions of Macon, McLean, and Piatt counties (see Figure 2.4-19). Available groundwater supplies for DeWitt County exceed 39 mgd (CPS, 2002). In 1995, public groundwater withdrawals totaled 1.48 mgd in DeWitt County; see Table 2.4-16 (USGS, 1995b). The USGS reported in 1995 that the rural groundwater use in the county was approximately 0.4 MGD. This indicates that the present water demands are less than 2 mgd, or approximately 5 percent of the total available supplies. Thus, groundwater is capable of meeting any foreseeable increase in water demand in DeWitt County. Similar conclusions may be drawn for the rest of the regional area since the hydrogeologic and population characteristics of the other counties are similar to those for DeWitt County.

#### 2.4.13.2.2 Regional Hydrogeologic Conditions

The Wisconsinan formations are generally composed of fine-grained sediments with only shallow and very localized deposits of sand and gravel. Thus, they are poor sources of groundwater. The water table in the upper (Wisconsinan) glacial deposits generally occurs within a few feet of the ground surface. Groundwater levels are deepest over topographically high areas and shallowest in topographically low or flat areas. Groundwater levels have been measured regionally by the ISWS in a statewide network of observation wells. The water table in wells, finished in Wisconsinan deposits, varies from 2 ft to 19 ft below the ground surface. Seasonal fluctuations in individual observation wells range from 1.5 ft to 12 ft and averages approximately 5 ft. Water levels are highest during spring when conditions are most favorable for recharge from precipitation. The water table falls from the spring peak during late spring, summer, and early fall when discharge by evapotranspiration and groundwater runoff exceeds recharge from precipitation. Regional groundwater movement on the Wisconsinan till plain is generally west and southwest toward the Illinois River, under a hydraulic gradient of approximately 2 ft/mi or 3 ft/mi. The water table is locally deflected and steepened toward stream courses that cross the till plain, and are tributaries to the Illinois River (CPS, 2002).

Reversals in the regional hydraulic gradient and regional declines in the potentiometric surface have resulted from intensive pumping in the heavily urbanized Champaign-Urbana district, 32 mi to the east, where pumpage is from the Mahomet Bedrock Valley aquifer. Although no positive evidence of these effects was identified in the CPS USAR for DeWitt County, declines may eventually occur in the eastern portion of the county if pumpage

continues to increase in the Champaign-Urbana district (CPS, 2002). These declines will probably not be significant at the site and no changes in the local pattern of groundwater movement are expected to occur.

In DeWitt County, reversals in the hydraulic gradient may also be expected to occur in response to pumping from the City of Clinton municipal well field. Lower potentiometric levels within the cone of influence induce higher recharge rates to the Mahomet Bedrock Valley aquifer. In turn, this may cause potentiometric levels in the overlying aquifers to decline slightly within the cone of influence. However, the cone of influence associated with the City of Clinton municipal well field is much smaller than the cone developed around Champaign-Urbana because pumping at Clinton totals less than one-tenth of that at Champaign-Urbana. The cone of influence at Clinton is likely limited to an area within a few miles of the well field and will have little, if any, effect on groundwater levels at the site. In addition, the main plant borings indicated the buried Mahomet Bedrock Valley is not present beneath the site (CPS, 2002).

#### 2.4.13.2.3 Site Hydrogeologic Conditions

Configuration of the water table in the immediate vicinity of the site was established by measuring water levels in piezometers installed in selected borings during the CPS Site investigations conducted in 1972 and 1973. Additional piezometers were installed in 1976 around the lake during construction (OW-1 through OW-8) and downstream from the dam in 1977 and 1979 (OW-9 through OW-24). Some of the piezometers having been destroyed by construction activities are no longer functional (CPS, 2002). A summary of the installation dates, tested intervals, and status of the piezometers is presented in Table 2.4-17.

Based on the data presented in the CPS USAR, the groundwater table in the upper glacial deposits (Wisconsinan) generally occurs a few feet below the ground surface (CPS, 2002). The highest groundwater level in the CPS Facility area measured during previous investigations was at an elevation of 729.7 ft above msl. The design ground water level for the EGC ESP Site is taken as 730 ft above msl. The water table in the vicinity of the CPS Facility occurs as a ridge-like mound in the Wisconsinan till between Salt Creek and North Fork of Salt Creek (see Figure 2.4-20). The position of the groundwater ridge marks a recharge area from which groundwater flows to the southeast toward Salt Creek and to the northwest, across the plant site, toward North Fork of Salt Creek. The magnitude of the hydraulic gradient at the plant site is approximately 0.09 ft/ft, or 450 ft/mi. This value is based upon a maximum head loss of 55 ft over a minimum distance of 640 ft from the plant site to the edge of the floodplain of North Fork of Salt Creek (CPS, 1982).

Prior to impoundment of the cooling lake, North Fork of Salt Creek served as the local base level for groundwater flow from the plant area to the floodplain. Impoundment of the cooling lake has raised the base level to an elevation of 690 ft above msl, causing the groundwater-surface water interface to shift to the southeast toward the plant (CPS, 1982).

Groundwater exists under water table conditions in the Wisconsinan till and under confinement in the underlying Illinoian and Kansan tills. Piezometer levels measured for the CPS Site investigation ranged from 675 ft above msl to 717 ft above msl and averaged at an elevation of about 713 ft above msl in the Illinoian till. In addition, the piezometer levels measured approximately at an elevation of 680 ft above msl in the Kansan till over a three yr

period of observation in the late 1970s. The potentiometric level in the Kansan outwash deposits of the buried Mahomet Bedrock Valley, as measured in the CPS Facility's test well, was at an elevation of approximately 600 ft above msl (CPS, 2002). The head relationships between the Wisconsinan, Illinoian, and Kansan aquifers indicate that the glacial drift aquifers are recharged by vertical seepage from the overlying drift under a net downward hydraulic gradient (CPS, 2002).

Three additional piezometers were installed southwest of the CPS Facility in July of 2002. Two of these piezometers were completed in the upper Wisconsinan glacial deposits (Wedron Formation), and the third was completed in the upper Illinoian glacial deposits (Glasford Formation). In these additional piezometers, water table elevations in the Wedron Formation were between 725 ft above msl and 730 ft above msl, and the piezometric head elevation in the Glasford Formation was approximately 710 ft above msl. These measurements are generally consistent with groundwater elevations observed in previous site investigations.

A correlation between daily precipitation volumes and groundwater elevations in site piezometers is not evident from a qualitative review of the figures presenting this data in the CPS USAR. "Typical" seasonal variations (higher groundwater levels in the spring, lower groundwater levels in the fall and summer) are also not apparent. These conditions are consistent with the fine-grained nature of much of the glacial drift that inhibits groundwater flow and, therefore, recharge velocity.

Some groundwater in the upper glacial drift deposits are discharged into streams from springs present within the general vicinity of the CPS Facility and Clinton Lake. As part of the CPS site investigations, a survey was conducted by use of air photo interpretations, field reconnaissance, and personal interviews with local farmers in order to locate springs in the vicinity of the site. The springs found during this survey are shown in Figure 2.4-21. None of these springs are currently being used as a potable water supply (CPS, 2002).

Falling-head and constant-head-type permeability tests were performed in the laboratory on representative soil samples of the Salt Creek Alluvium (Henry Formation), the interglacial zone (weathered material at the top of Illinoian deposits and the bottom of the Wisconsinan till deposits), and the Illinoian glacial till (the Glasford Formation). The tests resulted in measurements of the vertical permeability of each soil formation. The results of these tests are presented in Table 2.4-18. Only one sample of the Salt Creek Alluvium was tested, the results of which indicate a vertical permeability of  $1.0\text{E-}08$  cm/sec ( $5.1\text{E-}05$  ft/day) for the fine-grained floodplain deposits; the underlying outwash was not tested. Vertical permeability of sand samples from the interglacial zone (weathered portion of the Glasford Formation) averages  $2.1\text{E-}03$  cm/sec (6 ft/day), ranging from  $1.8\text{E-}04$  cm/sec (0.5 ft/day) to  $4.7\text{E-}03$  cm/sec (13 ft/day). In the Illinoian deposits (unaltered Glasford Formation), the vertical permeability ranges from  $3.8\text{E-}09$  cm/sec ( $1.1\text{E-}05$  ft/day) to  $2.3\text{E-}07$  cm/sec ( $6.5\text{E-}04$  ft/day), and averages  $3.8\text{E-}08$  cm/sec ( $1.1\text{E-}04$  ft/day). Also presented in Table 2.4-18 is an estimate of the porosity for each sample. The porosity was calculated using laboratory data that included degree of saturation, wet density, moisture content, and an assumed specific gravity (CPS, 2002).

During the CPS site investigations, falling-head-type field permeability tests were also performed on samples collected from the Clinton Lake Dam Site and the CPS Site. The tests

were performed in piezometers to estimate average horizontal permeability within the zone of percolation in the borehole, and the results are provided in [Table 2.4-19](#). Average horizontal permeability values range from 1.5E-06 cm/sec (3.4E-03 ft/day) to 2.6E-06 cm/sec (0.01 ft/day) in the Wisconsinan till and 6.1E-06 cm/sec (0.02 ft/day) to 1.4E-05 cm/sec (0.04 ft/day) in the Illinoian till ([CPS, 2002](#)).

Using a hydraulic conductivity of 2.6E-06 cm/sec (0.01 ft/day) from field hydraulic conductivity testing of the Wisconsinan till, a water table gradient of 0.086, and an assumed porosity of 0.25 (based on one value provided for the Wisconsinan till in the USAR report ([CPS, 2002](#)); the estimated average linear groundwater velocity for the upper portion of the Wisconsinan till is 2.5E-03 ft/day. Additional laboratory data for Wisconsinan glacial till and Mahomet Bedrock Valley Outwash are provided in [Tables 2.4-20](#) and [2.4-21](#), respectively.

### 2.4.13.3 Accident Effects

Following the approach used in the CPS USAR ([CPS, 2002](#)), the potential impact of a postulated accidental release of radioactive liquids is evaluated assuming that coincident with the failure of the tank, the walls and foundation of the cubicle in which the tank is located develop cracks through which direct communication is established between the interior of the building and the surrounding groundwater environment. The level of radioactive liquids in the building would have to exceed the groundwater level at the plant before seepage out of the building could occur.

The USAR indicates that the design basis for hydrostatic loading on the power plant foundation for the CPS of 730 ft above msl is based on the highest groundwater level (729.7 ft above msl) measured in the Wisconsinan deposits during site investigations. The water table in individual wells, finished in Wisconsinan deposits, were observed to vary seasonally from 1.5 ft to 12 ft and averaged approximately 5 ft ([CPS, 2002](#)). Based on the maximum seasonal variation reported in the CPS USAR of 12 ft, the lowest water levels in the Wisconsinan deposits encountered were at about elevation 718 ft above msl or about 18 ft below the CPS grade elevation of 736 ft above msl. Grade elevation for the EGC ESP Facility is approximately 735 ft above msl. Similar, to the existing Clinton Power Facility, this conservative (lower) groundwater elevation is expected to be higher than the fluid level inside the EGC ESP Facility buildings where radioactive liquids are collected and stored. Therefore, there would be no hydraulic gradient from the interior to the outside and rather than fluids leaking out, groundwater would be forced into the building to relieve the prevailing hydrostatic pressure. Thus, it is extremely unlikely that any radioactive liquids would be released to the surrounding groundwater environment.

Based on the maximum embedment depth of up to approximately 140 ft (elevation 595 ft above msl), a portion of the power plant foundation will be in the Illinoian till. Groundwater in the Illinoian till exists under confined conditions with piezometer levels measured during the CPS Site investigation with elevations from 675 ft above msl to 717 ft above msl, with an average of 713 ft above msl. Thus, piezometric levels in the deeper formations will also limit the potential for radioactive liquids to seep out of the lower portions of the building.

If liquid waste storage tanks are located in structures above grade, it is assumed following a postulated tank failure that the contents would ultimately reach the lower elevations of the buildings and would also be contained therein due to high ambient groundwater level.

For tanks located outside of structures which potentially contain radioactive fluids, positive means to collect and prevent uncontrolled releases such as dikes and collection basins will be provided, thereby, eliminating them from consideration as a source for groundwater contamination.

#### **2.4.13.4 Monitoring**

Groundwater levels in the vicinity of Clinton Lake and the CPS Facility have been monitored intermittently since site investigations began in 1972. The present groundwater monitoring system is described in [Section 2.4.13.2.3](#). A Pre-application Monitoring Program for groundwater will be used to support the assessment of site acceptability and to identify the groundwater system impacts that could result from construction and operation of the EGC ESP Facility. A Construction Hydrologic Monitoring Program for groundwater will monitor and provide for control of anticipated impacts from site preparation and construction and to detect any unexpected impacts arising from the construction activities. A Preoperational Monitoring Program will provide the database for evaluating hydrologic changes arising from the operation of the EGC ESP Facility. A limited Operational Hydrologic Monitoring Program will be implemented in order to establish the impacts to the groundwater system from the operation of the EGC ESP Facility and detect any unexpected impacts from plant operation.

#### **2.4.13.5 Design Bases for Subsurface Hydrostatic Loading**

Grade elevation for the EGC ESP Facility is approximately 735 ft above msl. The groundwater level site characteristic at the EGC ESP Site is established as 730 ft above msl (See [Section 2.4.13.2.3](#)) or 5 ft below grade (see [Table 1.4-1](#), [Section 1.4.2](#)).

#### **2.4.14 Technical Specification and Emergency Operation Requirements**

The EGC ESP Facility, together with its associated safety-related facilities, will be designed to function and shutdown in a safe manner despite the occurrence of any of the adverse hydrological events discussed in the preceding sections. Therefore, technical specifications outlining emergency procedures for plant shutdown due to hydrological conditions are not expected to be necessary.

## 2.5 Geology, Seismology, and Geotechnical Engineering<sup>1</sup>

### 2.5.1 Site and Regional Geology

This section of the SSAR presents a summary of the regional and site geology for the EGC ESP Site based on the results of a review of published literature dealing with regional and site geology for the area. The intent of this review is to address paragraph (vi) within 10 CFR 52.17 which requires “the seismic, meteorological, hydrologic, and geologic characteristics of the proposed site be provided in the proposed application.” As required by paragraph (c) of [10 CFR 100.23](#), the geologic characteristics of the EGC ESP Site are described:

- to allow an adequate evaluation of the proposed site,
- to provide sufficient information to support evaluations performed to arrive at estimates of the Safe Shutdown Earthquake Ground Motion, and
- to permit adequate engineering solutions to actual or potential geologic and seismic effects at the proposed site.

In addition and in accordance with paragraph (d) of [10 CFR 100.23](#), the discussions in [Sections 2.5.1.1](#) and [2.5.1.2](#) also cover geologic characteristics related to the evaluation of surface tectonic and nontectonic deformations, the design bases for seismically induced floods and water waves, and other design condition.

The EGC ESP Site is located within 700 ft of the CPS Site. In view of the proximity of the EGC ESP Site to the CPS Site, the starting point for the evaluation of regional and site geology was Section 2.5.1.1 and Section 2.5.1.2 of the CPS USAR – covering regional and site geology, respectively. Following the guidelines set forth in Regulatory Guide 1.132 ([USNRC, 1979](#)) and Regulatory Guide 1.165 ([USNRC, 1997](#)), an evaluation of the existing information and newly published information was conducted. Results of this evaluation are summarized in this section of the SSAR and discussed in more detail within [Section 5.1](#) of Appendix A - *Geotechnical Report for the EGC ESP* and within [Section 2.1](#) of Appendix B - *Seismic Hazard Report for the EGC ESP*. These discussions support a conclusion that both the regional

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#### <sup>1</sup> Preface to Section 2.5

The approach taken in Section 2.5 of the SSAR involves summarizing results of the work completed for the EGC ESP Site in Section 2.5 and presenting details in two appendices. This approach was taken because of the large amount of information developed as part of the EGC ESP application. Much of the information for Section 2.5 was developed to support the update of a probabilistic seismic hazard analysis (PSHA) that was conducted for the adjacent CPS Site in the mid-to-late 1980s (EPRI, 1989-1991). The PSHA for the CPS Site was updated as part of the EGC ESP application, in accordance with Regulatory Guide 1.165 ([USNRC, 1997](#)). Rather than presenting the details for the update in the main text of this SSAR, supporting details are given in the two appendices, and the presentation in Section 2.5 is limited to summaries of the methodologies followed and the conclusions reached in the areas of geology, seismology, and geotechnical engineering.

Either of two appendices to Section 2.5 of the SSAR should be consulted for details related to Section 2.5 of the EGC ESP application. The first appendix ([Appendix A – Geotechnical Report for the EGC ESP](#)) covers field explorations, laboratory testing, and engineering analyses completed as part of the EGC ESP Site work. The geotechnical work was conducted in support of the seismic hazard evaluation and to demonstrate similarity in geologic conditions between the EGC ESP and CPS Sites. The second appendix ([Appendix B - Seismic Hazard Report for the EGC ESP](#)) provides full details for the seismic hazard analyses. These details include updates to seismic source characterization information, ground motion models, rock spectra, ground surface spectra, and design basis spectra.

geology and the site geology at the EGC ESP Site are suitable for development and operation of a new EGC ESP Facility.

### 2.5.1.1 Regional Geology

The regional geologic information in Section 2.5.1.1 of the CPS USAR, as well as literature published since the preparation of the CPS USAR (which is discussed more fully in [Section 2.1](#) and [3.1](#) of Appendix B), indicate that the EGC ESP Site location in north central United States is one of the most geologically stable areas in the United States. The regional processes that led to current geologic conditions at the EGC ESP Site were the same as those at the CPS Site, and these conditions have remained much the same since the end of the last glaciation.

The available information indicate that the regional surface geology is dominated by relatively thin deposits of Quaternary glacial drift. During the Quaternary, widespread glacial deposition occurred in the regional area, as a result of continental glaciation. The Quaternary deposits are classified as part of the Pleistocene Series. The deposits consist predominantly of glacial or glacially-derived sediments of glacial till, outwash, loess (a wind-blown silt), and glaciolacustrine deposits, as well as alluvium. The same general depositional process would have occurred at the EGC ESP Site as at the CPS Site resulting in the same stratigraphic sequence. As discussed subsequently, results of explorations into rock located nearly 300 ft below the ground surface confirm the similarity in soil deposits at the EGC ESP Site and the CPS Site.

Past evaluations of the regional geology for the area have concluded that there were four major periods of glaciation during the Pleistocene time in the regional area. From youngest to oldest, these periods are known as the Wisconsinan, Illinoian, Kansan, and Nebraskan Stages. Wisconsinan deposits are found throughout the EGC ESP and CPS Sites. Illinoian age deposits are present beyond the limit of Wisconsinan glaciation in northern and central Illinois. Illinoian age deposits are also found beneath the Wisconsinan drift cover. Kansan and Nebraskan age glacial deposits are present at the surface and in the subsurface in areas of Iowa, Missouri, and parts of western and east-central Illinois. These glacial periods resulted in significant ice loading to surficial sediments at the EGC ESP and CPS Sites, which has served to reduce local variations in certain soil properties (for example, soil density, void ratio, and overconsolidation ratio) that influence seismic wave propagation and foundation stability.

The available literature also indicates that most of the regional Quaternary glacial materials are underlain by thick sequences of gently dipping Paleozoic sedimentary rock, although Mesozoic and Cenozoic age deposits lie above Paleozoic rock in a few areas in the Mississippi Embayment, western Illinois, eastern Missouri, and southern Indiana. The bedrock surface throughout much of Illinois is of Paleozoic-age, Pennsylvanian bedrock that ranges from hundreds to thousands of feet in thickness. The Paleozoic sedimentary rock sequence is punctuated by several unconformities of regional importance, reflecting widespread advances and withdrawals of the Paleozoic seas across the interior of North America. Older Paleozoic bedrock up to thousands of feet thick underlay Pennsylvanian bedrock. The thickness of bedrock sequences is dependant on original deposition and subsequent erosion, and Paleozoic bedrock is significantly thicker at the center of structural basins such as the Illinois Basin. Beneath the Paleozoic is a basement complex of

Precambrian igneous and metamorphic rock. Basement Precambrian igneous rock is found from 2,000 to 13,000 feet below the ground surface.

Intermittent slow subsidence and gentle uplift through the Paleozoic have resulted in broad regional geologic basins of gently dipping sedimentary rocks, and intervening broad arches or highs. Locally, folds and faults have been superimposed on this pattern. The CPS and EGC ESP Sites are located on the northwest flank of the Illinois Basin, slightly west of the LaSalle Anticlinal Belt or the LaSalle anticlinorium ([Figure 2.5-1](#)).

The review of recent literature also determined that there has been no significant change in the understanding of the regional geology in the area since the first regional geologic studies were completed for the CPS Site. More recent information has become available for the Mahomet Bedrock Valley. This information indicates that glacial materials proximate to the site are dominated by fine-grained silts and clays. Therefore, conditions are consistent with geologic profiles described in the CPS USAR and encountered during explorations at the EGC ESP Site.

It was concluded from the review of the regional geology information in the CPS USAR and in more recent publications for the general region that there are no regional geologic conditions, other than seismicity, which constitute a hazard that could affect construction or operation of the EGC ESP Facility. From a regional geologic standpoint, the site is judged suitable for the proposed development.

### 2.5.1.2 Site Geology

The ground surface topography in the vicinity of the EGC ESP Site is relatively flat, ranging from approximately 730 to 740 ft above mean sea level (msl). The closest distance to Clinton Lake is approximately 800 ft northwest of the EGC ESP Site. Generally, the ground surface at the site is covered by grasses and small bushes, and is transected by a grid of gravel access roads and associated drainage ditches. Localized clusters of small trees are present in some areas. The site is currently clear of construction, except for a fenced-in storage yard and a buried power line. Some remnants of surface grading, filling, and building demolition operations from the construction of the CPS Facility are present at the EGC ESP Site.

The available information in the CPS USAR and the new information collected and reviewed as part of the EGC ESP Site evaluation confirmed that the EGC ESP Site is located in a tectonically stable area of North America. There is no evidence of surface faulting within 25 mi of the EGC ESP Site. Additional discussion of active faulting for the project region is summarized in [Section 2.5.3](#) of this SSAR and described in detail in [Chapter 5](#) of [Appendix B](#).

Approximately 170 to 360 ft of Quaternary deposits overlie an irregular Pennsylvanian bedrock surface within the general CPS and EGC ESP Site areas. The bedrock is largely erosional in origin and characterized by valleys (such as the Mahomet Bedrock Valley) and uplands that developed before glacial time. Similar to the CPS Site, the EGC ESP Site is located a few miles inside the limits of the Wisconsinan glaciation, and is located in the Bloomington Ridged Plain physiographic subsection of the Till Plains section in Central Illinois ([Figure 2.5-2](#)).

Surficial deposits in the upland areas consist of a veneer of Richland loess over glacial till of

the Wedron Formation, both of the Woodfordian substage of the late Wisconsinan Stage. Other stratigraphic units in the upland area, with increasing depth, consist of the organic Robien silt (of the Farmdalian substage of the Wisconsinan Stage), reworked and weathered Glasford Formation glacial till of the Illinoian Stage (also referred to as the Sangamonian substage Interglacial Zone on CPS Site borehole logs), and unweathered Glasford Formation till. Beneath the Glasford Formation lie Yarmouthian Stage lacustrine deposits and pre-Illinoian Stage glacial tills (Figure 2.5-3).

In areas of low bedrock elevation in the vicinity, sandy glacial outwash of the Kansan Stage (likely the Mahomet Sand Member of the Banner Formation) is present above bedrock. However, because of a local bedrock high, the Mahomet sands are not present at the EGC ESP and CPS Sites. Rather, fine-grained alluvial soils associated with pre-Illinoian glaciations are typically present in immediate contact with bedrock.

With the exception of the upper few tens of feet, soils have been subjected to ice loads from glaciations. These loads have compressed the soils, resulting in a very hard or dense consistency of the soil. Both the EGC ESP and CPS Sites have been affected similarly by the glacial loading.

Bedrock in the vicinity of the EGC ESP and CPS Sites is Pennsylvanian age, and belongs to the Bond and Modesto Formations of the McCleansboro Group. These formations generally consist of alternating bands of limestone, shale, siltstone, sandstone, and some coal seams. The base of the Bond Formation is marked by the Shoal Creek Limestone Member, which corresponds to the top of the Modesto Formation at an approximate elevation of 495 ft msl at the CPS Site. The No. 8 Coal Member within the Modesto Formation was encountered as a 1-ft thick layer at borehole P-38 during the original CPS Site investigation (at an elevation of 431 ft msl).

The long-term location of groundwater is approximately 30 ft below the ground surface at the EGC ESP Site, similar to the CPS Site. Groundwater is also encountered perched on low-permeability layers within the upper 30 ft of soil profile. The location and thickness of the perched layers vary according to the time of year and surface topography. Additional discussions of groundwater are presented in Section 2.4.13 of this SSAR and in Section 2.4 of the CPS USAR.

More detailed descriptions of the site physiography, stratigraphy, structural geology, surficial geology, geologic history, groundwater conditions, and geologic considerations are summarized in Sections 2.1 and 5.1 of Appendix A and in Section 2.5.1.2 of the CPS USAR. The information in Appendix A includes results of the EGC ESP Site evaluation of published literature that has been written since the original site geology work was completed for the CPS Site. This newer literature includes geologic hazard reports prepared by the Illinois State Geological Survey (ISGS) for DeWitt and surrounding counties, as well as soils information obtained by drilling and sampling four boreholes within the footprint of the EGC ESP Site<sup>2</sup>. Results of the soils exploration were also reviewed and compared to geologic descriptions that are given for the CPS Site. During the review of published geologic information, particular emphasis was placed on identification of new geologic

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<sup>2</sup> Results of field explorations conducted for the EGC ESP Site are summarized in Section 2.5.4.3 of this SSAR and described in detail in Appendix A.

hazards that may have been reported in the area since the publication of the CPS USAR in the 1970s.

It was concluded from the review of site geology for the EGC ESP Site that:

- The physiography of the EGC ESP Site is the same as the CPS Site. As noted above and in the discussion in [Appendix A](#), the sites are within 700 ft of each other and the ground surface is relatively level. Therefore, similar physiography is to be expected.
- Site stratigraphy across the EGC ESP and CPS Sites is very similar in terms of soil consistency and layering. The primary difference between the two sites is that the depth to bedrock is approximately 50 ft deeper at the EGC ESP Site than at the CPS Site. Otherwise, the overburden and bedrock formations are the same.
- The understanding of site geologic history has not changed since the original site geology work was done for the CPS Site. This history indicates that most of the soil profile was formed during past glaciations, and much has been over-ridden by the glaciers, resulting in very hard or dense soil conditions.
- Site groundwater conditions are consistent with previous reports that have been prepared since the filling of Clinton Lake. The groundwater piezometric surface within the Illinoian till is approximately 30 ft below the ground surface, and perched groundwater is located above this depth.
- There are no other geologic considerations, such as karst terrain, mine subsidence, natural gas and oil field production, groundwater springs, and landslides that pose a hazard to the construction or operation of a new generating system at the EGC ESP Site.

These conclusions indicate that no geologic conditions were found at the site that result in a hazard which could affect construction or operation of the EGC ESP Facility. From a site geology point-of-view, the site is judged suitable for the proposed development.

## 2.5.2 Vibratory Ground Motions

An evaluation of vibratory ground motions was made for the EGC ESP Site to estimate the SSE for the site. This evaluation was performed to address seismic hazard update requirements in Regulatory Guide 1.165 ([USNRC, 1997](#)) and to meet the SSE requirements given in paragraph (d) of [10 CFR 100.23](#). Later sections of this SSAR address the potential for surface tectonic and nontectonic deformations, the design bases for seismically induced floods and water waves, and other design conditions, as also required in paragraph (d) of [10 CFR 100.23](#).

Regulatory Guide 1.165 provides the framework for assessing the appropriate SSE ground motion levels for new power generating plants. As noted in Regulatory Guide 1.165, an acceptable starting point for the SSE assessment at sites in the central and eastern United States (CEUS) is the PSHA conducted by the Electric Power Research Institute (EPRI) for the Seismicity Owners' Group (SOG) in the 1980's. Regulatory Guide 1.165 further specifies that the adequacy of the EPRI-SOG hazard results must be evaluated in light of more recent data and evolving knowledge pertaining to seismic hazard evaluation in the CEUS.

Appendix E, Section E.3 of Regulatory Guide 1.165 outlines a three-step process for the seismic hazard evaluation:

- Step 1: Evaluate whether recent information suggests significant differences from the previous seismic hazard input characterizations developed for the EPRI-SOG PSHA study.
- Step 2: If potentially significant differences are identified, perform sensitivity analyses to assess whether those differences have a significant impact on the site hazard.
- Step 3: If Step 2 indicates that there are significant differences in the site hazard, then the PSHA for the site is revised by either updating the previous calculations or, if necessary, performing a new PSHA. If not, the previous EPRI-SOG results may be used to assess the appropriate SSE ground motions.

Implementation of the three-step process at the EGC ESP Site included a review of literature published since completion of the EPRI-SOG hazard analysis in the mid-to-late 1980s. An evaluation of the EPRI-SOG PSHA seismic source characterizations consistent with Step 1 using the results of the literature review identified the need for changes in some the EPRI-SOG expert teams' seismic source characterization parameters. Sensitivity analyses were conducted consistent with Step 2 to evaluate the potential effects of the new information on the site hazard. These sensitivity analyses showed a change in the hazard, warranting an update to the SSE. The update was needed to address new information identified as significant in Step 2. As part of the development of the updated SSE ground motion, a new ground motion model for the CEUS was used, and site-specific response analyses were conducted to obtain surface SSE ground motions that are hazard-consistent with motions derived from the updated PSHA at rock level.

The following subsections summarize the procedure followed and results from the vibratory ground motion studies that were carried out for the EGC ESP Site. Additional details for each component of these seismic hazard evaluations are provided in [Appendix B](#). Supporting information about the geotechnical conditions at the site, including the results of field explorations and laboratory testing, is provided in [Appendix A](#).

As discussed below in [Section 2.5.2.6](#), the SSE spectra for the EGC ESP site are developed using the graded performance-based, risk-consistent method described in ASCE Standard XXX (ASCE, 2003)<sup>3</sup>. The method specifies the level of conservatism and rigor in the seismic design process such that the performance of structures, systems, and components (SSCs) of the plant achieve a uniform seismic safety performance consistent with the NRC's safety goal policy statement ([USNRC, 1986](#); [USNRC, 2001a](#)). This approach for development of the site SSE design response spectra is discussed in detail in [Section 2.5.4.9](#).

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<sup>3</sup> ASCE Standard XXX (2003) provides a detailed methodology and commentary on procedures required to achieve risk-consistent seismic design of SSCs for nuclear facilities. This Standard is a national consensus standard developed by the Dynamic Analysis of Nuclear Structures Subcommittee of the Nuclear Standards Committee of the American Society of Civil Engineers. The Dynamic Analysis Subcommittee comprises a group of leading designers, researchers, owners, and regulatory staff who are involved in the design and operations of nuclear facilities. The Standard has received technical approval by the Subcommittee and is now undergoing administrative review and approval by the Nuclear Standards Committee of the American Society of Civil Engineers. Publication of the document is expected in 2004.

### 2.5.2.1 Seismicity

The starting point for the development of a current earthquake catalog relevant to the EGC ESP Site was the EPRI-SOG study (EPRI, 1989-1991). The earthquake catalog used in the EPRI-SOG study covered the time period from 1777 to the beginning of 1985 within the region of the EGC ESP Site. This earthquake catalog is plotted on Figure 2.5-4.

For this study, the earthquake catalog was updated using information from the following sources.

- The National Center for Earthquake Engineering Research (NCEER) Earthquake Catalog (1991),
- The United States Geological Survey (USGS) National Hazard Mapping Catalog (1995),
- The Center for Earthquake Research and Information (CERI) New Madrid Catalog (1974 - 8/1/2002), and
- The Council of the National Seismic System (CNSS) Composite Catalog (1985 - 8/1/2002).

An updated earthquake catalog for the EGC ESP Site region was created by adding post-1984 data to the EPRI-SOG catalog. The two principal catalog sources were USGS National Hazard Mapping Catalog (Mueller et al., 1997) for the period of 1985 through June 1995 and the CNSS catalog for the time period of July 1995 through June 2002. Figure 2.5-5 compares the map distribution of earthquakes in the EPRI-SOG catalog to the distribution of earthquakes recorded post 1984. The spatial distribution of earthquakes is very similar for the two time periods. Additional details of this work, including consideration of the CERI New Madrid catalog, are found in Section 2.1.3 of Appendix B.

The catalog update determined that since 1985, two earthquakes larger than magnitude 4.0 have occurred in the study region: (1) a **M** 5.0 earthquake on June 10, 1987 east of Olney, Illinois; and (2) a **M** 4.45 earthquake on June 18, 2002 in southern Indiana near Evansville. Additional information about both earthquakes, including information on the likely focal depths and mechanisms, is discussed in Section 2.1.3 of Appendix B. The focal mechanisms and depths are similar to other earthquakes in the region over the past 28 years.

In addition to updating the EPRI-SOG earthquake catalog for more recent information, an evaluation of prehistoric liquefaction information for evidence of prehistoric earthquakes also was made. This evaluation involved a review of publications dealing with paleoliquefaction<sup>4</sup>. Previous investigations of paleoliquefaction features at sites in the southern Illinois basin and in parts of Indiana, Illinois, and Missouri have identified a number of episodes of paleoliquefaction occurrence that have been interpreted to have been caused by Holocene and latest Pleistocene earthquakes with estimated moment magnitudes of **M** 6 to ~7.8 (Figure 2.5-6). One set of these features located approximately 30 mi southwest of the EGC ESP Site, has been interpreted by scientists involved in these

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<sup>4</sup> Paleoliquefaction refers to liquefaction that occurred in prehistoric times. These occurrences are identified by relic liquefaction features, such as sand boils (or blows), dikes, and sills. By establishing the date and geographical distribution of these features, it is possible to estimate the earthquake magnitude that caused the feature.

investigations to have been caused by an earthquake centered there between 5,900 and 7,400 yr before present. The magnitude of this earthquake, called the Springfield Earthquake, has been estimated through the evaluation of the spatial distribution of paleoliquefaction features to range from **M** 6.2 to 6.8. Evidence for the location, size, and timing of the Springfield Earthquake, as well as other earthquakes, is summarized in [Attachment 1](#) to Appendix B.

This published information on prehistoric seismicity was augmented by a field reconnaissance to search for additional paleoliquefaction features within the near region (that is, approximately 25- to 30-mi radius of the EGC ESP Site). Results of the reconnaissance of paleoliquefaction for the EGC ESP Site are described in [Attachment 1](#) of Appendix B. The primary conclusions from the paleoliquefaction reconnaissance are listed below.

- Evidence for a hypsithermic (post-mid-Holocene) earthquake comparable to the postulated Springfield event was not observed in the study area. Sufficient exposures of pre-hypsithermic (> 6,000 to 7,000 years before present) deposits were observed to demonstrate the absence of paleoliquefaction features indicative of an energy source for a comparable event (estimated to be **M** 6.2 to 6.8) in the vicinity of the site.
- Isolated features of mid-Holocene and latest Pleistocene/early Holocene age were observed in the study area that may be interpreted as evidence of seismically induced paleoliquefaction. Features of probable mid-to-early Holocene age were observed approximately 11.5 to 13 mi from the EGC ESP Site. The small scale of the features and lack of evidence for similar features elsewhere in the area studied suggest either a more distant source (possibly related to one of the previously reported events) or a low magnitude event [at or close to threshold of paleoliquefaction, estimated Modified Mercalli Intensity (MMI) VI or VII]. Radiocarbon ages for samples from one location indicate these features formed after  $9,550 \pm 40$  yr before present.
- Older features were observed approximately 17 mi from the EGC ESP Site. The dike injection features are inferred to be latest Pleistocene to early Holocene in age (<17,000 to 10,000 years before present). Sedimentary and stratigraphic characteristics of host deposits and material source as well as conduit morphology are consistent with a seismic origin for these features. It is estimated that if seismically triggered, clastic dikes observed at this location would imply MMI values of at least VII -VIII at that location.
- Clastic dikes observed in till deposits approximately 29 mi north-northeast of the EGC ESP Site appear to have formed during the latest glacial advance in that region ( $\sim 17,700 \pm 1,000$  years before present). The triggering event that caused the injection of the clastic dikes at this location is uncertain. Both dewatering related to glacial processes and seismic shaking are viable mechanisms.
- The extensive Mahomet gravel pit exposures provide strong evidence for the absence of strong ground motion that would produce significant liquefaction since deposition of the upper silt approximately 17,000 to 18,000 years before present.

Additional details about the paleoliquefaction reconnaissance carried out for the EGC ESP Site seismic hazard evaluation are given in [Section 2.1.4](#) and [Attachment 1](#) of Appendix B. These details include a discussion of each of the identified features, pictures of the features,

results of radiocarbon dating, and criteria for differentiating seismic versus non-seismic liquefaction features.

It was concluded from these evaluations of recent and prehistoric earthquakes that the range of maximum magnitude earthquakes assigned to a random background earthquake in the PSHA for the EGC ESP Site must include events comparable to that estimated for the Springfield earthquake (that is, **M** 6.2 to 6.8).

### 2.5.2.2 Geologic Structure and Tectonic Activity

This subsection of the SSAR summarizes the geologic structure and activity that could potentially result in seismic-induced, vibratory ground motions at the EGC ESP Site. The summary addresses Regulatory Positions 1 and 2 within Regulatory Guide 1.165 (USNRC, 1997), which requires that investigation of seismic sources be performed within a 200-mi radius of the site. Two major sources of potential earthquakes are located within or just beyond this distance: (1) the New Madrid seismic zone (NMSZ) and (2) the Wabash Valley seismic zone (WVSZ) in southern Illinois and southern Indiana. The New Madrid region was the location of three earthquakes in 1811-1812, which are the largest earthquakes recorded in the CEUS. The Wabash Valley region is a zone of elevated seismicity in which a number of paleo-earthquakes have been identified.

Extensive new data sets have been compiled and interpreted from numerous site-specific and regional studies throughout the CEUS in the time interval since the completion of the EPRI-SOG study. Many of these studies, funded under the National Earthquake Hazards Reduction Program (NEHRP), have focused on the NMSZ and WVSZ. The studies have included extensive paleoliquefaction investigations, acquisition and reprocessing of shallow high-resolution and industry seismic reflection data, paleoseismic trenching and mapping investigations, and seismological studies. These studies have used a variety of techniques to characterize the location, extent, and activity of tectonic features; the location, magnitude, and rates of seismic activity; and the general characteristics of the continental crust throughout the central U.S.

This new information includes identification of new seismic sources as well as revisions to the characterization of previously identified seismic sources. In addition to individual articles, reports, and maps published by state and federal agencies and in professional/academic journals, several major compilations of new data have been published in the past few years. A summary of geologic and geophysical data and seismicity catalogs relevant to the EGC ESP Site is provided in [Section 2.1](#) of Appendix B to this SSAR.

The regional tectonic information shows that the Illinois Basin is in the stable continental region of the North American craton, which is characterized by low rates of historical seismicity ([Figure 2.5-4](#)). The Illinois Basin is bounded on the north by the Wisconsin Arch, on the east by the Kankakee and Cincinnati Arches, on the south by the Mississippi Embayment, and on the west by the Ozark Dome and Mississippi River Arch ([Figure 2.5-7](#)). Two major structural elements characterize the basin: a cratonic depression and a rift system. Basement elevation ranges from approximately -2,950 ft in the northern part of the basin to -14,100 ft in southeastern Indiana. [Section 2.1.1](#) of Appendix B provides a summary of recent publications describing the major structures in the depression, including the tectonic history and crustal architecture of the southern part of the Illinois Basin as they

relate to neotectonic activity in the region. This summary includes discussions of the regional stress fields and present tectonic strains, including the rate of strain accumulation based on geodetic measurements.

The evaluation of the geologic structure and tectonic activity for the EGC ESP Site included a detailed update of structural features (folds and faults) within the site region. The starting point for this review was the CPS USAR, which describes the regional structural geology and provides a description of the important structures (folds and faults) within a 200-mi radius of the site. Results of this update indicate that the general structural picture remains the same, but new information (Nelson, 1995; Kolata and Hildenbrand, 1997; McBride and Kolata, 1999; Harrison and Schultz, 2002) is available regarding the style and timing of most recent deformation. Tables 2.1-1 and 2.1-2 of Appendix B list folds and faults in the region (that is, Illinois, Iowa, Missouri, and Wisconsin). These tables provide updated information for those features where evidence of neotectonic activity has been reported, or where new data have implications for seismic source characterization and models relevant to seismic hazard analysis for the EGC ESP Site region. These summary tables identify key features of the fold or fault, such as means of identification, recency of movement, and comparison to information in the CPS USAR. Section 2.1.2 of Appendix B includes detailed discussions of the seismogenic potential of specific features. This information formed the basis of updating the EPRI-SOG study.

### 2.5.2.3 Correlation of Earthquake Activity with Geology Structure or Tectonic Province

Pursuant to the guidance given in Regulatory Guide 1.165 (USNRC, 1997) and 10 CFR 100.23, a PSHA was selected as the means to determine the SSE and to account for uncertainties in the seismological and geological evaluations for the EGC ESP Site. The probabilistic approach was based on the PSHA conducted by the EPRI for CEUS in the mid-to-late 1980s (EPRI, 1989-1991) – updated to include new information that has become available since the EPRI study, as required by Regulatory Guide 1.165. Sections 2.1.5.1 and 2.2.1 of Appendix B provide summaries of the ERPI-SOG source and ground motion characterization, respectively, from the work that was conducted by the EPRI in the 1980s.

The EPRI-SOG evaluation indicated that the most significant contributors to hazard at the EGC ESP Site are the NMSZ, the WVSZ, and the random background event in the local zone. New information relative to characterization of each of these zones is summarized below and discussed in detail within Section 2.1.5 and 2.2.2 of Appendix B:

- The New Madrid region is the source of the 1811-1812 New Madrid earthquakes, which includes the three largest earthquakes to have occurred in historical time in CEUS. Extensive geologic, geophysical, and seismologic studies have been conducted to characterize the location and extent of the likely causative faults of each of these earthquakes, and to assess the maximum magnitude and recurrence of earthquakes in this region. Table 2.1-3 in Appendix B provides a summary of recent publications pertinent to the identification and characterization of seismic sources in this region. These data have been incorporated into recent source characterizations for seismic hazard analyses (for example, Cramer, 2001; Toro and Silva, 2001; Atkinson and Beresnev, 2002; Frankel et al., 2002). Further discussion of alternative source geometries, the northern boundary of the NMSZ, major structures that are pertinent to the source, as well maximum magnitudes, are provided in Section 2.1.5.2.1 of Appendix B.

- Recent publications pertinent to the identification and characterization of seismic sources in the WVSZ are provided in [Table 2.1-6](#) of Appendix B. These data have been incorporated into recent source characterizations for seismic hazard analyses (for example, [Frankel et al., 2002](#); [Toro and Silva, 2001](#); [Wheeler and Cramer, 2002](#)). Causative structures within the WVSZ have been interpreted from paleoliquefaction data and recently acquired industry seismic reflection data. Further discussions of recent studies conducted for the WVFS are provided in [Section 2.1.5.2.2](#) of Appendix B.
- Evidence from recent paleoliquefaction studies and seismic reflection data suggests that significant earthquakes may occur in parts of the Illinois basin where there are no obvious faults or folds at the surface. The location, size, and recurrence of such events are not well constrained by available data. The presence of paleoliquefaction features, however, suggests that the range of maximum magnitudes assigned to a random background (that is, not associated with specific source) earthquake must include events comparable to that estimated for the postulated Springfield earthquake (that is, **M** 6.2 to 6.8). Further discussion of background seismicity in the Illinois Basin is provided in [Section 2.1.5.2.3](#) of Appendix B.

The PSHA conducted in the EPRI-SOG study characterized earthquake ground motions using three strong ground motion attenuation relationships developed by Nuttli (1986), Boore and Atkinson (1987), and McGuire et al. (1988) combined with the response spectral relationships of Newmark and Hall (1982). These relationships were based to a large extent on modeling of earthquake ground motions using simplified physical models of earthquake sources and wave propagation. Estimation of earthquake ground motions for the EGC ESP Site focused on research that has taken place since completion of the EPRI-SOG studies. This research has resulted in the development of a number of ground motion attenuation relationships. A discussion of the relevant features of these new models is presented in [Section 2.2.2](#) of Appendix B.

The recently-developed ground motion attenuation models predict lower levels of low-frequency ground motion than does the Nuttli (1986), Newmark and Hall (1982) model based on an improved understanding of the effects of crustal properties on ground motion amplitudes. The Newmark and Hall (1982) spectral shapes are based primarily on western North America ground motion recordings. Recent studies have shown that significant differences in the crustal properties between western and eastern North America lead to significant differences in the frequency content of ground motions in the two regions. For this reason, the current consensus is that the Newmark and Hall (1982) western North America spectral shape is not appropriate for ground motions on hard rock in the CEUS. The recently-developed ground motion attenuation models typically have a greater degree of variability in ground motion about the median attenuation relationships (larger standard deviation) than the values used in the EPRI-SOG study.

From the data obtained post the EPRI-SOG study, it was concluded that: (1) there are no additional specific seismic sources in the site region, (2) with the exception of large earthquakes occurring on the central faults in the NMSZ, the EPRI-SOG recurrence parameters provide a good estimate of the current rate of seismicity in the study region, (3) the maximum magnitude distributions for the central Illinois and Wabash Valley/Southern Illinois source zones developed by the EPRI-SOG expert teams likely underestimate what

would be assessed given the present state-of-knowledge, and (4) current ground motion models for the CEUS are generally consistent with the median models used in the EPRI-SOG study. However, the aleatory variability about the median ground motions used in the EPRI-SOG study is generally lower than current estimates. Furthermore, a significant amount of research on ground motion modeling in the CEUS has been conducted since the completion of the EPRI-SOG study. Additional discussions of each of these conclusions are provided in [Sections 3.1.1](#) through [3.1.4](#) of Appendix B.

Based on the above assessments, the following adjustments were made to the source parameters and the ground motion relationship in PSHA sensitivity tests for the EGC ESP Site:

- The mean return period for large characteristic earthquakes on the central faults of the NMSZ was set to 500 - 1,000 years.
- The maximum magnitude for the WVSZ was adjusted upward.
- A large upward shift in the maximum magnitude distribution for central Illinois sources was made.
- Newer attenuation models were introduced.

The sensitivity tests conducted for the EGC ESP Site are described in [Section 3.2](#) of Appendix B. [Section 3.2.1](#) presents sensitivity tests conducted using the full EPRI-SOG source model, and [Section 3.2.2](#) presents sensitivity tests conducted using a simplified source model. The sensitivity test results are presented in the form of graphical comparisons of the levels of exceedance in peak ground acceleration (pga) and spectral velocity at 1 Hz for the original EPRI-SOG and modified models.

It was concluded from these sensitivity tests that the post-EPRI-SOG information results in changes in site hazard that may be considered significant – requiring an updated PSHA for the EGC ESP Site to determine the SSE. Use of this information in the evaluation of maximum earthquake potential at the EGC ESP Site is provided in the next section of this SSAR.

#### **2.5.2.4 Maximum Earthquake Potential**

The maximum earthquake potential for the EGC ESP Site was determined by updating the EPRI-SOG PSHA that had been conducted for the CPS Site in the mid-to-late 1980s. The intent of the update was to incorporate new information related to the original EPRI-SOG experts' assessment, as required by Position 3 of Regulatory Guide 1.165. This update involved re-running the PSHA for the EGC ESP Site, using the updated seismic source and ground motion models, to define the response spectra on hard rock.

Based on the evaluation of new information and data, as well as the results of the sensitivity tests described in the previous section, four specific areas of the EPRI-SOG model were updated: (1) characteristic earthquakes occurring on the central faults of the New Madrid region with an average repeat time of approximately 500 years were added to the EPRI-SOG characterization of the NMSZ, (2) the maximum magnitude distribution for the Wabash Valley/Southern Illinois sources was modified to shift the probability mass to higher values, (3) the maximum magnitude distribution for the local background source zone was

modified to shift the probability mass to higher values, and (4) the ground motion attenuation models recently developed by EPRI (2003) were used. The revisions to the EPRI-SOG model are described in detail in [Section 4.1](#) of Appendix B.

The update of the ground motion attenuation model requires special note. The procedure used to update the ground motion attenuation model involved a SSHAC<sup>5</sup> Level 3 elicitation process (SSHAC, 1997). This evaluation process was managed by EPRI and carried out between the fall of 2002 and the summer of 2003. In the SSHAC Level 3 process experts (Expert Panel) were contacted regarding their views and recommendations on the ground motion attenuation models suitable for use in CEUS and the appropriate criteria for assessing the relative merits of the different models. A Technical Integrator (TI) team evaluated the models after receiving input from the Expert Panel, grouped the models into a limited number of categories, and then assessed relative weights for each group of models. The Expert Panel reviewed the recommendations from the TI team, and then the TI team evaluated the Expert Panel's comments to develop the recommended ground motion attenuation model for the CEUS. Results of this SSHAC Level 3 elicitation process were incorporated into the update of the PSHA. The development of the ground motion models is documented in EPRI (2003) and the models are described in [Section 4.1.4](#) of Appendix B.

The PSHA was conducted by combining the hazard from EPRI-SOG seismic sources (with updated maximum magnitude distributions) with the hazard from the New Madrid characteristic earthquake sources. Earthquakes occurring within the seismic sources for the EPRI-SOG model were treated as point sources consistent with the EPRI-SOG analysis. Appropriate adjustments to the ground motion models to account for this point-source representation were made using the approach developed in EPRI (2003). The characteristic earthquake ruptures on the central New Madrid faults were assumed to rupture the entire fault, and the closest approach of the fault to the EGC ESP Site was used as the distance to rupture. Characteristic earthquakes occurring on the central New Madrid faults were assumed to rupture as clustered events within a short time period relative to the return period for the events. Results of these analyses are presented in [Section 4.1.5](#) of Appendix B. These results show the contributions of different model components to the mean and median probabilities of exceedance for peak ground acceleration and spectral acceleration at frequencies of 5 and 1 Hz.

The development of uniform hazard spectra and identification of controlling earthquakes is presented in [Section 4.1.6](#) of Appendix B. PSHA calculations were performed for peak ground acceleration and spectral acceleration at periods of 0.04, 0.1, 0.2, 0.4, 1.0, and 2.0 seconds. Peak ground acceleration is assumed to be at a period of 0.01 seconds (a frequency of 100 Hz) following guidance given in EPRI (1993a). The hazard results were interpolated to obtain uniform hazard spectra for rock site conditions. [Figure 2.5-8](#) shows the uniform hazard spectra for the mean  $10^{-4}$  and  $10^{-5}$  exceedance frequency. The mean  $10^{-4}$  and  $10^{-5}$  spectra form the basis for determining the risk-consistent, design response spectrum (DRS), as discussed in [Section 2.5.4.9](#) of the SSAR.

Deaggregation of the hazard results indicated that the high frequency ground motion hazard (5 to 10 Hz) results from contributions from a wide range of magnitudes and seismic

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<sup>5</sup> Senior Seismic Hazard Analysis Committee (SSHAC) refers to the group of individuals who developed the four-level methodology for resolving uncertainty and using expert opinion during seismic hazard evaluations.

sources, with nearby earthquakes in the magnitude range of  $m_b$  5 to 6.5 becoming the dominant contributor to the hazard, as the probability of exceedance decreases (the ground motion amplitude increases). The characteristic earthquakes on the central faults of the NMSZ dominate the hazard for low frequency ground motions (1 to 2.5 Hz).

### 2.5.2.5 Seismic Wave Transmission Characteristics of the Site

The uniform hazard spectra described in the preceding section are defined on hard rock, which is located several thousand feet or more below the ground surface at the EGC ESP Site. To determine the SSE at the ground surface, it was necessary to adjust the uniform hazard spectra for amplification or deamplification as the vibratory ground motion propagated to the ground surface. The adjustment was made by conducting site response analyses following Approach 2B described in NUREG/CR-6728 (McGuire et al., 2001). The steps in these analyses included defining the shear wave velocity and material damping characteristics in the soil and rock profile between the ground surface and the depth of hard rock, and then conducting site response studies using a one-dimensional, equivalent linear computer code.

The soil profile at the EGC ESP Site is shown in Figure 2.5-3, summarized in Section 2.5.4.2 of this SSAR, and described in Appendix A. As discussed, the surface soils consist of a thin layer of loess underlain by interbedded glacial tills and lacustrine deposits of Quaternary age to a depth of nearly 300 ft. The upper 30 ft of bedrock encountered at the EGC ESP Site consists of limestone, shale, sandstone, siltstone, and a single 1-foot thick interval of coal. The bedrock is of Pennsylvanian age.

The dynamic properties of the soil profile were characterized during a field and laboratory testing program, as summarized in Sections 2.5.4.2 and 2.5.4.3 of this SSAR. The results of these programs include:

- Shear wave velocity data measured at the EGC ESP Site. These results are shown in Figure 2.5-9. The data consist of one borehole velocity profile to a depth of 310 ft and two seismic cone velocity profiles to depths of 55 and 76 feet. The CPS USAR shear wave velocity results are consistent with the velocity data from the EGC ESP Site.
- A set of shear modulus reduction and damping data obtained in the laboratory on samples taken from boreholes drilled and sampled at the EGC ESP Site. In general, the modulus and damping data are consistent with the EPRI (1993a) relationships, except that the laboratory data tend to show higher damping levels at very low shearing strains. The test data are also generally consistent with Vucetic and Dobry (1991) relationships.

As noted in the previous section, the uniform hazard spectra were established on hard rock. The consistency of rock used in the CEUS ground motion relationships is defined as hard rock. Based on EPRI (1993a), CEUS hard rock conditions correspond to a shear wave velocity of at least 9,300 fps. Since the shear wave velocity of the rock encountered at a depth of 300 ft at the EGC ESP Site is approximately 4,000 fps, the shear wave velocity profile between 300 ft and hard rock conditions was estimated from results of borehole compression wave velocity surveys conducted in the area. A number of compression wave velocity profiles have been obtained in deep boreholes drilled within about 10 mi of the EGC ESP Site. The compression wave velocities ( $V_p$ ) measured in these surveys were

converted into shear wave velocities ( $V_s$ ) using representative values of the ratio  $V_p/V_s$  ranging from 1.7 to 2.0. Results of these conversions are shown in [Figure 2.5-10](#). Additional discussion of the deep velocity determinations is provided in [Section 4.2.1](#) of Appendix B.

The site response analyses were conducted using randomized shear wave velocity profiles and soil modulus and damping relationships to account for variation in the dynamic soil properties across the EGC ESP Site. The depth to hard rock was also randomized to reflect its uncertainty. The site response also assumed that the sedimentary rock below 300 ft remains linear during earthquake shaking. Damping in the rock was based on published information. Additional details about the generation of profiles for the site response analyses are included in [Sections 4.2.1](#) and [4.2.2](#) of Appendix B.

Following the recommended procedure for site response method 2B outlined in NUREG/CR-6728 ([McGuire et al., 2001](#)), representative rock site response spectra were developed for the controlling earthquakes. Time histories for the site response analyses were obtained from the CEUS time history library provided with NUREG/CR-6728 ([McGuire et al., 2001](#)). These records were adjusted to match the controlling earthquake response spectra. The development of the controlling earthquake response spectra and the selection and scaling of time histories are described in [Section 4.2.3](#) of Appendix B.

A total of 180 site response analyses were conducted to develop the soil amplification function for each controlling earthquake rock spectrum using the computer program SHAKE ([Schnabel et al., 1972](#)). The weighted mean of the site amplification functions of the individual site response analyses was used to develop site amplification factors for the EGC ESP Site, as recommended in NUREG/CR-6728 ([McGuire et al., 2001](#)). The site amplification factors indicate a maximum amplification of about 3 for periods between 0.3 and 1.0 seconds and deamplification of high-frequency ground motions due to soil non-linearity. For reference, the EPRI-SOG generic amplification factors in this period range for site category IV were about 1.65 to 2 for comparable levels of input motion. Discussions of the results of the site response analyses for the EGC ESP Site are provided in [Section 4.2.4](#) of Appendix B. These amplification factors were used to adjust the spectra on hard rock to the ground surface, as discussed in [Section 2.5.2.6](#).

### 2.5.2.6 Safe Shutdown Earthquake

The design response spectrum (DRS) for horizontal motions was developed following the graded performance-based, risk-consistent method described in ASCE Standard XXX ([ASCE, 2003](#)). This approach uses the mean  $10^{-4}$  and  $10^{-5}$  spectra to develop the DRS.

- The first step is to develop the appropriate mean  $10^{-4}$  and mean  $10^{-5}$  spectra for the ground surface. Following the procedure described in Regulatory Position 4 of Regulatory Guide 1.165 ([USNRC, 1997](#)), the soil amplification functions described above in [Section 2.5.2.5](#) were used to scale the rock controlling earthquake response spectra to ground surface conditions. Smooth envelope response spectra were then constructed to provide soil surface motions representative of  $10^{-4}$  and mean  $10^{-5}$  mean hazard. These envelope ground surface response spectra are shown on [Figure 2.5-11](#).
- The second step is to construct the DRS by scaling the mean  $10^{-4}$  spectrum by a frequency dependent design factor (DF) that is based on the relative amplitude of the mean  $10^{-4}$  and  $10^{-5}$  spectra. The basis for DF is described in [Section 2.5.4.9](#). Based on the

mean  $10^{-4}$  and mean  $10^{-5}$  soil surface spectra shown on [Figure 2.5-11](#), the DF values ranged from a minimum of 1.0 at a frequency of 3.3 Hz and at frequencies between 16 and 50 Hz to a maximum of approximately 1.4 at a frequency of 0.5 Hz. The resulting horizontal DRS is shown on [Figure 2.5-12](#). Details of the development of the horizontal DRS are presented in [Section 4.3.1](#) of Appendix B.

The corresponding vertical DRS was developed using the vertical-to-horizontal spectral ratios recommended in NUREG/CR-6728 ([McGuire et al., 2001](#)) for rock site conditions and consideration of the effects of soil conditions on vertical motions. The result is a frequency-dependent set of vertical-to-horizontal spectral ratios. The vertical DRS, along with the horizontal DRS and the Regulatory Guide 1.60 spectrum anchored at 0.3g, is shown on [Figure 2.5-12](#). [Section 4.3.2](#) of Appendix B provides a detailed description of the development of the vertical DRS.

### 2.5.2.7 Operating Basis Earthquake

The Operating Basis Earthquake (OBE) for the EGC ESP Site was not determined as part of the EGC ESP Application. Paragraph IV.a.2 of Appendix S to 10 CFR Part 50 indicates that the OBE must be characterized by response spectra and that the value of the OBE must be set to one of the following choices:

- One-third or less of the SSE ground motion design response spectra. In this case the requirements associated with the OBE can be satisfied without the applicant performing explicit response or design analyses.
- A value greater than one-third of the SSE design response spectra. Analyses and design must be performed to demonstrate that SSCs of the nuclear plant remain functional and are within applicable stress, strain, and deformation limits – thereby not resulting in undue risk to the health and safety of the public. In this case the design must take into account soil-structure interaction effects and the duration of vibratory ground motion.

In either case the plant must shut down if the vibratory ground motion exceeds that of the OBE or if significant plant damage occurs. Appendix S to 10 CFR Part 50 also requires that prior to resuming operations “the licensee must demonstrate to the Commission that no functional damage has occurred to those features necessary for continued operations without undue risk to the health and safety of the public.”

Since the OBE is related to design and performance of the generating system, it will be determined during the COL stage based on the level of peak ground acceleration and associated response spectrum that could cause damage to the selected generating facility.

### 2.5.3 Surface Faulting

There is no evidence for surface faulting or fold deformation at the EGC ESP Site. Recent detailed geotechnical investigations of the EGC ESP Site were used to develop a site-specific geologic cross section. Irregularities in the upper units (that is, Illinoian glacial till and younger strata) are not reflected in the older units. In particular, the contact between a lacustrine unit and the overlying Illinoian till is flat-lying across the entire site. Previous investigations of the CPS Site are consistent with these conclusions, as discussed in [Section 2.5.3](#) of the CPS USAR.

There have been no historically reported earthquakes within 25 mi of the site that reasonably can be associated with a local structure. Historical earthquakes have been postulated to be associated with faults and inferred structures at greater distances within the site region discussed in [Section 5.2](#) of Appendix B. The evidence for capable tectonic sources inferred from the possible association of historical seismicity is considered in the characterization of alternative seismic sources included in the updated PSHA for the EGC ESP Site.

Paleoliquefaction studies were conducted as part of the EGC ESP Site study to search for evidence of nearby prehistoric earthquakes. The results of these investigations ([Section 2.1.4](#) of Appendix B and [Attachment 1](#) to Appendix B) suggest that there have not been repeated moderate to large (for example, comparable to the postulated **M** 6.2 to 6.8 Springfield earthquake) events in the vicinity of the site in latest Pleistocene to Holocene time that would indicate the presence of a capable tectonic structure within 25 mi of the site. More detailed discussions of surface faulting evaluations conducted for the EGC ESP Site are provided in [Section 5](#) of Appendix B.

#### **2.5.4 Stability of Subsurface Materials and Foundations**

This section of the SSAR presents the evaluation of the stability of subsurface materials that underlie the site. The subsurface stability information is based on soil studies conducted as part of the EGC ESP Site evaluation and on information presented in the CPS USAR. The intent of these studies is to meet the regulatory requirements cited in [10 CFR 100.23](#).

The scope of these subsurface stability studies included:

- Establishing that the soil conditions at the CPS and EGC ESP Sites are consistent by conducting field explorations and laboratory tests on samples of soil recovered from the EGC ESP Site and then comparing information collected from the field and laboratory programs to similar information reported in the CPS USAR.
- Performing geotechnical engineering evaluations for the EGC ESP Site to estimate liquefaction potential and to make conclusions regarding static stability.
- Assessing other requirements of design and construction based on information reported in the CPS USAR and observed during explorations, laboratory testing, and geotechnical evaluations for the EGC ESP Site.

The work described in this section of the SSAR followed the guidelines given in Regulatory Guide 1.132 ([USNRC, 1979](#)) and 1.138 ([USNRC, 1978](#)) dealing with Site Investigations and Laboratory Investigations, respectively. Guidance provided in Draft Regulatory Guide 1101 ([USNRC, 2001b](#)) and Draft Regulatory Guide 1109 ([USNRC, 2001d](#)) which are proposed updates to Regulatory Guide 1.132 and 1.138, respectively, as well as a new guidance on liquefaction (Draft Regulatory Guide 1105 -- [USNRC, 2001c](#)) were also considered during the evaluation of the stability of subsurface materials and foundations.

As discussed previously, the EGC ESP Site is located within 700 ft of the CPS Site. The CPS Site was investigated extensively in the early-to-late 1970s as part of the CPS plant site licensing efforts. These investigations included a large number of field explorations, laboratory tests, and geotechnical analyses to demonstrate that the site was suitable for

development. As noted in [Section 2.5.1](#) of this SSAR, conditions at the EGC ESP and CPS Sites are also the same from the standpoint of site and regional geology. These conditions consist of nearly 300 ft of hard soils over rock with a groundwater table approximately 30 ft below the ground surface ([Figure 2.5-3](#)). The information presented in the following subsections provides a basis for concluding that the EGC ESP and CPS Sites are the same from a foundation engineering standpoint. By providing this justification, it is possible to use information presented in the CPS USAR to address subsurface stability issues such as allowable bearing pressures. It is also possible to estimate how a new facility at the EGC ESP Site can be designed or will perform, without key information regarding loads and dimensions of the EGC ESP facility being known.

The information presented in [Section 2.5.4](#) of this SSAR also provides an update to dynamic property information required for site response analyses summarized in [Section 2.5.2.5](#) of this SSAR and described in detail in [Appendix B](#). In the area of dynamic property characterization, significant advances in field and laboratory dynamic testing methods have occurred since the original work was conducted at the CPS Site. These updated methods allow more precise determination of the in situ (that is, in-place) shear wave velocities of the soil, and they allow more accurate determination of the modulus and damping properties of the soil in the laboratory. This information was used in developing the site model that was used to estimate how ground motions propagated from hard rock to the ground surface, as required within Regulatory Guide 1.165 ([USNRC, 1997](#)).

#### **2.5.4.1 Geologic Features**

The geologic features at the EGC ESP Site and the CPS Site are very similar. The ground surface is relatively flat, with the closest slopes being located along the shores of Clinton Lake which is located 800 ft northwest of the EGC ESP Site.

The subsurface geology at the EGC ESP Site consists of nearly 300 ft of hard or dense soil overlying rock. Other than the upper few tens of feet, the soils have been overridden during past glaciations. As shown in [Figure 2.5-3](#), there are seven primary soil layers at the EGC ESP Site. The soils within each layer are generally silts and clays with varying amounts of sand and some gravel. From a spatial variability standpoint, each layer is relative consistent in thickness, soil classification, and density or hardness. Boundaries between layers are relatively horizontal.

The groundwater piezometric surface in the Illinoian till is located approximately 30 feet below the ground surface. Perched water is located within 30 ft of the ground surface on shallower soil layers. No faults or other geologic hazards, such as karsts or underground mine openings, were identified at or near the EGC ESP Site during the review of site geology ([Section 2.5.1.2](#) of this SSAR).

Additional discussions of the regional and site geologic features for the EGC ESP Site are summarized in [Section 2.5.1](#) of this SSAR, and reported in more detail in [Appendix A](#) and [Appendix B](#) and in Section 2.5.1 of the CPS USAR.

#### **2.5.4.2 Properties of Subsurface Materials**

The properties of subsurface materials at the EGC ESP Site have been established by conducting field and laboratory measurements following guidelines in Regulatory Guide

1.132 and Regulatory Guide 1.138, and by drawing upon the extensive database of information that was developed for the CPS Site. The property information includes strength, consolidation, dynamic/cyclic, and physical test results from soil samples recovered from the EGC ESP and CPS Sites. These properties were established from the ground surface to the top of rock located nearly 300 ft below the ground surface.

The purpose of the EGC ESP Site material property characterization testing was (1) to show that soil characteristics at the EGC ESP Site are consistent with those at the CPS Site and (2) to update the dynamic property information for the site. To meet this second requirement, the EGC ESP Site material property testing program included six sets of resonant column/cyclic torsional shear tests. These tests were conducted to determine the variation in shear modulus and material damping ratio with shearing strain amplitude. The results of the resonant column/cyclic torsional shear tests also provided information about the variation of shear modulus and material damping ratio with effective confining pressure and frequency of loading.

The resonant column/cyclic torsional shear test results were used to show that the behavior of representative soil from the EGC ESP Site during cyclic (dynamic) loading is consistent with published relationships defining the variation of dynamic properties with shearing strain level. As discussed more fully in [Section 5.2.4](#) of Appendix A, comparisons were not made between dynamic properties reported in the CPS USAR for the CPS Site and the results of the EGC ESP Site cyclic testing program. Significant advances have been made in the area of cyclic testing since cyclic tests were conducted on soils from the CPS Site, limiting the value of any comparison.

Dynamic properties obtained for the EGC ESP Site were considered but not used explicitly for the site response studies described previously in [Section 2.5.2.6](#). Rather, the EPRI modulus and damping curves were used as the base case for the site response analyses. The rationale for using the EPRI curves rather than the EGC ESP Site data was that a much larger database was used to develop the EPRI curves and, therefore, average EPRI results are expected to be representative of conditions at the EGC ESP Site if an extensive dynamic testing program had been conducted. It is important to note that the dynamic test results for the EGC ESP Site are very consistent with the EPRI curves, indicating that use of the EPRI curves is acceptable. A comparison of the EPRI and EGC ESP Site cyclic test results is included in [Figures 5-20](#) and [5-21](#) of Appendix A.

The following conclusions were reached regarding the properties of subsurface materials existing at the EGC ESP Site based on the material property tests:

- The physical property tests indicate that the soil profile consists primarily of low plasticity silts and clays. Sands and occasionally gravels are found in the predominantly fine-grained soil profile. Average physical properties for the predominant soil layers are summarized in [Table 2.5-1](#).
- Results of compressibility and strength tests indicate that the soil has low compressibility and very high strength. The compression indices for tests on samples from the Illinoian till and deeper soils at the EGC ESP Site range from 0.08 to 0.09, the recompression indices range from 0.006 to 0.009, and the preconsolidation pressure ranges from 5 to 7 tsf. Unconfined compressive strengths vary from 1 to 15 tsf,

unconsolidated undrained strengths vary from 2 to 9 tsf, and the effective strength friction angle from a consolidated undrained triaxial test is 32.6 degrees.

- The modulus and damping properties of soil from resonant column/cyclic torsion shear tests indicate that the low-strain shear wave velocity of samples ranges from approximately 800 fps to over 2,000 fps, depending on the specific layer from which the soil sample was obtained. Low-strain material damping ratios for the same samples vary from approximately 5 percent to less than 1 percent. The changes in shear modulus and material damping ratios with the level of shearing strain are consistent with published modulus and damping characteristics of low plasticity soil.

Results of testing on samples from the EGC ESP Site are presented in [Section 5.2](#) of Appendix A. Attachments to Appendix A include supporting information for the test results.

As noted above, part of the purpose of the EGC ESP Site laboratory testing program was to show that the properties from the EGC ESP Site are similar to those reported in the CPS USAR. If similar conditions could be demonstrated, then the extensive database summarized in the CPS USAR could be used to augment the information collected at the EGC ESP Site. Furthermore, some of the conclusions regarding stability for the CPS Site could be extrapolated to the EGC ESP Site.

The existing database of soil property information in the CPS USAR includes static and dynamic properties of the subsurface materials. The CPS USAR information was developed from results of exploration programs conducted at the site and from laboratory testing of materials obtained during the exploration program and imported for construction. The scope of the material testing reported in the CPS USAR includes the following tests:

- Strength tests on soil and rock. Tests were conducted on intact samples of soil and rock using unconsolidated undrained, unconfined, and consolidated undrained (with pore pressure measurements) triaxial shear testing methods. Results of these tests were used to characterize the undrained strength and effective strength properties of soils from the site, as well as unconfined compressive strengths and modulus of elasticity of rock.
- Dynamic tests on intact and remolded samples of soil from the CPS Site. These tests involved use of cyclic triaxial, resonant column, and shockscope testing methods. Results of the cyclic triaxial and resonant column tests were used to determine the shear modulus and material damping characteristics of soils from the CPS Site. Results of the shockscope tests were used to determine the compression wave velocity in the unconfined state.
- Other physical tests including Atterberg limits, consolidation, in situ moisture and density, laboratory permeability, and relative density. These tests were conducted to determine soil types and to obtain information necessary for estimating settlement and dewatering requirements.
- Chemical tests on groundwater samples and coal samples.
- Tests on soils excavated and placed during construction of the CPS Facilities. This program included additional strength, dynamic, and physical property tests.

Liquefaction tests were conducted using cyclic triaxial testing methods to evaluate the liquefaction resistance of backfill material. Hundreds of physical property tests (for example, Atterberg limits, compaction, moisture/density, particle size, and relative density) were conducted as part of the CPS construction quality control program.

Results of the laboratory testing program conducted for the CPS Site are summarized in Section 2.5.4.2 of the CPS USAR. These results provide full characterization of soil at the CPS Site from the ground surface into the top of rock located up to 250 ft below the ground surface. The spatial coverage of the CPS Site testing program extends beyond the planned footprint of the EGC ESP Site.

The soil classification, strength, and consolidation test results from the EGC ESP and CPS Site laboratory testing programs were compared during EGC ESP Site characterization review to show the similarity of conditions between the sites. These comparisons are provided in Section 5.2 of Appendix A. The comparisons demonstrate that soil conditions at the EGC ESP and CPS Site locations are consistent. Average values of water content, Atterberg limits, density, strength, and compressibility are similar for samples obtained at similar depths from each site. This similarity is not surprising, in view of the regional geology of each site and the proximity of the two sites.

### 2.5.4.3 Explorations

Subsurface explorations were carried out as part of the EGC ESP Site characterization effort. This exploration program consisted of drilling and sampling four boreholes and conducting four electric cone penetrometer tests (CPT) with pore pressure measurements within the footprint of the proposed EGC ESP Site. The purpose of the exploration work was to establish the location and consistency of soil layers, to collect soil samples for laboratory testing, and to install piezometers for groundwater monitoring.

As discussed in Section 2.5.4.2 of this SSAR, one of the objectives of the EGC ESP Site explorations was to collect information that could be used to confirm that the EGC ESP and CPS Sites are similar from the standpoint of soil layering and soil consistency. Geological information for the region and the site suggest that the soil conditions are similar; however, it was necessary to obtain quantitative information to validate this view.

The drilling and sampling program for the EGC ESP Site followed guidelines given in Regulatory Guide 1.132, with the exception of the number and depth of explorations. Fewer explorations were justified by the similarity of soil conditions at the EGC ESP Site with those at the CPS Site. Section 3.1.1 of Appendix A provides additional discussions of the number and depth of explorations relative to guidelines given in Appendix C of Regulatory Guide 1.132 (USNRC, 1979).

The four explorations were drilled at the EGC ESP Site using mud rotary drilling methods. Two of the explorations extended to 100 ft below the ground surface, and the other two extended 20 to 30 ft into rock at nearly 300 ft below the ground surface. Standard Penetration Test (SPT), Shelby, and Pitcher tube sampling methods were used to collect representative soil samples. SPT blowcounts were obtained in each borehole. The hammer system used to obtain the SPT blowcounts was calibrated in one borehole. Details of this work, including the resulting borehole logs, are included in Section 3.1 of Appendix A.

A CPT program was also conducted at the EGC ESP Site. Results of the CPT soundings were used to evaluate the consistency of soils in the upper 50 to 80 ft of soil in the EGC ESP Site area. The CPT soundings included pore water pressure measurements, and during two of the soundings, shear wave velocity data were obtained. Details of these tests, including the test methods used and the sounding results, are provided in [Section 3.3](#) of Appendix A.

The exploration program for the EGC ESP Site was augmented by results from similar programs conducted at the CPS Site. An extensive drilling and sampling program was conducted during work on the CPS Site. Seventy-six locations were drilled and sampled for the CPS Site investigation, some of which were located within or adjacent to the footprint of the ESP EGC Site. A number of these explorations extended into rock located nearly 250 ft below the ground surface. Soil samples were recovered using Dames & Moore, Pitcher, Shelby, Osterberg, and double tube core methods. Piezometers were installed in a number of the boreholes. The results of these explorations are shown on borehole logs included in the CPS USAR.

Comparisons were made between results of the drilling and sampling programs for the EGC ESP and CPS Sites. Both visual descriptions of recovered soil samples and SPT blowcounts were considered during this evaluation. [Section 5.2](#) of Appendix A includes plots showing the similarity in blowcounts from the SPT, as well as soil cross sections showing the similarity in soil descriptions. Results of these comparisons show that both sites consist of over 250 feet of predominantly silts and clays overlying rock. The silts and clays are very stiff to hard in consistency – as a result of past glaciations. Rock is slightly deeper at the EGC ESP Site (specifically, nearly 250 ft below ground surface at the CPS Site versus over 280 ft at the EGC ESP Site); however, rock descriptions and quality are consistent between the sites. It was concluded from this comparison that the engineering characteristics of the two sites are consistent; therefore, the database from the CPS Site can be used in evaluating site response to gravity and seismic loading at the EGC ESP Site.

#### **2.5.4.4 Geophysical Surveys**

A series of geophysical surveys was conducted at the EGC ESP Site. The purpose of these tests was to determine the low-strain shear wave velocity of the soil and the upper layer of rock. This information was used to develop the site model for evaluating the effects of the soil profile on the propagation of seismic motions from the top of rock to the ground surface, as discussed in [Section 2.5.2.5](#) of this SSAR. Information from the shear wave velocity tests may also be used during the COL stage of design to evaluate spring constants required for soil-structure interaction studies.

Two types of geophysical seismic tests were conducted during the EGC ESP Site geophysical program. First, a P-S suspension logging test was performed in one borehole. Shear and compression wave velocities were obtained by conducting P-S suspension logging tests at approximately 1.5 ft depth intervals to approximately 20 ft into the top of rock. The second method involved use of the cone penetrometer. Shear wave velocities were obtained at two locations in the upper 50 to 80 ft of soil profile at approximately 3-ft intervals. The seismic cone penetrometer test (seismic cone) involved a testing method that was similar to the downhole seismic technique. An energy source was created at the ground surface by striking a board with a sledge hammer, and the wave arrivals were detected by a velocity-sensitive transducer mounted in the tip of the cone penetrometer rod. Details for

these velocity testing methods, including plots of velocity versus depth from the two methods, are provided in [Sections 3.3](#) and [3.4](#) of Appendix A.

Results of the shear wave velocity measurements made during the EGC ESP Site geophysical program are shown in [Figure 2.5-9](#). These measurements were used to establish the minimum site characteristic shear wave velocities, which are summarized as follows:

- 820 fps in the upper 50 ft of soil profile,
- 1,090 fps to nearly 3,000 fps at depths of 50 ft to the top of rock, and
- 2,580 fps in the upper 20 ft of rock.

In comparison, the subsurface evaluation at the CPS Site included multiple geophysical exploration programs, including refraction, uphole, surface wave, and downhole velocity measurements, as well as ambient vibration measurements. These methods were used to investigate the subsurface soil layering across the site and to determine shear and compression wave velocities at the center of the CPS Site. Explosive methods were used to generate the source motions for the uphole and downhole measurements. Results of these surveys determined that the shear wave velocity varied from approximately 900 fps near the ground surface to 2,100 fps immediately above the rock. The shear wave velocity in rock was reported to be 5,700 fps. Compression wave velocities ranged from 2,000 fps in the upper 16 ft (above water table) to 7,500 fps above the rock, and 10,500 fps in rock. These velocities were used during the dynamic modeling of structures planned for the CPS Site.

A comparison of the velocities between the CPS Site and EGC ESP Site shows very similar average conditions. A much smaller depth interval was used for the measurements during the EGC ESP Site program and, therefore, the EGC ESP Site velocity results provide a much better indication of the variation in velocity within each of the predominant stratigraphic units. The much larger spacing used during geophysical tests at the CPS Site resulted in greater averaging of measured soil velocity with depth. As discussed in [Section 4.2.1](#) of Appendix B, the more detailed results from the P-S suspension logging test were used in the assessment of site effects at the EGC ESP Site. Uncertainties associated with the variation in velocity both with depth and spatially were accounted for in the site response studies by evaluating different potential realizations of the measured velocity profile, as discussed in [Section 4.2.2](#) of Appendix B.

#### **2.5.4.5 Excavation and Backfill**

Construction of the facilities at the EGC ESP Site will likely require excavations to a depth of approximately 55 to 60 ft below the ground surface to avoid potential settlement and liquefaction concerns, as discussed in a later section. Information given in the CPS USAR provides valuable insight into the likely conditions that will be encountered during the excavation. The excavation information for the CPS USAR also provides a large-scale calibration of borehole information collected during the exploratory phase of the program at the CPS Site. For these reasons, the following summary of excavation and backfill information from the CPS Site is presented.

The excavation and backfill work for the CPS Site was completed at the station, the circulating water screen house, and the Essential Service Water (ESW) outlet structure and pipeline. The discussions for the CPS Site cover materials encountered when excavations

were made to approximately 56 ft below the ground surface, dewatering requirements, excavation base treatment, structural fill and backfill, and general fill requirements.

The following observations were made during excavations at the CPS Site:

- The excavation work at the CPS Site shows that the drilling and sampling program provided a good description of soil conditions in the upper 56 ft at the site, confirming that the boreholes completed within the EGC ESP Site footprint for both the CPS and EGC ESP Sites will be representative of conditions in the upper 56 ft of soil profile.
- Seepage into the construction excavation was very limited at the CPS Site. This observation indicates that dewatering requirements within the upper 56 ft at the EGC ESP Site will be minimal – because of the similarity in groundwater location and soil types.
- Some localized pockets of sand were encountered at the base of the excavation at a depth of 56 ft. These pockets were either compacted or removed and replaced with a flyash-backfill mixture. Similar conditions could be encountered at the EGC ESP Site.

Nothing discussed within Section 2.5.4.5 of the CPS USAR indicates a condition that would significantly affect the construction or operation of a new generating facility at the EGC ESP Site.

#### **2.5.4.6 Groundwater Conditions**

Three piezometers were installed during the EGC ESP Site exploration to obtain more specific information about groundwater conditions at the EGC ESP Site. Methods used to install the piezometers and results of three sets of readings from the piezometers are included in [Section 3.2](#) of Appendix A.

The groundwater measurements indicate that the static groundwater table within the Illinoian till is approximately 30 ft below the ground surface, but that there are shallower perched groundwater layers closer to the surface. Although the monitoring period for the new groundwater measurements is limited to less than a year, the results of the monitoring appear to be consistent with groundwater information shown on borehole logs in the CPS USAR and discussed in Sections 2.4 of the CPS USAR and this SSAR.

Groundwater conditions for the general site and for the EGC ESP Site are discussed more extensively in Section 2.4 of the CPS USAR and this SSAR. These sections should be reviewed to obtain a more complete understanding of groundwater conditions for the general site region and for the CPS and EGC ESP Sites.

#### **2.5.4.7 Response of Soil and Rock to Dynamic Loading**

No attempt has been made to define information needed for soil-rock-structure interaction analyses for the EGC ESP Site. These properties will depend on the geometry and weight of the selected power generating system, and on the method that will be used during the COL stage to evaluate soil-structure interaction, if such analyses are necessary<sup>6</sup>.

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<sup>6</sup> The modulus and damping properties obtained for the EGC ESP Site and presented in [Appendix A](#) are for free-field conditions. Soil beneath and alongside a generating system will likely differ from these properties due to changes in mean confining pressure (below the power generating system) or changes in material type (imported granular material for backfill).

The CPS USAR includes a discussion of properties to use in developing spring constants for soil-rock-structure interaction analyses. These properties include values for soil density, Poisson's ratio, static modulus of elasticity, dynamic modulus of rigidity (shear modulus), and material damping. Results of laboratory and geophysical tests were used when determining these properties.

While the site conditions between the CPS and EGC ESP Sites are the same, some of the details from the dynamic field and laboratory testing carried out during the original investigation for the CPS Site in the mid-to-late 1970s are not necessarily accepted at this time. Thus, before adopting any of the dynamic property information given in the CPS USAR for evaluation of a structure at the EGC ESP Site, the preferred approach for future design work will be to re-derive dynamic properties based on the results of field and laboratory information collected during the EGC ESP Site program and future programs, and then to use the latest published information on dynamic property representation. The potential uncertainty in these property determinations must be established as part of these future evaluations.

#### 2.5.4.8 Liquefaction Potential

An evaluation of liquefaction potential was conducted at the EGC ESP Site. The empirical blowcount procedure was used to perform this evaluation. This approach, which was not available at the time of the original work for the CPS Site, was developed with correlations between the blowcounts recorded during the SPT and liquefaction observations at sites that did or did not liquefy. Draft Regulatory Guide 1105 (USNRC, 2001c) provides a general description of the empirical method. For the EGC ESP Site liquefaction evaluation, the latest correction factors and chart for liquefaction strength, as reported by Youd et al. (2001), were used. The method used for the EGC ESP Site liquefaction evaluation is an update of the methods reported in Draft Regulatory Guide 1105.

The liquefaction assessment was made using a peak ground acceleration of 0.3g consistent with the value set forth in Regulatory Guide 1.60 (USAEC, 1973), which represents the peak acceptable value for the plant that form the basis of the Plant Parameter Envelope (see Section 1.4), and using a range of earthquake magnitudes ( $M = 5.5, 6.5, \text{ and } 8$ ) consistent with the range of source mechanisms potentially causing ground shaking at the EGC ESP Site. Figure 2.5-13 presents typical results of the liquefaction analysis conducted for the EGC ESP Site. Additional results of the liquefaction analyses are summarized in Section 6.1 of Appendix A. These results indicate that the factor of safety (FOS) against liquefaction is greater than 1.1 for liquefiable soil layers below a depth of 60 ft bgs based on a conservative assumption on pga (that is, 0.3g versus 0.26g for the DRS) and an upper bound earthquake magnitude (that is  $M8$  versus a more likely level of  $M6.5$ ). The FOS against liquefaction is less than 1.1 for some soil intervals within 60 ft of ground surface, for the modeled conditions. However, these soils will need to be excavated and replaced or improved for settlement considerations, thereby mitigating any liquefaction potential.

These conclusions regarding liquefaction potential at the EGC ESP Site are consistent with the results of liquefaction evaluations reported in the CPS USAR. The liquefaction potential of structural fill and native material located beneath the containment structure is reported in

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Once the generating system and the likely construction method are defined, the determination of these properties can be made.

the CPS USAR. As discussed in Section 2.5.4.8 of the CPS USAR, the approach used for evaluating the liquefaction potential in the structural fill involved determining the liquefaction strengths of the granular fill using cyclic triaxial testing methods and comparing these strengths (that is, resistance to development of liquefaction) to the shearing stresses that would be imposed by the SSE. Simplified methods, rather than computer modeling, were used to estimate the shearing stresses. Results of these analyses indicated that the factor of safety with respect to liquefaction was greater than 2; therefore, liquefaction was not an issue for the CPS Site. In the native materials below a depth of 56 ft, the liquefaction of sand lenses was evaluated on the basis of relative densities expected to occur. It was concluded from these evaluations that liquefaction potential in materials beneath the CPS excavation was very low, since the factor of safety was greater than 2.0.

Normal design requirements preclude location of a critical structure on material that could liquefy. As noted previously, potentially liquefiable soils in the upper 60 ft at the EGC ESP Site will likely have to be removed to meet settlement requirements. In this situation characteristics of the fill material can be selected to be stronger than the material removed, similar to the situation reported in the CPS USAR.

Based on the liquefaction evaluations for the EGC ESP Site, the conclusion for the liquefaction site characteristic is that liquefaction is not a design consideration for the EGC ESP Site.

#### **2.5.4.9 Earthquake Design Basis**

Regulatory Guide 1.165 (USNRC, 1997) calls for the SSE ground motions to be based on the site PSHA results for a suggested reference probability of the median  $10^{-5}$  hazard level. The basis for the selected reference probability is described in Appendix B of Regulatory Guide 1.165. The reference probability corresponds to the median annual frequency of exceeding the SSE ground motions for a specific set of licensed nuclear power plants. These probabilities were computed using ground motion models developed in the mid-to-late 1980's. As discussed in Regulatory Position 3 in Regulatory Guide 1.165, significant changes to the overall database for assessing seismic hazard in the CEUS warrants a change in the reference probability. The availability of the recently developed EPRI ground motion characterization for the CEUS (EPRI, 2003) represents a significant advancement in the seismic hazard database for the CEUS. Appendix B of Regulatory Guide 1.165 discusses that selection of another reference probability may be appropriate, such as one founded on risk-base considerations. That is the approach taken for developing the EGC ESP SSE design ground motions.

The SSE design response spectra (DSR) have been developed using the graded performance-based, risk-consistent method described in ASCE Standard XXX (ASCE, 2003). The method specifies the level of conservatism and rigor in the seismic design process such that the performance of SSCs of the plant achieve a uniform seismic safety performance consistent with the NRC's safety goal policy statement (USNRC, 1986; USNRC, 2001a). The ASCE Standard XXX aims to achieve a quantitative safety performance goal,  $P_F$ , together with qualitative performance limit states such that SSCs are designed depending on their importance to overall seismic safety performance of the plant, to assure that the plant level seismic performance target is met. The method is based on site-specific mean seismic hazard and the seismic design criteria and procedures contained in NUREG-0800.

The NRC's safety goal policy statement establishes recognition that nuclear plant safety regulation is a societal risk management activity and provides the foundation for equitably managing the nuclear facility risk in the context of other societal risks. Subsequent to adopting the policy statement the NRC has continued to develop and evolve supporting policies for a comprehensive risk management framework for nuclear regulation together with supporting implementation guidelines (USNRC, 1998; USNRC, 2002). The seismic design methodology provided in ASCE Standard XXX is a further step in the development of a risk-based standard for seismic design and regulation. The graded performance-based approach is compatible with the direction provided by the NRC's Risk-Informed, Performance-Based Regulation guidance (USNRC, 1999; USNRC, 1998) and with developing NRC guidance for the determination of DRS (McGuire, et al., 2001; McGuire, et al., 2002).

The ASCE Standard XXX seismic design method and criteria are intended to implement the NRC's established qualitative safety goals and the companion quantitative implementation objectives. The qualitative safety goals provide that the consequences of nuclear power plant operation should cause no significant additional risk to the life and health of individuals and that the societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks posed by generating electricity by viable competing technologies and should not be a significant addition to other societal risks. The NRC's quantitative objectives for implementation of the safety goals are stated in terms of risk to individuals and to society. For an average individual in the vicinity of a nuclear power plant the risk that might result from a reactor accident should not exceed one-tenth of one percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the population are generally exposed. The risk to the public of cancer due to nuclear power plant operation should not exceed one-tenth of one percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes (USNRC, 2001a).

A target  $10^{-4}$  mean annual risk of core damage due to all accident initiators can implement these quantitative safety goals. The ASCE Standard XXX assumes that seismic initiators contribute about 10 percent of the risk of core damage posed by all accident initiators. Thus the Standard is intended to conservatively achieve a mean  $10^{-5}$  per yr risk of core damage due to seismic initiators. The NRC's seismic design criteria contained in NUREG-0800 conservatively assure a risk reduction factor of at least 10, as discussed further in the next paragraph. Thus, a mean ground motion hazard of  $10^{-4}$  per yr is appropriate for determining the site-specific DRS for the EGC ESP Site. The seismic safety performance goal,  $P_F$ , for Category 1 (Design Category 5 in the ASCE Standard XXX) (that is, mean  $10^{-5}$  per yr) is the same as established in DOE-STD-1020-94 (USDOE, 1996) for seismic design of PC-4 SSCs in U.S. Department of Energy's nuclear facilities, which have comparable radiological safety performance requirements.

The target mean annual performance goal for nuclear plants of mean  $10^{-5}$  per yr is achieved by coupling site-specific DRS with the deterministic seismic design criteria and procedures specified by NUREG-0800. The ASCE Standard XXX criteria for deriving a site-specific DRS are based on the conservative assumption that the seismic design criteria specified by NUREG-0800 achieve less than a one percent chance of failure for a given DRS. The conservatism of this assumption is demonstrated by analyses described in McGuire, et al. (2002), which show plant level risk reduction factors ranging from about 20 to about 40 are

attained by the NRC's seismic design criteria. The method is based on use of mean hazard results consistent with the recommendation contained in McGuire, et al. (2002) and with the NRC's general policy on use of seismic hazard in risk-informed regulation.

The site-specific DRS is defined in terms of the site-specific Uniform Hazard Response Spectrum (UHRS) as:

$$\text{DRS} = \text{DF} * \text{UHRS} \quad \text{Equation 2.5-1}$$

where UHRS is the site-specific UHRS at the ground surface, defined for ASCE Seismic Design Category SDC-5 at the mean  $10^{-4}$  per yr annual frequency of exceedance, and DF is the Design Factor that is based on the slope of the mean hazard curve. When used to scale the UHRS, the derived DRS is a uniform risk spectrum, which used with the NRC's seismic design criteria assures a consistent risk against failure across all SSCs. The procedure for derivation of the DRS is as follows.

For each spectral frequency at which the UHRS is defined, a slope factor  $A_R$  is determined from:

$$A_R = \frac{S A_{0.1H_D}}{S A_{H_D}} \quad \text{Equation 2.5-2}$$

where  $S A_{H_D}$  is the spectral acceleration at the target mean UHRS exceedance frequency  $H_D$  (that is,  $10^{-4}$  per yr) and  $S A_{0.1H_D}$  is the spectral acceleration at  $0.1H_D$  (that is,  $10^{-5}$ /yr). Then the Design Factor, DF, at this spectral frequency is given by:

$$\text{DF} = \text{Maximum} (\text{DF}_1, \text{DF}_2). \quad \text{Equation 2.5-3}$$

For ASCE SDC-5:

$$\text{DF}_1 = 1.0 \quad \text{Equation 2.5-3a}$$

$$\text{DF}_2 = 0.6(A_R)^{0.80} \quad \text{Equation 2.5-3b}$$

The derivation of DF is described in detail in Commentary to the ASCE Standard XXX (ASCE, 2003). Implementation of the ASCE Standard XXX approach for the EGC ESP is also described in Section 4.3.1 of Appendix B. The resulting DRS are shown on Figure 2.5-12.

The resulting DRS for the EGC ESP site are generally enveloped by the Regulatory Guide 1.60 response spectrum anchored to a peak acceleration of 0.3g except at some frequencies above 16 Hz. EPRI (1993b) presents an assessment of the significance of high frequency ground motions to the seismic safety performance of nuclear power plants. That study indicates that there are two factors that lead to reduced effectiveness of high frequency motions to adversely affect performance at high frequencies: (1) the increased incoherence of ground motions at frequencies greater than 10 Hz compared to those at lower frequencies and (2) the capacity of structures and equipment in nuclear power plants to in-elastically absorb the small displacements associated with high frequency ground motions without significant effect. The incoherence reductions are consistent with those recommended in ASCE 4 *Seismic Analysis of Safety-Related Nuclear Structures and Commentary on Standard for Seismic Analysis of Safety-Related Nuclear Structures* (ASCE, 1998).

EPRI (1993b) recommends procedures for reducing the high-frequency portion of DRS to account for these effects. The recommended reduction factors for ground motion incoherency are 10 percent at a frequency of 10 Hz increasing to 20 percent for frequencies of 25 Hz and larger. These factors are appropriate for a building width of approximately 150 ft. For a 75 ft dimension, such as might be associated with a diesel generator building or pump house, these reductions are approximately 50 percent of those for a 150-ft dimension. The reduction factors due to in-elastic absorption of small displacements are of comparable magnitude.

When modified by the high frequency adjustment factors recommended by EPRI (1993b), the vertical and horizontal DRS in Figure 2.5-12 either will be enveloped by the Regulatory Guide 1.60 response spectrum, in the case of a large structure (that is, dimensions equal to approximately 150 ft), or result in only minor exceedances at frequencies in excess of 25 Hz for structures where dimensions are on the order of 75 ft. Based on these results, it is concluded that the high-frequency exceedances of the Regulatory Guide 1.60 response spectrum anchored to 0.3g peak acceleration by the EGC ESP DRS are not significant – indicating that the EGC ESP Site is suitable for any design based on a Regulatory Guide 1.60 response spectrum.

#### **2.5.4.10 Static Stability**

Independent estimates of bearing capacity, settlement, and lateral earth pressures were not made for the EGC ESP Site, since a generating system has not been selected. The candidate generating systems have different footprint sizes, depths of embedment, and effective weights, and these variables will affect the determination of bearing pressures, settlement, and lateral earth pressures. For this reason the determination of this stability information will be performed at the COL stage.

While static stability considerations are not explicitly addressed for the EGC ESP Site, high allowable bearing values and low compressibility are expected at the EGC ESP Site because of the similarity in soil conditions to those occurring at the CPS Site. This is also due to the assumption that the foundation levels and the net weights of the structures at the EGC ESP Site will generally be the same as those at the CPS Site. These conditions will have to be evaluated after the power generating system is selected.

The static stability discussions in the CPS USAR cover bearing capacities, settlement, and lateral earth pressure recommendations appropriate for design of the CPS structures. The bearing capacity discussion indicates that allowable bearing pressures range from 25 to 60 tsf, that settlements were less than predicted, and that conventional methods were used to estimate lateral earth pressures. The very high bearing capacities and the low settlement values are related to the general consistency of soils supporting the CPS Site facilities, as well as the geometry and net loads introduced by the structures. The soils at both the CPS and EGC ESP Sites at the CPS Site foundation level (that is, approximately 55 ft below the ground surface) have been overconsolidated by glaciers that once overrode the site. The weight of the glaciers compressed the soils, thereby resulting in soils that have very high strength and very low compressibility.

Based on the bearing values given in the CPS USAR, the minimum site characteristic value for bearing pressures at the EGC ESP Site is 25 tsf. Additional discussions of Static Stability

are presented in [Section 6.2](#) of Appendix A.

#### **2.5.4.11 Design Criteria**

The design criteria for EGC ESP Site Category I structures will be established during the COL stage when the physical characteristics of the operating system are known. The following sections of this SSAR provide preliminary information that will be considered when design criteria are developed for the EGC ESP Site:

- Liquefaction potential in [Section 2.5.4.8](#);
- Bearing capacity in [Section 2.5.4.10](#);
- Settlement in [Section 2.5.4.10](#);
- Static slope stability in [Section 2.5.5](#);
- Dynamic slope stability in [Section 2.5.5](#).

Additional valuable information relevant to each of these areas is presented under the same section numbers in the CPS USAR. In view of the similarity in soil conditions at the EGC ESP Site and the CPS Site, design criteria given in the CPS USAR serve as a reasonable starting point for developing design criteria for the EGC ESP Site.

#### **2.5.4.12 Techniques to Improve Subsurface Conditions**

Localized areas and pockets of loose granular materials were encountered in the base of excavations for the CPS Category I structures (approximately 55 ft below the ground surface) during construction at the CPS Site. These materials were either compacted or removed and replaced with a flyash backfill material. Additional discussions of the replacement work is described in Section 2.5.4.5 of the CPS USAR.

Until the power generating system is selected, the need for ground improvement for the EGC ESP Site is unknown. Some of the generating systems being considered extend to as deep as 140 ft below the ground surface. It is unlikely that these systems would require any improvement. Systems that are founded at depths of 55 ft or above could require ground improvement as discussed for the CPS Site in the CPS USAR. Alternatives other than the ground improvement used at the CPS Site (that is, excavation and replacement of approximately 20 feet of soil between depths of 35 ft and 55 ft) exist. These include use of stone columns, cement soil mixing, or grouting, and could be considered if the excavation approach discussed in the CPS USAR is found to be inappropriate.

In view of the soil conditions discussed in the CPS USAR, in this section of the SSAR, and in [Appendix A](#), nothing was identified that would result in unreasonable requirements relative to construction or operation of a new power generating system at the EGC ESP Site. Decisions regarding the need for and type of ground improvement will be made during the COL stage after a generating system is selected.

#### **2.5.4.13 Subsurface Instrumentation**

A settlement instrumentation system was installed during construction of the CPS plant structures. These settlement points were monitored every 4 months until the movement of the structures stabilized. Graphical recordings of the measurements are included in the CPS

USAR. The amount of movement was less than was predicted using conventional settlement prediction methods.

These settlement measurements provide valuable calibration data for future settlement predictions at the EGC ESP Site. Since soil conditions are consistent between the EGC ESP and CPS Sites, conventional methods can be used with considerable confidence to estimate the settlement of future facilities at the EGC ESP Site. This assumes that the new facilities are reasonably similar in size, load, and foundation level to those constructed at the CPS Site.

#### **2.5.4.14 Construction Notes**

The CPS USAR provides valuable information from the construction of the CPS Facilities. This information was reviewed as part of the EGC ESP Site work. While this information does not have direct relevance to the EGC ESP Site application, it provides information that will be considered again during the COL stage of the project.

Any future excavation associated with the construction of a new generating system will be mapped to confirm that soil types and consistency are in general accord with the conditions identified during previous construction at the site and that have been interpreted from the field explorations carried out at the EGC ESP Site. This field mapping will involve inspecting excavated slopes for the presence of previously unknown fault offsets.

In addition to mapping excavations for EGC ESP Seismic Category I structures, a commitment is made in this SSAR to

- notify the NRC staff immediately if previously unknown geologic features that could represent a hazard to the plant are encountered during excavation, and
- notify the NRC staff when the excavations are open for examination and evaluation.

#### **2.5.5 Stability of Slopes**

Slope stability analyses were not carried out for the EGC ESP Site Application – either for the CPS UHS or any other slopes that could be associated with future development. The closest existing natural slopes to the site are located nearly 800 ft to the north. If a new intake structure into Clinton Lake is required for a future design, additional assessment of slope stability at the point of entry into the lake could be required. The slopes for the existing CPS Unit 2 Facility are approximately 30-ft deep and are located over 500 ft from the EGC ESP Site, and therefore, they don't pose a hazard.

The foundation depths of the new generating system are also unknown. These depths are needed to assess the potential height of slopes required for construction. Once the generating system is selected, the requirements for additional slope stability studies related to either construction of the power block or the outfall will be determined and provided at the COL stage.

A starting point for any future stability assessments will be the information in the CPS USAR. Extensive evaluation of the stability of slopes was conducted during design work for the CPS Site. Slopes associated with the Lake Clinton main dam and the CPS UHS were evaluated for stability under gravity and seismic loading conditions. As discussed in Section

2.5.5 of the CPS USAR, only the CPS UHS was evaluated for the SSE. The downstream dam was not considered a Category I structure.

It was concluded from the review of the stability information in the CPS USAR that potential future issues associated with slope stability will not, for the most part, result in any unusual construction requirements or constraints. The strength of soils at the EGC ESP and CPS Sites are generally very high, thereby allowing relatively steep construction slopes. The slopes along a future intake structure alignment also will be in soils that can be cut or worked on without significant construction difficulty. A number of ground improvement methods are also available for mitigating slope stability concerns, if they were to be found. These evaluations can be conducted during the COL stage once the characteristics of the generating system are established.

Additional studies may be required during the COL stage to show that the CPS UHS meets stability requirement under the updated SSE. The existing slopes for the CPS UHS appear to have some reserve capacity because of their flatness. Nevertheless, detailed analyses would have to be conducted to confirm the adequacy of these slopes.

## **2.5.6 Embankments and Dams**

Two areas related to dams and embankments were considered. The first involves the Clinton Lake main dam and CPS UHS. The second deals with the potential for seismically induced floods and water waves. As will be discussed, the only potential source of seismically induced floods and water waves is a seiche on Clinton Lake.

### **2.5.6.1 Design of Main Dam and CPS UHS**

The CPS USAR includes an extensive discussion of the explorations and design of the CPS UHS and the Clinton Lake main dam. As noted previously, the main dam is not considered a Category I structure. Emergency cooling water needs for the CPS facilities are provided by the CPS UHS. Since there are no plans to modify or rely on the Clinton Lake main dam for emergency cooling water for the EGC ESP Site facilities, information in the CPS USAR regarding the design, construction, and performance of the dam was not reviewed.

The EGC ESP Facility will use cooling towers for cooling with Clinton Lake being used to provide make-up water to the cooling towers. Additional description and discussion of the use of the UHS to supply shutdown-cooling water for the existing CPS Facility and makeup water to the EGC ESP Facility safety-related cooling towers are provided in [Section 2.4.8.1.5](#). If appropriate, evaluations will be made at the COL stage to assess performance of the submerged dam forming the UHS under the updated SSE and OBE.

The starting point for the COL stage assessment will be Section 2.5.6 of the CPS USAR. This section includes a detailed summary of the design of the CPS UHS. The description in Section 2.5.6 indicates that embankments were constructed before filling Clinton Lake. The design effort for the CPS UHS involved evaluations of slope stability, seepage control, and monitoring. Both static and dynamic methods of analysis were used when evaluating the stability of the slopes. Liquefaction potential was considered during these evaluations. The CPS UHS discussions also indicate that monitoring of the CPS UHS since construction and flooding of Clinton Lake has included periodic fathometer surveys and underwater inspections.

### 2.5.6.2 Seismically Induced Floods and Water Waves

The design basis for seismically induced floods and water waves is considered because they could affect a site if the source of water were to inundate the site. Generally, the source of flooding is from failure of dams located upstream of the facility or large water retaining structures (steel and concrete tanks) located near the facility. Another potential source of water inundation is from a seiche. These water waves result from sloshing of water in a lake.

The potential for seismically induced floods and water waves at the EGC ESP Site is negligible. There are no dams located upstream of the site, and there are no large water retaining structures (tanks) located in proximity to the existing facilities. Potential flooding from a seiche is also minimal because of the configuration of Clinton Lake and the relative elevation difference between the water level in the lake and the plant site grade. The ground surface at the EGC ESP Site is located at approximate elevation 730 ft msl, while the normal operating pool for Clinton Lake is at approximate elevation 690 ft msl, resulting in 40 ft of elevation change. The EGC ESP Site is also approximately 800 ft from the shoreline of Clinton Lake. Any seiche caused by an SSE would be too small to reach the site because of the distance and the height above the normal lake elevation. Additional discussion of maximum surge and seiche flooding is provided in [Section 2.4.5](#) of this SSAR.

# References

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## Chapter Introduction

10 CFR 52. Code of Federal Regulations. "Early Site Permits; Standard Design Certification; and Combined Licenses for Nuclear Power Plants."

## Section 2.1

10 CFR 20. Code of Federal Regulations. "Standards for Protection Against Radiation."

10 CFR 50. Code of Federal Regulations. "Domestic Licensing of Production and Utilization Facilities."

10 CFR 100. Code of Federal Regulations. "Reactor Site Criteria."

Clinton Chamber of Commerce (CCC), Number of Small Businesses. Available at: [www.clintonillinois.com](http://www.clintonillinois.com). August 8, 2002.

Clinton Power Station (CPS). *Clinton Power Station Updated Safety Analysis Report*. Revision 10. 2002.

Illinois Agricultural Statistics Service. *Illinois Farm Report*. Volume 23. No. 4. March 25, 2002.

Illinois Department of Commerce and Community Affairs (IDCCA). *Community Profiles*. Available at: <http://www.commerce.state.il.us/com/index.html>. July 1, 2002.

Illinois Plan for Radiological Accidents (IPRA). Volume VIII. July 2001

Illinois State University (ISU). Available at: <http://www.cadus.ilstu.edu/data.html>. July 2, 2002.

National Center for Education Statistics (NCES). Available at: <http://www.capitolimpact.com/>. July 2, 2002.

U.S. Census Bureau. Census 2000 County and County Equivalent Areas of Illinois Generalized Boundary File. Available at: <http://www.census.gov/geo/www/cob/co2000.html>. June 26, 2002a.

U.S. Census Bureau. Census 2000 Incorporated/Census Designated Places of Illinois Generalized Boundary File. Available at: <http://www.census.gov/geo/www/cob/pl2000.html>. June 26, 2002b

U.S. Census Bureau. Census 2000 Summary File 1. 2001.

U.S. Census Bureau. Census 2000 TIGER/Line Files (machine-readable data files). Roads, Railroads and Water Features. Washington D.C. 2000.

U.S. Department of Commerce (USDOC). Bureau of Economic Analysis. Available at: <http://www.bea.doc.gov/bea/regional/reis/July 2 2002>.

U.S. Geological Survey (USGS). Topographic Map. Clinton 7.5-minute Quadrangle. 1990.

U.S. Nuclear Regulatory Commission (USNRC). *Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants*. Regulatory Guide 1.70, Revision 3. November 1978.

## Section 2.2

Bureau of Transportation Statistics. National Transportation Atlas. Airport Locations. 2000 Chicago Sectional Aeronautical Chart (CSAC), 63<sup>rd</sup> Edition, November 1, 2001.

Clinton Power Station (CPS). *Clinton Power Station Updated Safety Analysis Report*. Revision 10. 2002.

Illinois Department of Natural Resources (IDNR). GIS Layer of Electrical Line Locations in Illinois. 1993.

Illinois Department of Natural Resources (IDNR). GIS Layer of Pipeline Locations in Illinois. 1984.

Illinois Power Corporation Transmittal to NRC, Illinois Power Evaluation of Potential Transportation Accidents, February 11, 1998.

National Transportation Safety Board (NTSB). Aviation Accident Database and Synopses. Available at: <http://www.nts.gov/nts/query.asp>. April 29, 2003.

State of Illinois Department of Transportation (SIDOT). Internet Website. Available at: [www.dot.state.il.us/](http://www.dot.state.il.us/). October 25, 2002.

U.S. Census Bureau. Census 2000 County and County Equivalent Areas of Illinois Generalized Boundary File. Available at: <http://www.census.gov/geo/www/cob/co2000.html>. June 26, 2002a.

U.S. Census Bureau. Census 2000 Incorporated/Census Designated Places of Illinois Generalized Boundary File. Available at: <http://www.census.gov/geo/www/cob/pl2000.html>. June 26, 2002b.

U.S. Census Bureau. Census 2000 TIGER/Line Files (machine-readable data files). Roads, Railroads and Water Features. Washington D.C. 2000.

U.S. Nuclear Regulatory Commission (USNRC). *Aircraft Hazards*, NUREG-0800, DRAFT Standard Review Plan 3.5.1.6 included with draft Review Standard RS-002, *Processing Applications for Early Site Permits*. December 2002.

U.S. Nuclear Regulatory Commission (USNRC). *Aircraft Hazards*. NUREG-0800, Standard Review Plan 3.5.1.6, Revision 2. July 1981.

U.S. Nuclear Regulatory Commission (USNRC). *Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release*. Regulatory Guide 1.78, Revision 1. December 2001.

U.S. Nuclear Regulatory Commission (USNRC). *Evaluation of Explosions Postulated To Occur on Transportation Routes Near Nuclear Power Plants*. Regulatory Guide 1.91, Revision 1. February 1978b.

U.S. Nuclear Regulatory Commission (USNRC). *Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants*. Regulatory Guide 1.70, Revision 3. November 1978a.

## Section 2.3

American Meteorological Society (AMS). *Glossary of Meteorology*. American Meteorological Society. Boston, Massachusetts. 1970.

American National Standards Institute (ANSI)/ American Nuclear Society (ANS) Standard 2.3. *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. 1983.

American Society of Civil Engineers (ASCE). *Minimum Design Loads for Buildings and Other Structures*. ASCE-7-98. March 2000.

Association of American Railroads (AAR). *Glaze Storm Loading Summary*. 1927-28 to 1936-37. 1955.

Bryson, R.A. *Airmasses, Streamlines and the Boreal Forest*. Technical Report No. 24. pp 13-57. University of Wisconsin: Department of Meteorology. Madison, Wisconsin. 1966.

Campbell, Robert J. *Annual Radioactive Effluent Release Report for the Clinton Power Station, January 1, 2001 through December 31, 2001*. Attached to AmerGen letter from Michael J Pacilio to the NRC Document Control Desk, Clinton letter reference number U-603543, NRC Adams Accession Number ML020800817 and ML020800855, March 8, 2002.

Changnon, S. A. "Temporal Fluctuations of Hail in Illinois." Illinois State Water Survey Misc. Publication 167, pp.19. 1995.

Changnon, S. A., Jr. "Climatology of Severe Winter Storms in Illinois." Bulletin 53. Illinois State Water Survey. Urbana, Illinois. 1969.

Changnon, S.A., Jr. "Thunderstorm-Precipitation Relations in Illinois." Report of Investigation No. 34. Illinois State Water Survey. Urbana, Illinois. 1957.

Clinton Power Station (CPS). *Clinton Power Station Construction Phase Environmental Report*. 1973.

Clinton Power Station (CPS). *Clinton Power Station Operating License Stage Environmental Report*. Supplement 3. April 1982.

Clinton Power Station (CPS). *Clinton Power Station Updated Safety Analysis Report*. Revision 10. 2002.

Electric Power Research Institute (EPRI). Letter from E. E. Kintner (EPRI) to Dr. Thomas Murley (USNRC), May 5, 1992.

Fujita, T.T., *US Tornadoes, Part 1, 70 Year Statistics*. AMRP. Research Paper 218. Published by University of Chicago, Illinois. 1987

Gale Research Company. *Climates of the States*. Third Edition, Volume 1. Alabama - New Mexico. ISBN 0-8103-1042-2. 1985.

Gale Research Company. *The Weather Almanac*. Sixth Edition. ISBN 8103-2843-7. 1992b.

Gale Research Company. *Weather of U.S. Cities*. Fourth Edition. ISBN 0-8103-4827-6. 1992a.

Grazulis, T.P. *110-Year Perspective of Significant Tornadoes*. Paper in: *The Tornado: Its Structure, Dynamics, Prediction, and Hazards*. Geophysical Monograph 79, Published by the American Geophysical Union, Washington, D.C. 1993

Holzworth, G.C., *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*. AP-101. U.S. Environmental Protection Agency, Office of Air Programs. Research Triangle Park, North Carolina. January 1972.

Hosler, C.R. "Low-Level Inversion Frequency in the Contiguous United States." *Monthly Weather Review*, Volume 89, pp. 319-339. September 1961.

Huff, F.A. and Changnon, S.A., Jr. Hail. "Climatology of Illinois." Report of Investigation 38. Illinois State Water Survey. Urbana, Illinois. 1959.

Marshall, J.L. "Probability of a Lightning Stroke. Lightning Protection." Chapter 3. pp. 30-31. John Wiley and Sons. New York, New York. 1971.

National Oceanic and Atmospheric Administration (NOAA). National Climatic Data Center. "Storm Damage Reports in Illinois." Available at: <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>. 2002b.

National Oceanic and Atmospheric Administration (NOAA). U.S. National Weather Service Public Information Statement. 10:00 AM CST Tuesday March 5, 2002. Available at: <http://www.crh.noaa.gov/ilx/torstats.htm>. 2002a.

Thom, J. C. S. "Tornado Probabilities." *Monthly Weather Review*. Volume 91. pp. 730-736. 1963.

U.S. Department of Commerce (USDOC). "Severe Local Storm Occurrences, 1955-1967" WBTM FCST 12. USDOC, ESSA. Silver Spring, Maryland. September 1969.

U.S. Geological Survey (USGS). Enhanced Digital Raster Graphic 30 X 60. 1984.

U.S. Geological Survey (USGS). Enhanced Digital Raster Graphic 30 X 60. 1989.

U.S. Nuclear Regulatory Commission (USNRC). Advisory Committee on Reactor Safeguards memo providing a summary of Issues Pertaining to Evolutionary and Passive Light Water Reactors and Their Relationship to Current Regulatory Requirements, May 13, 1992.

U.S. Nuclear Regulatory Commission (USNRC). *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*. Regulatory Guide 1.145, Revision 1. Office of Nuclear Regulatory Research. February 1983.

- U.S. Nuclear Regulatory Commission (USNRC). *Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purposed of Evaluating Compliance with 10 CFR 50, Appendix I. Regulatory Guide 1.109, Revision 1.* Office of Nuclear Regulatory Research. March 1976.
- U.S. Nuclear Regulatory Commission (USNRC). *Design Basis Tornado for Nuclear Power Plants.* Regulatory Guide 1.76. 1974a.
- U.S. Nuclear Regulatory Commission (USNRC). *Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design, Main Report.* NUREG-1503. July 1994.
- U.S. Nuclear Regulatory Commission (USNRC). Letter from Lester S. Rubenstein to Edwin E. Kintner. *ALWR Design Basis Tornado.* March 25, 1988.
- U.S. Nuclear Regulatory Commission (USNRC). *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases From Light Water-Cooled Reactors.* Regulatory Guide 1.111, Revision 1. Office of Nuclear Regulatory Research. July 1977.
- U.S. Nuclear Regulatory Commission (USNRC). *NRC Review of Electric Power Research Institute's Advanced Light Water Reactor Utility Requirements Document,* NUREG-1242, Volume 3, Part 1. August 1994a.
- U.S. Nuclear Regulatory Commission (USNRC). *Onsite Meteorological Programs.* Regulatory Guide 1.23. Office of Nuclear Regulatory Research. February 1972.
- U.S. Nuclear Regulatory Commission (USNRC). *PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations.* NUREG/CR-2858. September 1982.
- U.S. Nuclear Regulatory Commission (USNRC). *Policy, Technical and Licensing Issues pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs,* SECY-93-087. April 1993.
- U.S. Nuclear Regulatory Commission (USNRC). Staff Requirements Memorandum, July 15, 1993a.
- U.S. Nuclear Regulatory Commission (USNRC). *Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants.* Regulatory Guide 1.70, Revision 3. November 1978.
- U.S. Nuclear Regulatory Commission (USNRC). *Technical Basis for Interim Regional Tornado Criteria,* WASH-1300. 1974b.
- U.S. Nuclear Regulatory Commission (USNRC). *Tornado Climatology of the Contiguous United States,* NUREG/CR-4461. May 1986.
- Wilson, J.W., and S.A. Changnon, Jr., *Illinois Tornadoes.* Circular 103. Illinois State Water Survey. Urbana, Illinois. 1971.

## Section 2.4

American Society of Civil Engineers (ASCE). *Minimum Design Loads for Buildings and Other Structures.* ASCE-7-98. March, 2000.

- Chow, V. T. *Handbook of Applied Hydrology*. McGraw-Hill Book Co., New York. 1964.
- Clinton Power Station (CPS). *Clinton Power Station Operating License Stage Environmental Report*. Supplement 3. April 1982.
- Clinton Power Station (CPS). *Clinton Power Station Updated Safety Analysis Report*. 2002
- Illinois Division of Waterways (IDOW) and U.S. Geological Survey (USGS). W. D. Mitchell, "Unit Hydrographs in Illinois." 1948.
- Illinois State Geological Survey (ISGS). GIS Layer of Well Locations. 2002.
- Illinois State Water Survey (ISWS). "Potential Surface Water Reservoirs of North-Central Illinois." J. H. Davis and M. L. Terstriep, Report of Investigation No. 56, Illinois State Water Survey. Urbana, Illinois. 1966.
- Illinois State Water Survey (ISWS). GIS Layer of One-Hundred and Five-Hundred Year Floodzones for Unincorporated Areas in Illinois by County. 1996.
- Kempton, John P., et al. "Topography, Glacial Drift Stratigraphy, and Hydrogeology." Geological Society of America Special Paper 258. Mahomet Bedrock Valley, East-Central Illinois. 1991.
- Knapp, H.V., "Sangamon River Streamflow Assessment Model: 1999 Update to the Hydrologic Analysis." Illinois State Water Survey Contract Report 650. 1999.
- Midwest Regional Climate Center (MRCC). Database File of Evaporation Data 1963-2002. August 12, 2002a.
- Midwest Regional Climate Center (MRCC). Database File of Rainfall Data 1910-2002. August 12, 2002b.
- Surface Water Supply of the United States (SWSUS). Rating Table. Water Year 1958-1959. Page 452. 1959.
- University of Illinois Agricultural Experiment Station (UIAES). Soils of Illinois. Soil Report No. 725. August 1967.
- University of Illinois Agricultural Experiment Station (UIAES). DeWitt County Soils, Bulletin 67. June 1960.
- U.S. Army Corp of Engineers (USACOE). March, 1965. "Standard Project Flood Determinations." Civil Engineer Bulletin No. 52-8. EM 1110-2-1411. March 1952. Revised.
- U.S. Army Corps of Engineers (USACOE). "Shore Protection, Planning and Design." Technical Report 4, 3<sup>rd</sup> edition, Coastal Engineering Research Center. 1966b.
- U.S. Army Corps of Engineers (USACOE). "Spillway Rating and Flood Routing." Computer Program 22-J2-L-210, Hydrologic Engineering Center. 1966a.
- U.S. Army Corps of Engineers (USACOE). "Water Surface Profiles." Computer Program 22-J2-L-232, Hydrologic Engineering Center. December 1968.

U.S. Army Corps of Engineers (USACOE). Written Communication on SPF and PMF for the Illinois River. November 2, 1970.

U.S. Army Corps of Engineers (USACOE). "Waves in Inland Reservoirs." Technical Memorandum No. 132. November 1962.

U.S. Census Bureau. Census 2000 Incorporated/Census Designated Places of Illinois Generalized Boundary File. Available at:  
<http://www.census.gov/geo/www/cob/pl2000.html>. June 26, 2002.

U.S. Census Bureau. Census 2000 TIGER/Line Files (machine-readable data files). Roads, Railroads and Water Features. Washington D.C. 2000.

U. S. Department of Commerce (USDOC) and U.S Army Corp of Engineers (USACOE). E.M. Hansen, L.C. Schreiner and J.F. Miller, "Application of Probable Maximum Precipitation Estimates - United States East of the 105<sup>th</sup> Meridian," NOAA Hydrometeorological Report No.52. August 1982

U.S. Department of Interior (USDOI), Bureau of Reclamation, *Design of Small Dams*, Second Edition, 1973.

U.S. Environmental Protection Agency (USEPA). Source Water Protection. Designated Sole Source Aquifers in EPA Region V. Available at:  
<http://www.epa.gov/OGWDW/swp/ssa/reg5.html>. August 8, 2002.

U.S. Geological Survey (USGS). DeWitt 7.5 Minute Quadrangle Digital Raster Graphic. 1979.

U.S. Geological Survey (USGS). Enhanced Digital Raster Graphic 30 X 60. 1984.

U.S. Geological Survey (USGS). Enhanced Digital Raster Graphic 30 X 60. 1989.

U.S. Geological Survey (USGS). Flood Zone Boundaries Based on USGS National Digital Elevation Model. 1999.

U.S. Geological Survey (USGS). Ground Water Atlas of the United States – Segment 10. Hydrologic Investigations Atlas 730-K. 1995a.

U.S. Geological Survey (USGS). National Water Information System 1978-1999. Available at:  
<http://waterdata.usgs.gov/nwis>. August 20, 2002.

U.S. Geological Survey (USGS). National Water-Use Data Files. Available at:  
<http://water.usgs.gov/watuse/spread95/ilco95.txt>. [August 14, 2002] 1995b.

U.S. Nuclear Regulatory Commission (USNRC). *Design Basis for Floods for Nuclear Power Plants*. Regulatory Guide 1.59, Revision 2. Office of Standards Development. August 1977.

U.S. Nuclear Regulatory Commission (USNRC). *Final Environmental Statement related to the operation of Clinton Power Station, Unit No. 1, Docket No. 50-461*. NUREG-0854. Office of Nuclear Reactor Regulation. May 1982.

U.S. Weather Bureau (USWB) and U.S Army Corp of Engineers (USACOE). J. T. Reigel, J. F. Appleby, and R. W. Schloemer, "Seasonal Variation of the Probable Maximum Precipitation East of the 105<sup>th</sup> Meridian for Areas from 10 to 1000 square mi and Durations of 6, 12, 24, and 48 hours." Hydrometeorological Report No. 33. April 1956.

U.S. Weather Bureau (USWB). "Climatology of the United States." No. 86-9, Washington, D.C. 1964.

U.S. Weather Bureau (USWB). D. M. Hershfield, "Rainfall Frequency Atlas of the United States." Technical Paper No. 40. May 1961.

## Section 2.5

10 CFR 50. Code of Federal Regulations. "Domestic Licensing of Production and Utilization Facilities."

10 CFR 52. Code of Federal Regulations. "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plant."

10 CFR 100. Code of Federal Regulations. "Reactor Site Criteria."

American Society of Civil Engineers (ASCE). "Seismic Analysis of Safety Related Nuclear Structures and Commentary." ASCE 4. ASCE, Reston, VA, 1998.

American Society of Civil Engineers (ASCE). "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities and Commentary." ASCE Standard XXX, Approval Draft, ASCE, Reston, VA, July 25, 2003.

Atkinson, G.M., and I.A. Beresnev. "Ground Motions at Memphis and St. Louis from M 7.5-8.0 Earthquakes in the New Madrid Seismic Zone." Bulletin of the Seismological Society of America. Vol. 92, No. 3. pp. 1015-1024. 2002.

Boore, D.M., and G.M. Atkinson. "Stochastic Prediction of Ground Motion and Spectral Response Parameters at Hard-Rock Sites in Eastern North America." Bulletin of the Seismological Society of America. Vol. 77, No. 2. pp. 440-467. 1987.

Cramer, C.H. "A Seismic Hazard Uncertainty Analysis for the New Madrid Seismic Zone." Engineering Geology. Vol. 62. pp. 251-266. 2001.

Electric Power Research Institute (EPRI). "Probabilistic Seismic Hazard Evaluations at Nuclear Power Plant sites in the Central and Eastern United States." EPRI Report NP-4726, All Volumes, 1989-1991.

Electric Power Research Institute (EPRI). "Guidelines for Determining Design Basis Ground Motions - Volume 1: Method and Guidelines for Estimating Earthquake Ground Motion in Eastern North America." EPRI Report TR-102293, 1993a.

Electric Power Research Institute (EPRI). "Analysis of High-Frequency Seismic Effects." EPRI Report TR-102470, 1993b.

Electric Power Research Institute (EPRI). CEUS Ground Motion Project - Model Development and Results, TR-1008910, 2003

Frankel, A.D., M.D. Petersen, C.S. Mueller, K.M. Haller, R.L. Wheeler, E.V. Leyendecker, R.L. Wesson, S.C. Harmsen, C.H. Cramer, D.M. Perkins, and K.S. Rukstales. "Documentation for the 2002 Update of the National Seismic Hazard Maps." U. S. Geological Survey Open-File Report 02-420, 33 pp. 2002.

- Harrison, R.W., and A. Schultz. "Tectonic Framework of the Southwestern Margin of the Illinois Basin and Its Influence on Neotectonism and Seismicity." *Seismological Research Letters*. Vol. 73, No. 5. pp. 698-731. September/October 2002.
- Kolata, D.R., and T.G. Hildenbrand. "Structural Underpinnings and Neotectonics of the Southern Illinois Basin: An Overview." *Seismological Research Letters*. Vol. 68, No. 4. pp. 499-510. July/August 1997.
- McBride, J.H., and D.R. Kolata. "Upper Crust Beneath the Central Illinois Basin, United States." *Geological Society of America Bulletin*. Vol. 111. pp. 372-394. 1999.
- McGuire, R.K., G.R. Toro, and W.J. Silva. "Engineering Model of Earthquake Ground Motion for Eastern North America." Electric Power Research Institute Technical Report NP-6074. 1988.
- McGuire, R.K., W.J. Silva, and C.J. Costantino. "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-consistent Ground Motion Spectra Guidelines." NUREG/CR-6728. Washington, D.C., U.S. Nuclear Regulatory Commission. May 2001.
- McGuire, R. K., W. J. Silva, and C. J. Costantino. "Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Development of Hazard-and Risk-Consistent Seismic Spectra for Two Sites", NUREG/CR-6769, U. S. Nuclear Regulatory Commission, Washington, DC, 2002.
- Mueller, C., M. Hopper, and A. Frankel. "Preparation of Earthquake Catalogs for the National Seismic-Hazard Maps: Contiguous 48 States." U.S. Geological Survey Open-File Report 97-464. 1997.
- Nelson, W.J. "Structural Features in Illinois." *Illinois State Geological Survey Bulletin* 100. 144 pp. 1995.
- Newmark, N.M., and W.J. Hall. "Earthquake Spectra and Design." Earthquake Engineering Research Institute. Berkeley, California. 1982.
- Nuttli, O. W. "Yield Estimates of Nevada Test Site Explosions obtained from Seismic Lg Waves, *Journal of Geophysical Research*, Vol. 91, pp. 2137-2151, 1986.
- Schnabel, P.B., J. Lysmer, and H.B. Seed. "SHAKE - A Computer Program for Earthquake Response Analysis of Horizontally Layered Sites." University of California Berkeley, College of Engineering, Report No. EERC 72-12. December 1972.
- Senior Seismic Hazard Analysis Committee (SSHAC). "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts", NUREG/CR-6372, Volume 1, Washington, D.C., U.S. Nuclear Regulatory Commission, 1997.
- Toro, G.R., and W.J. Silva. *Scenario Earthquakes for Saint Louis, MO, and Memphis, TN, and Seismic Hazard Maps for the Central United States Region including the Effect of Site Conditions*. Final Technical Report Submitted to the U.S. Geological Survey under USGS External Grant Number 1434-HQ-97-GR-02981. 2001.

U.S. Atomic Energy Commission (USAEC). *Design Response Spectra for Seismic Design of Nuclear Power Plants*. Regulatory Guide 1.60, Revision 1. Directorate of Regulatory Standards. December 1973.

U.S. Department of Energy (USDOE). "DOE Standard: Natural Phenomena Hazards, Design and Evaluation Criteria for Department Energy Facilities." DOE-STD-1020-94 including Change Notice #1. January 1996.

U.S. Nuclear Regulatory Commission (USNRC). *Laboratory Investigations of Soils For Engineering Analysis And Design of Nuclear Power Plants*. Regulatory Guide 1.138. Office of Nuclear Regulatory Research. April 1978.

U.S. Nuclear Regulatory Commission (USNRC). *Site Investigations for Foundations of Nuclear Power Plants*. Regulatory Guide 1.132. Office of Nuclear Regulatory Research. March 1979.

U.S. Nuclear Regulatory Commission (USNRC). "Safety Goals for the Operation of Nuclear Power Plants: Policy Statement", *Federal Register*, 10 CFR Part 50, Vol. 51, No. 149, 1986.

U.S. Nuclear Regulatory Commission (USNRC). *Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Motion*. Regulatory Guide 1.165. Office of Nuclear Regulatory Research. March 1997.

U.S. Nuclear Regulatory Commission (USNRC). "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Regulatory Guide 1.174. Office of Nuclear Regulatory Research. July 1998.

U.S. Nuclear Regulatory Commission (USNRC). "White Paper on Risk-Informed, Performance-Based Regulation", SECY-98-144, Washington, DC, 1999.

U.S. Nuclear Regulatory Commission (USNRC). "Modified Reactor Safety Goal Policy Statement", SECY-01-0009, Washington, DC, 2001a.

U.S. Nuclear Regulatory Commission (USNRC). *Site Investigations for Foundations of Nuclear Power Plants*. Draft Regulatory Guide 1101. Office of Nuclear Regulatory Research. February 2001b.

U.S. Nuclear Regulatory Commission (USNRC). *Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites*. Draft Regulatory Guide 1105. Office of Nuclear Regulatory Research. March 2001c.

U.S. Nuclear Regulatory Commission (USNRC). *Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants*. Draft Regulatory Guide 1109. Office of Nuclear Regulatory Research. August 2001d.

U.S. Nuclear Regulatory Commission (USNRC). "Update of the Risk-Informed Regulation Implementation Plan", SECY-02-0131, Washington, DC, 2002.

Vucetic, M., and R. Dobry. "Effect of Soil Plasticity on Cyclic Response." *Journal of Geotechnical Engineering*, ASCE, Vol. 117, No. 1, pp. 89-107. October 1991.

Wheeler, R.L., and C.H. Cramer. "Updated Seismic Hazard in the Southern Illinois Basin - Geological and Geophysical Foundations for Use in the 2002 USGS National Seismic-Hazard Maps. *Seismological Research Letters*. Vol. 73, No. 5. pp. 776-791. 2002.

Youd et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 and 1998 NCEER/NSF Workshops of Evaluation of Liquefaction Resistance of Soils." Journal of Geotechnical and Environmental Engineering, ASCE, Vol. 127, No. 10, pp. 817-833. October 2001.

## CHAPTER 2

# Tables

**TABLE 2.1-1**  
2000 Resident and Transient Population Within 16 km (10 mi)

	km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
<b>North-Residential</b>		0	10	16	30	25	51	<b>132</b>
<b>North-Transient</b>		0	0	0	3	1	3	<b>7</b>
<b>North North East-Residential</b>		0	9	12	49	33	88	<b>191</b>
<b>North North East-Transient</b>		0	0	0	7	1	3	<b>11</b>
<b>North East-Residential</b>		1	5	4	11	8	85	<b>114</b>
<b>North East-Transient</b>	1,115		0	0	0	1	3	<b>1,119</b>
<b>East North East-Residential</b>		1	3	194	16	27	164	<b>405</b>
<b>East North East-Transient</b>		0	0	264	0	1	3	<b>268</b>
<b>East -Residential</b>		0	3	10	42	11	43	<b>109</b>
<b>East -Transient</b>		0	0	864	0	1	2	<b>867</b>
<b>East South East-Residential</b>		0	0	12	5	39	58	<b>114</b>
<b>East South East-Transient</b>		0	0	0	0	1	2	<b>3</b>
<b>South East-Residential</b>		0	1	15	11	440	35	<b>502</b>
<b>South East-Transient</b>		0	1,848	0	0	162	2	<b>2,012</b>
<b>South South East-Residential</b>		0	8	8	11	15	69	<b>111</b>
<b>South South East-Transient</b>		0	0	0	0	1	9	<b>10</b>
<b>South-Residential</b>		0	2	19	10	13	73	<b>117</b>
<b>South-Transient</b>	630		0	3	0	1	3	<b>637</b>
<b>South South West-Residential</b>		0	0	92	21	12	60	<b>185</b>
<b>South South West-Transient</b>		0	0	0	0	1	3	<b>4</b>
<b>South West-Residential</b>		0	0	24	46	68	161	<b>299</b>
<b>South West-Transient</b>		0	437	0	1	677	403	<b>1,518</b>
<b>West South West-Residential</b>		0	8	29	22	198	2,147	<b>2,404</b>
<b>West South West-Transient</b>		0	821	0	0	4	537	<b>1,362</b>
<b>West -Residential</b>		0	55	37	23	1,245	5,207	<b>6,567</b>
<b>West -Transient</b>		0	3	0	1	11	3,749	<b>3,764</b>
<b>West North West-Residential</b>		1	16	8	10	23	743	<b>801</b>
<b>West North West-Transient</b>		0	0	0	1	1	19	<b>21</b>
<b>North West-Residential</b>		5	11	11	12	11	150	<b>200</b>
<b>North West-Transient</b>		0	0	0	0	1	153	<b>154</b>
<b>North North West-Residential</b>		0	11	14	9	13	60	<b>107</b>
<b>North North West-Transient</b>		73	0	0	0	1	3	<b>77</b>
<b>Residential Total</b>		<b>8</b>	<b>142</b>	<b>505</b>	<b>328</b>	<b>2,181</b>	<b>9,194</b>	<b>12,358</b>
<b>Cumulative Total (Residential plus Transient)</b>		<b>1,826</b>	<b>3,251</b>	<b>1,636</b>	<b>341</b>	<b>3,047</b>	<b>14,091</b>	<b>24,192</b>

Source: Residential Population is from U.S. Census Bureau, 2001. Transient Population is from U.S. Census Bureau, 2001; USDOC, 2002

**TABLE 2.1-2**  
Resident and Transient Population Projections Within 16 km (10 mi)

	km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
<b>North-Residential</b>								
2010 population		0	9	15	29	24	52	<b>129</b>
2020 population		0	9	15	28	24	53	<b>129</b>
2030 population		0	9	15	27	23	55	<b>129</b>
2040 population		0	9	14	27	22	57	<b>129</b>
2050 population		0	8	14	26	22	59	<b>129</b>
2060 population		0	8	14	25	21	60	<b>128</b>
<b>North-Transient</b>								
2010 population		0	0	0	3	1	3	<b>7</b>
2020 population		0	0	0	3	1	3	<b>7</b>
2030 population		0	0	0	3	1	3	<b>7</b>
2040 population		0	0	0	3	1	3	<b>7</b>
2050 population		0	0	0	3	1	3	<b>7</b>
2060 population		0	0	0	3	1	4	<b>7</b>
<b>North North East-Residential</b>								
2010 population		0	9	11	47	31	86	<b>184</b>
2020 population		0	9	11	46	30	86	<b>182</b>
2030 population		0	8	11	44	30	86	<b>179</b>
2040 population		0	8	10	43	29	85	<b>175</b>
2050 population		0	8	10	42	28	85	<b>173</b>
2060 population		0	8	10	41	27	85	<b>171</b>
<b>North North East-Transient</b>								
2010 population		0	0	0	7	1	3	<b>11</b>
2020 population		0	0	0	7	1	3	<b>10</b>
2030 population		0	0	0	6	1	3	<b>10</b>
2040 population		0	0	0	6	1	3	<b>10</b>
2050 population		0	0	0	6	1	3	<b>10</b>
2060 population		0	0	0	6	1	3	<b>10</b>
<b>North East-Residential</b>								
2010 population		1	5	4	10	8	81	<b>109</b>
2020 population		1	5	4	10	8	79	<b>107</b>
2030 population		1	4	4	10	8	77	<b>104</b>
2040 population		1	4	4	10	7	76	<b>102</b>
2050 population		1	4	4	9	7	74	<b>99</b>
2060 population		1	4	4	9	7	72	<b>97</b>
<b>North East-Transient</b>								
2010 population		1,115	0	0	0	1	3	<b>1,119</b>
2020 population		1,115	0	0	0	1	3	<b>1,119</b>
2030 population		1,115	0	0	0	1	3	<b>1,119</b>
2040 population		1,115	0	0	0	1	3	<b>1,119</b>
2050 population		1,115	0	0	0	1	3	<b>1,118</b>
2060 population		1,115	0	0	0	1	3	<b>1,118</b>
<b>East North East-Residential</b>								
2010 population		1	3	184	16	26	155	<b>385</b>
2020 population		1	3	180	15	25	152	<b>376</b>
2030 population		1	3	175	15	25	148	<b>367</b>
2040 population		1	3	171	15	24	145	<b>359</b>
2050 population		1	3	167	14	24	141	<b>350</b>
2060 population		1	3	163	14	23	137	<b>341</b>

**TABLE 2.1-2**  
Resident and Transient Population Projections Within 16 km (10 mi)

	km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
<b>East North East-Transient</b>								
2010 population		0	0	250	0	1	3	<b>254</b>
2020 population		0	0	245	0	1	3	<b>249</b>
2030 population		0	0	238	0	1	3	<b>242</b>
2040 population		0	0	233	0	1	3	<b>236</b>
2050 population		0	0	227	0	1	3	<b>231</b>
2060 population		0	0	222	0	1	3	<b>225</b>
<b>East-Residential</b>								
2010 population		0	3	10	40	10	41	<b>104</b>
2020 population		0	3	9	39	10	41	<b>102</b>
2030 population		0	2	9	38	10	41	<b>100</b>
2040 population		0	2	9	37	9	41	<b>98</b>
2050 population		0	2	9	36	9	41	<b>97</b>
2060 population		0	2	8	35	9	40	<b>94</b>
<b>East-Transient</b>								
2010 population		0	0	864	0	1	2	<b>867</b>
2020 population		0	0	778	0	1	2	<b>780</b>
2030 population		0	0	778	0	1	2	<b>780</b>
2040 population		0	0	778	0	1	2	<b>780</b>
2050 population		0	0	778	0	1	2	<b>780</b>
2060 population		0	0	691	0	1	2	<b>694</b>
<b>East South East-Residential</b>								
2010 population		0	0	11	5	37	57	<b>110</b>
2020 population		0	0	11	5	37	57	<b>110</b>
2030 population		0	0	11	5	36	57	<b>109</b>
2040 population		0	0	10	5	35	57	<b>107</b>
2050 population		0	0	10	5	34	58	<b>107</b>
2060 population		0	0	10	5	33	58	<b>106</b>
<b>East South East-Transient</b>								
2010 population		0	0	0	0	1	2	<b>3</b>
2020 population		0	0	0	0	1	2	<b>3</b>
2030 population		0	0	0	0	1	2	<b>3</b>
2040 population		0	0	0	0	1	2	<b>3</b>
2050 population		0	0	0	0	1	2	<b>3</b>
2060 population		0	0	0	0	1	2	<b>3</b>
<b>South East-Residential</b>								
2010 population		0	1	14	10	418	35	<b>478</b>
2020 population		0	1	14	10	408	35	<b>468</b>
2030 population		0	1	13	10	398	36	<b>458</b>
2040 population		0	1	13	10	389	36	<b>449</b>
2050 population		0	1	13	9	379	37	<b>439</b>
2060 population		0	1	12	9	369	37	<b>428</b>
<b>South East-Transient</b>								
2010 population		0	1,848	0	0	154	2	<b>2,004</b>
2020 population		0	1,848	0	0	150	2	<b>2,000</b>
2030 population		0	1,848	0	0	147	2	<b>1,997</b>
2040 population		0	1,848	0	0	143	2	<b>1,993</b>
2050 population		0	1,848	0	0	140	2	<b>1,990</b>
2060 population		0	1,848	0	0	136	2	<b>1,986</b>

**TABLE 2.1-2**  
 Resident and Transient Population Projections Within 16 km (10 mi)

	km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
<b>South South East-Residential</b>								
2010 population		0	8	7	10	14	69	<b>108</b>
2020 population		0	8	7	10	14	68	<b>107</b>
2030 population		0	7	7	10	13	68	<b>105</b>
2040 population		0	7	7	9	13	68	<b>104</b>
2050 population		0	7	7	9	13	67	<b>103</b>
2060 population		0	7	7	9	12	67	<b>102</b>
<b>South South East-Transient</b>								
2010 population		0	0	0	0	1	9	<b>10</b>
2020 population		0	0	0	0	1	9	<b>10</b>
2030 population		0	0	0	0	1	9	<b>10</b>
2040 population		0	0	0	0	1	9	<b>10</b>
2050 population		0	0	0	0	1	9	<b>10</b>
2060 population		0	0	0	0	1	9	<b>10</b>
<b>South-Residential</b>								
2010 population		0	1	18	10	12	73	<b>114</b>
2020 population		0	1	18	9	12	73	<b>113</b>
2030 population		0	1	17	9	12	73	<b>112</b>
2040 population		0	1	17	9	11	73	<b>111</b>
2050 population		0	1	17	9	11	72	<b>110</b>
2060 population		0	1	16	9	11	72	<b>109</b>
<b>South-Transient</b>								
2010 population		630	0	3	0	1	3	<b>637</b>
2020 population		630	0	3	0	1	3	<b>637</b>
2030 population		630	0	3	0	1	3	<b>637</b>
2040 population		630	0	3	0	1	3	<b>637</b>
2050 population		630	0	3	0	1	3	<b>636</b>
2060 population		630	0	3	0	1	3	<b>636</b>
<b>South South West-Residential</b>								
2010 population		0	0	87	20	12	59	<b>178</b>
2020 population		0	0	85	20	12	58	<b>175</b>
2030 population		0	0	83	19	11	57	<b>170</b>
2040 population		0	0	81	19	11	57	<b>168</b>
2050 population		0	0	79	18	11	56	<b>164</b>
2060 population		0	0	77	18	10	56	<b>161</b>
<b>South South West-Transient</b>								
2010 population		0	0	0	0	1	3	<b>4</b>
2020 population		0	0	0	0	1	3	<b>4</b>
2030 population		0	0	0	0	1	3	<b>4</b>
2040 population		0	0	0	0	1	3	<b>4</b>
2050 population		0	0	0	0	1	3	<b>4</b>
2060 population		0	0	0	0	1	3	<b>4</b>
<b>South West-Residential</b>								
2010 population		0	0	22	44	65	154	<b>285</b>
2020 population		0	0	22	43	63	150	<b>278</b>
2030 population		0	0	21	42	62	147	<b>272</b>
2040 population		0	0	21	41	60	143	<b>265</b>
2050 population		0	0	20	40	59	139	<b>258</b>
2060 population		0	0	20	39	57	136	<b>252</b>

**TABLE 2.1-2**  
Resident and Transient Population Projections Within 16 km (10 mi)

	km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
<b>South West-Transient</b>								
2010 population		0	437	0	1	647	385	<b>1,471</b>
2020 population		0	437	0	1	627	375	<b>1,441</b>
2030 population		0	437	0	1	617	368	<b>1,423</b>
2040 population		0	437	0	1	597	358	<b>1,393</b>
2050 population		0	437	0	1	587	348	<b>1,373</b>
2060 population		0	437	0	1	567	340	<b>1,346</b>
<b>West South West-Residential</b>								
2010 population		0	8	27	21	188	2,041	<b>2,285</b>
2020 population		0	7	27	20	184	1,993	<b>2,231</b>
2030 population		0	7	26	20	180	1,945	<b>2,178</b>
2040 population		0	7	26	19	175	1,898	<b>2,125</b>
2050 population		0	7	25	19	171	1,850	<b>2,072</b>
2060 population		0	7	24	18	166	1,802	<b>2,017</b>
<b>West South West-Transient</b>								
2010 population		0	821	0	0	4	510	<b>1,335</b>
2020 population		0	718	0	0	4	498	<b>1,221</b>
2030 population		0	718	0	0	4	486	<b>1,208</b>
2040 population		0	718	0	0	4	475	<b>1,197</b>
2050 population		0	718	0	0	3	463	<b>1,185</b>
2060 population		0	718	0	0	3	451	<b>1,172</b>
<b>West-Residential</b>								
2010 population		0	52	36	22	1,183	4,950	<b>6,243</b>
2020 population		0	51	35	21	1,155	4,834	<b>6,096</b>
2030 population		0	50	34	21	1,128	4,719	<b>5,952</b>
2040 population		0	48	33	20	1,100	4,603	<b>5,804</b>
2050 population		0	47	32	20	1,073	4,487	<b>5,659</b>
2060 population		0	46	31	19	1,045	4,372	<b>5,513</b>
<b>West-Transient</b>								
2010 population		0	3	0	1	10	3,564	<b>3,578</b>
2020 population		0	3	0	1	10	3,480	<b>3,494</b>
2030 population		0	3	0	1	10	3,398	<b>3,411</b>
2040 population		0	3	0	1	10	3,314	<b>3,327</b>
2050 population		0	3	0	1	9	3,231	<b>3,244</b>
2060 population		0	3	0	1	9	3,148	<b>3,160</b>
<b>West North West-Residential</b>								
2010 population		1	15	8	10	22	706	<b>762</b>
2020 population		1	15	8	9	22	689	<b>744</b>
2030 population		1	14	7	9	21	673	<b>725</b>
2040 population		1	14	7	9	21	656	<b>708</b>
2050 population		1	14	7	9	20	640	<b>691</b>
2060 population		1	13	7	9	20	624	<b>674</b>
<b>West North West-Transient</b>								
2010 population		0	0	0	1	1	18	<b>20</b>
2020 population		0	0	0	1	1	18	<b>19</b>
2030 population		0	0	0	1	1	17	<b>19</b>
2040 population		0	0	0	1	1	17	<b>19</b>
2050 population		0	0	0	1	1	16	<b>18</b>
2060 population		0	0	0	1	1	16	<b>18</b>

**TABLE 2.1-2**

Resident and Transient Population Projections Within 16 km (10 mi)

	km mi	0-2 0-1.2	2-4 1.2-2.5	4-6 2.5-3.7	6-8 3.7-5	8-10 5-6.2	10-16 6.2-10	Total for Sector
<b>North West-Residential</b>								
2010 population		4	10	11	12	11	142	<b>190</b>
2020 population		4	10	10	11	10	139	<b>184</b>
2030 population		4	10	10	11	10	136	<b>181</b>
2040 population		4	10	10	11	10	132	<b>177</b>
2050 population		4	9	10	11	10	129	<b>173</b>
2060 population		4	9	9	10	9	126	<b>167</b>
<b>North West-Transient</b>								
2010 population		0	0	0	0	1	145	<b>146</b>
2020 population		0	0	0	0	1	142	<b>143</b>
2030 population		0	0	0	0	1	139	<b>140</b>
2040 population		0	0	0	0	1	135	<b>136</b>
2050 population		0	0	0	0	1	132	<b>132</b>
2060 population		0	0	0	0	1	129	<b>129</b>
<b>North North West-Residential</b>								
2010 population		0	10	13	9	12	59	<b>103</b>
2020 population		0	10	13	9	12	60	<b>104</b>
2030 population		0	10	12	8	12	61	<b>103</b>
2040 population		0	9	12	8	11	62	<b>102</b>
2050 population		0	9	12	8	11	63	<b>103</b>
2060 population		0	9	11	8	11	63	<b>102</b>
<b>North North West-Transient</b>								
2010 population		73	0	0	0	1	3	<b>77</b>
2020 population		73	0	0	0	1	3	<b>77</b>
2030 population		73	0	0	0	1	3	<b>77</b>
2040 population		73	0	0	0	1	3	<b>77</b>
2050 population		73	0	0	0	1	3	<b>77</b>
2060 population		73	0	0	0	1	3	<b>77</b>
<b>2010 population</b>								
Residential Total		7	134	478	315	2,073	8,760	<b>11,767</b>
Cumulative Total (Residential plus Transient)		1,825	3,243	1,595	328	2,900	13,423	<b>23,309</b>
<b>2020 population</b>								
Residential Total		7	132	469	305	2,026	8,567	<b>11,506</b>
Cumulative Total (Residential plus Transient)		1,825	3,138	1,494	317	2,829	13,123	<b>22,719</b>
<b>2030 population</b>								
Residential Total		7	126	455	298	1,979	8,379	<b>11,244</b>
Cumulative Total (Residential plus Transient)		1,825	3,132	1,473	310	2,767	12,834	<b>22,330</b>
<b>2040 population</b>								
Residential Total		7	123	445	292	1,927	8,189	<b>10,983</b>
Cumulative Total (Residential plus Transient)		1,825	3,129	1,458	304	2,691	12,537	<b>21,929</b>
<b>2050 population</b>								
Residential Total		7	120	436	284	1,882	7,998	<b>10,727</b>
Cumulative Total (Residential plus Transient)		1,825	3,126	1,444	295	2,632	12,242	<b>21,544</b>

**TABLE 2.1-2**  
Resident and Transient Population Projections Within 16 km (10 mi)

	<b>km</b>	<b>0-2</b>	<b>2-4</b>	<b>4-6</b>	<b>6-8</b>	<b>8-10</b>	<b>10-16</b>	<b>Total for</b>
	<b>mi</b>	<b>0-1.2</b>	<b>1.2-2.5</b>	<b>2.5-3.7</b>	<b>3.7-5</b>	<b>5-6.2</b>	<b>6.2-10</b>	<b>Sector</b>
<b>2060 population</b>								
Residential Total		7	118	423	277	1,830	7,807	<b>10,462</b>
Cumulative Total (Residential plus Transient)		1,825	3,124	1,339	288	2,556	11,947	<b>21,057</b>

Source: ISU, 2002

Notes: 2010 and 2020 projections are based on a methodology determined by the Illinois State University. They are based on 1990 populations and fertility, mortality, and migration rates from the early 1990s. They have not been adjusted for the 2000 Census population. Population projections from the 2000 Census are being prepared by the State of Illinois and is expected to be released in 2004 to 2006. A ratio of the population in 2010 and 2020 was used to determine the projected population for 2030, 2040, 2050, and 2060. Transient population was assumed to follow the same population trends as residential population.

**TABLE 2.1-3**

2000 Resident and Transient Population Between 16 km and 80 km (10 mi and 50 mi)

	<b>km mi</b>	<b>16-40 10-25</b>	<b>40-60 25-37</b>	<b>60-80 37-50</b>	<b>Total for Sector</b>
<b>North-Residential</b>		10,558	5,161	6,645	22,364
<b>North-Transient</b>		39	329	81	449
<b>North North East-Residential</b>		4,874	2,426	12,357	19,657
<b>North North East-Transient</b>		4,063	40	124	4,227
<b>North East-Residential</b>		1,852	4,552	3,665	10,069
<b>North East-Transient</b>		21	52	78	151
<b>East North East-Residential</b>		3,987	7,622	18,845	30,454
<b>East North East-Transient</b>		133	230	421	784
<b>East -Residential</b>		9,734	114,051	8,157	131,942
<b>East -Transient</b>		63	1,934	60	2,057
<b>East South East-Residential</b>		3,266	22,665	8,686	34,617
<b>East South East-Transient</b>		37	235	82	354
<b>South East-Residential</b>		7,436	3,381	11,508	22,325
<b>South East-Transient</b>		58	63	262	383
<b>South South East-Residential</b>		2,526	5,910	9,581	18,017
<b>South South East-Transient</b>		33	51	132	216
<b>South-Residential</b>		14,620	12,296	3,125	30,041
<b>South-Transient</b>		196	1,958	34,287	36,441
<b>South South West-Residential</b>		69,848	15,636	19,275	104,759
<b>South South West-Transient</b>		1,094	1,056	104	2,254
<b>South West-Residential</b>		4,058	3,324	11,585	18,967
<b>South West-Transient</b>		40	45	11,418	11,503
<b>West South West-Residential</b>		1,585	3,483	58,674	63,742
<b>West South West-Transient</b>		34	43	241	318
<b>West -Residential</b>		1,381	20,729	5,931	28,041
<b>West -Transient</b>		26	1,196	71	1,293
<b>West North West-Residential</b>		3,770	3,724	12,702	20,196
<b>West North West-Transient</b>		67	54	101	222
<b>North West-Residential</b>		3,010	6,786	56,991	66,787
<b>North West-Transient</b>		27	294	412	733
<b>North North West-Residential</b>		79,919	35,630	14,481	130,030
<b>North North West-Transient</b>		1,423	1,097	155	2,675
<b>Residential Total</b>		<b>222,424</b>	<b>267,376</b>	<b>262,208</b>	<b>752,008</b>
<b>Cumulative Total (Residential plus Transient)</b>		<b>229,778</b>	<b>276,053</b>	<b>310,237</b>	<b>816,068</b>

Source: Residential Population is from U.S. Census Bureau, 2001. Transient Population is from U.S. Census Bureau, 2001; USDOC, 2002

**TABLE 2.1-4**  
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

	<b>km mi</b>	<b>16-40 10-25</b>	<b>40-60 25-37</b>	<b>60-80 37-50</b>	<b>Total for Sector</b>
<b>North-Residential</b>					
2010 population		10,972	5,363	6,809	<b>23,144</b>
2020 population		11,599	5,670	7,085	<b>24,354</b>
2030 population		12,227	5,977	7,361	<b>25,565</b>
2040 population		12,854	6,283	7,637	<b>26,774</b>
2050 population		13,481	6,590	7,913	<b>27,984</b>
2060 population		14,109	6,897	8,189	<b>29,195</b>
<b>North-Transient</b>					
2010 population		41	342	83	<b>465</b>
2020 population		43	361	86	<b>491</b>
2030 population		45	381	90	<b>516</b>
2040 population		47	401	93	<b>541</b>
2050 population		50	420	96	<b>566</b>
2060 population		52	440	100	<b>592</b>
<b>North North East-Residential</b>					
2010 population		5,065	2,518	12,207	<b>19,790</b>
2020 population		5,354	2,659	12,185	<b>20,198</b>
2030 population		5,644	2,800	12,163	<b>20,607</b>
2040 population		5,934	2,941	12,141	<b>21,016</b>
2050 population		6,223	3,082	12,119	<b>21,424</b>
2060 population		6,513	3,223	12,097	<b>21,833</b>
<b>North North East-Transient</b>					
2010 population		4,222	42	122	<b>4,386</b>
2020 population		4,463	44	122	<b>4,629</b>
2030 population		4,705	46	122	<b>4,873</b>
2040 population		4,947	48	122	<b>5,117</b>
2050 population		5,188	51	122	<b>5,360</b>
2060 population		5,429	53	121	<b>5,604</b>
<b>North East-Residential</b>					
2010 population		1,920	4,509	3,613	<b>10,042</b>
2020 population		2,026	4,446	3,572	<b>10,044</b>
2030 population		2,132	4,383	3,530	<b>10,045</b>
2040 population		2,237	4,320	3,489	<b>10,046</b>
2050 population		2,343	4,258	3,448	<b>10,049</b>
2060 population		2,449	4,195	3,406	<b>10,050</b>
<b>North East-Transient</b>					
2010 population		22	52	77	<b>150</b>
2020 population		23	51	76	<b>150</b>
2030 population		24	50	75	<b>149</b>
2040 population		25	49	74	<b>149</b>
2050 population		27	49	73	<b>149</b>
2060 population		28	48	72	<b>148</b>
<b>East North East-Residential</b>					
2010 population		3,981	8,208	19,670	<b>31,859</b>
2020 population		4,026	8,656	20,297	<b>32,979</b>
2030 population		4,070	9,104	20,925	<b>34,099</b>
2040 population		4,115	9,552	21,552	<b>35,219</b>
2050 population		4,159	10,000	22,179	<b>36,338</b>
2060 population		4,204	10,448	22,807	<b>37,459</b>

**TABLE 2.1-4**  
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

	<b>km mi</b>	<b>16-40 10-25</b>	<b>40-60 25-37</b>	<b>60-80 37-50</b>	<b>Total for Sector</b>
<b>East North East-Transient</b>					
2010 population		133	248	439	<b>820</b>
2020 population		134	261	453	<b>849</b>
2030 population		136	275	467	<b>878</b>
2040 population		137	288	481	<b>907</b>
2050 population		139	302	495	<b>936</b>
2060 population		140	315	510	<b>965</b>
<b>East -Residential</b>					
2010 population		10,430	123,506	8,818	<b>142,754</b>
2020 population		11,014	130,812	9,325	<b>151,151</b>
2030 population		11,598	138,118	9,833	<b>159,549</b>
2040 population		12,182	145,423	10,341	<b>167,946</b>
2050 population		12,766	152,729	10,849	<b>176,344</b>
2060 population		13,350	160,035	11,356	<b>184,741</b>
<b>East -Transient</b>					
2010 population		68	2,094	65	<b>2,227</b>
2020 population		71	2,218	69	<b>2,358</b>
2030 population		75	2,342	72	<b>2,490</b>
2040 population		79	2,466	76	<b>2,621</b>
2050 population		83	2,590	80	<b>2,752</b>
2060 population		86	2,714	84	<b>2,884</b>
<b>East South East-Residential</b>					
2010 population		3,348	24,544	9,119	<b>37,011</b>
2020 population		3,489	25,996	9,488	<b>38,973</b>
2030 population		3,631	27,447	9,858	<b>40,936</b>
2040 population		3,773	28,899	10,228	<b>42,900</b>
2050 population		3,914	30,351	10,597	<b>44,862</b>
2060 population		4,056	31,803	10,967	<b>46,826</b>
<b>East South East-Transient</b>					
2010 population		38	254	86	<b>378</b>
2020 population		40	270	90	<b>399</b>
2030 population		41	285	93	<b>419</b>
2040 population		43	300	97	<b>439</b>
2050 population		44	315	100	<b>459</b>
2060 population		46	330	104	<b>479</b>
<b>South East-Residential</b>					
2010 population		7,538	3,424	11,427	<b>22,389</b>
2020 population		7,830	3,505	11,515	<b>22,850</b>
2030 population		8,123	3,587	11,603	<b>23,313</b>
2040 population		8,415	3,668	11,691	<b>23,774</b>
2050 population		8,707	3,750	11,779	<b>24,236</b>
2060 population		9,000	3,831	11,868	<b>24,699</b>
<b>South East-Transient</b>					
2010 population		59	64	260	<b>383</b>
2020 population		61	65	262	<b>389</b>
2030 population		63	67	264	<b>394</b>
2040 population		66	68	266	<b>400</b>
2050 population		68	70	268	<b>406</b>
2060 population		70	71	270	<b>412</b>

**TABLE 2.1-4**

Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

	<b>km mi</b>	<b>16-40 10-25</b>	<b>40-60 25-37</b>	<b>60-80 37-50</b>	<b>Total for Sector</b>
<b>South South East-Residential</b>					
2010 population		2,563	5,901	9,614	<b>18,078</b>
2020 population		2,655	6,006	9,830	<b>18,491</b>
2030 population		2,748	6,111	10,046	<b>18,905</b>
2040 population		2,840	6,215	10,262	<b>19,317</b>
2050 population		2,932	6,320	10,478	<b>19,730</b>
2060 population		3,024	6,425	10,694	<b>20,143</b>
<b>South South East-Transient</b>					
2010 population		33	51	132	<b>217</b>
2020 population		35	52	135	<b>222</b>
2030 population		36	53	138	<b>227</b>
2040 population		37	54	141	<b>232</b>
2050 population		38	55	144	<b>237</b>
2060 population		40	55	147	<b>242</b>
<b>South-Residential</b>					
2010 population		14,988	12,540	3,174	<b>30,702</b>
2020 population		15,068	12,636	3,359	<b>31,063</b>
2030 population		15,147	12,733	3,543	<b>31,423</b>
2040 population		15,226	12,829	3,728	<b>31,783</b>
2050 population		15,305	12,926	3,912	<b>32,143</b>
2060 population		15,385	13,022	4,097	<b>32,504</b>
<b>South-Transient</b>					
2010 population		201	1,997	34,825	<b>37,022</b>
2020 population		202	2,012	36,854	<b>39,069</b>
2030 population		203	2,028	38,873	<b>41,104</b>
2040 population		204	2,043	40,903	<b>43,150</b>
2050 population		205	2,058	42,922	<b>45,485</b>
2060 population		206	2,074	44,952	<b>47,231</b>
<b>South South West-Residential</b>					
2010 population		71,610	16,027	19,193	<b>106,830</b>
2020 population		71,988	16,114	19,463	<b>107,565</b>
2030 population		72,366	16,202	19,733	<b>108,301</b>
2040 population		72,744	16,290	20,003	<b>109,037</b>
2050 population		73,122	16,378	20,273	<b>109,773</b>
2060 population		73,500	16,466	20,542	<b>110,508</b>
<b>South South West-Transient</b>					
2010 population		1,122	1,082	104	<b>2,308</b>
2020 population		1,128	1,088	105	<b>2,321</b>
2030 population		1,133	1,094	106	<b>2,334</b>
2040 population		1,139	1,100	108	<b>2,347</b>
2050 population		1,145	1,106	109	<b>2,361</b>
2060 population		1,151	1,112	111	<b>2,374</b>
<b>South West-Residential</b>					
2010 population		4,180	3,453	12,191	<b>19,824</b>
2020 population		4,207	3,508	12,467	<b>20,182</b>
2030 population		4,233	3,563	12,744	<b>20,540</b>
2040 population		4,260	3,618	13,021	<b>20,899</b>
2050 population		4,286	3,673	13,298	<b>21,257</b>
2060 population		4,313	3,729	13,575	<b>21,617</b>

**TABLE 2.1-4**  
Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

	<b>km mi</b>	<b>16-40 10-25</b>	<b>40-60 25-37</b>	<b>60-80 37-50</b>	<b>Total for Sector</b>
<b>South West-Transient</b>					
2010 population		41	47	12,015	<b>12,103</b>
2020 population		41	47	12,287	<b>12,376</b>
2030 population		42	48	12,560	<b>12,650</b>
2040 population		42	49	12,833	<b>12,924</b>
2050 population		42	50	13,106	<b>13,198</b>
2060 population		43	50	13,379	<b>13,472</b>
<b>West South West-Residential</b>					
2010 population		1,595	3,727	63,458	<b>68,780</b>
2020 population		1,589	3,787	65,682	<b>71,058</b>
2030 population		1,583	3,847	67,906	<b>73,336</b>
2040 population		1,577	3,907	70,130	<b>75,614</b>
2050 population		1,571	3,967	72,354	<b>77,892</b>
2060 population		1,565	4,028	74,578	<b>80,171</b>
<b>West South West-Transient</b>					
2010 population		34	46	261	<b>341</b>
2020 population		34	47	270	<b>351</b>
2030 population		34	47	279	<b>360</b>
2040 population		34	48	288	<b>370</b>
2050 population		34	49	297	<b>380</b>
2060 population		34	50	306	<b>390</b>
<b>West -Residential</b>					
2010 population		1,413	22,179	6,300	<b>29,892</b>
2020 population		1,415	22,525	6,631	<b>30,571</b>
2030 population		1,417	22,871	6,963	<b>31,251</b>
2040 population		1,419	23,218	7,294	<b>31,931</b>
2050 population		1,421	23,564	7,626	<b>32,611</b>
2060 population		1,423	23,910	7,957	<b>33,290</b>
<b>West -Transient</b>					
2010 population		27	1,280	75	<b>1,382</b>
2020 population		27	1,300	79	<b>1,406</b>
2030 population		27	1,320	83	<b>1,430</b>
2040 population		27	1,340	87	<b>1,454</b>
2050 population		27	1,360	91	<b>1,478</b>
2060 population		27	1,380	95	<b>1,502</b>
<b>West North West-Residential</b>					
2010 population		3,912	3,880	12,941	<b>20,733</b>
2020 population		3,991	3,945	13,134	<b>21,070</b>
2030 population		4,070	4,010	13,327	<b>21,407</b>
2040 population		4,149	4,074	13,519	<b>21,742</b>
2050 population		4,228	4,139	13,712	<b>22,079</b>
2060 population		4,307	4,204	13,904	<b>22,415</b>
<b>West North West-Transient</b>					
2010 population		70	56	103	<b>229</b>
2020 population		71	57	104	<b>233</b>
2030 population		72	58	106	<b>236</b>
2040 population		74	59	107	<b>240</b>
2050 population		75	60	109	<b>244</b>
2060 population		77	61	111	<b>248</b>

**TABLE 2.1-4**

Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

	<b>km mi</b>	<b>16-40 10-25</b>	<b>40-60 25-37</b>	<b>60-80 37-50</b>	<b>Total for Sector</b>
<b>North West-Residential</b>					
2010 population		3,116	6,994	58,417	<b>68,527</b>
2020 population		3,284	7,237	59,515	<b>70,036</b>
2030 population		3,451	7,480	60,613	<b>71,544</b>
2040 population		3,619	7,723	61,712	<b>73,054</b>
2050 population		3,787	7,966	62,810	<b>74,563</b>
2060 population		3,955	8,209	63,908	<b>76,072</b>
<b>North West-Transient</b>					
2010 population		28	303	422	<b>753</b>
2020 population		29	314	430	<b>773</b>
2030 population		31	324	438	<b>793</b>
2040 population		32	335	446	<b>813</b>
2050 population		34	345	454	<b>833</b>
2060 population		35	356	462	<b>853</b>
<b>North North West-Residential</b>					
2010 population		83,049	37,128	16,035	<b>136,212</b>
2020 population		87,798	39,354	17,933	<b>145,085</b>
2030 population		92,547	41,579	19,830	<b>153,956</b>
2040 population		97,296	43,804	21,728	<b>162,828</b>
2050 population		102,044	46,030	23,625	<b>171,699</b>
2060 population		106,793	48,255	25,523	<b>180,571</b>
<b>North North West-Transient</b>					
2010 population		1,479	1,143	172	<b>2,793</b>
2020 population		1,563	1,212	192	<b>2,967</b>
2030 population		1,648	1,280	212	<b>3,140</b>
2040 population		1,732	1,349	233	<b>3,314</b>
2050 population		1,817	1,417	253	<b>3,487</b>
2060 population		1,902	1,486	273	<b>3,660</b>
<b>2010 population</b>					
Residential Total		229,680	283,901	272,986	<b>786,567</b>
Cumulative Total (Residential plus Transient)		237,296	293,001	322,228	<b>852,525</b>
<b>2020 population</b>					
Residential Total		237,333	296,856	281,481	<b>815,670</b>
Cumulative Total (Residential plus Transient)		245,298	306,255	333,097	<b>884,650</b>
<b>2030 population</b>					
Residential Total		244,987	309,812	289,978	<b>844,777</b>
Cumulative Total (Residential plus Transient)		253,302	319,510	343,959	<b>916,771</b>
<b>2040 population</b>					
Residential Total		252,640	322,764	298,476	<b>873,880</b>
Cumulative Total (Residential plus Transient)		261,306	332,760	354,833	<b>948,899</b>
<b>2050 population</b>					
Residential Total		260,289	335,723	306,972	<b>902,984</b>
Cumulative Total (Residential plus Transient)		269,304	346,018	365,693	<b>981,016</b>

**TABLE 2.1-4**  
 Resident and Transient Population Projections Between 16 km and 80 km (10 mi and 50 mi)

	<b>km</b>	<b>16-40</b>	<b>40-60</b>	<b>60-80</b>	<b>Total for Sector</b>
	<b>mi</b>	<b>10-25</b>	<b>25-37</b>	<b>37-50</b>	
<b>2060 population</b>					
Residential Total		267,946	348,680	315,468	<b>932,094</b>
Cumulative Total (Residential plus Transient)		277,311	359,274	376,565	<b>1,013,150</b>

Source: ISU, 2002

Notes: 2010 and 2020 projections are based on a methodology determined by the Illinois State University. They are based on 1990 populations and fertility, mortality, and migration rates from the early 1990s. They have not been adjusted for the 2000 Census population. Population projections from the 2000 Census are being prepared by the State of Illinois and are expected to be released 2004 to 2006. A ratio of the population in 2010 and 2020 was used to determine the projected population for 2030, 2040, 2050, and 2060. Transient population was assumed to follow the same population trends as residential population.

**TABLE 2.1-5**  
Facilities and Institutions Within the Vicinity of the Low Population Zone

Facility/Institution	Type	Sector	Approximate Distance from LPZ (mi)	Estimated Daily Population
Douglas Elementary School	Educational	W	2.3	269
Webster Elementary School	Educational	W	2.3	274
Clinton Junior High School	Educational	W	2.7	508
Lincoln Elementary School	Educational	W	2.9	260
Washington Elementary School	Educational	W	2.9	319
Clinton Christian Academy	Educational	W	3.2	100
Clinton High School	Educational	W	3.5	791
Richland Community College	Educational	W	3.5	230
DeLand Elementary	Educational	SE	4.8	130
DeLand Weldon Middle School	Educational	SE	4.8	28
Head Start	Educational	W	2.6	15
Dora's Daycare	Educational	WNW	3.1	10
John Warner Hospital	Medical	W	3.0	217
Crestview Nursing Home	Medical	W	2.8	163
Clinton High Rise	Medical	W	7.5	50
Allen Court 1829 E. Main	Medical	W	2.5	25
Allen Court 1650 E. Main	Medical	W	2.5	25
DeWitt County Jail	Government	W	2.8	68

**TABLE 2.1-5**  
 Facilities and Institutions Within the Vicinity of the Low Population Zone

<b>Facility/Institution</b>	<b>Type</b>	<b>Sector</b>	<b>Approximate Distance from LPZ (mi)</b>	<b>Estimated Daily Population</b>
Arrowhead Acres Park	Recreational	SW	4.0	100
Clinton Country Club	Recreational	W	4.1	50
Little Galilee Christian Camp	Recreational	SW	3.5	300
Weldon Springs State Recreation Area	Recreational	SW	.3.0	676
Calvary United Church Camp	Recreational	NW	6.5	150
Green Acres Campground	Recreational	E	1	120

Source: NCES, 2002. IDCCA, 2002.

**TABLE 2.1-6**  
Recreational Facilities in the Vicinity of the EGC ESP Site

Area	Attendance		Approximate Distance and Direction
	Average Daily	Peak Daily	
Clinton Lake State Park	1,253	4,813	--
Arrowhead Acres	50	100	6.5 mi SW
Clinton County Club	50	50	6.6 mi W
Little Galilee Christian Assembly Church Camp	300	300	6.0 mi SW
Weldon Springs State Recreation Area	325	676	5.5 mi SW
Calvary United Church Camp	150	150	9 mi NW
Green Acres Campground	75	120	3.5 mi W
<b>TOTAL</b>	<b>2,353</b>	<b>6,909</b>	

**TABLE 2.1-7**  
 Peak Day Uses of Clinton Lake State Recreation Area

<b>Area</b>	<b>Attendance</b>	
	<b>Average Daily</b>	<b>Peak Daily</b>
Clinton Marine	176	630
Mascoutin State Rec Area	483	1,848
Northfork Boat and Canoe Access	56	73
Parnell Boat Access	64	261
Penninsula Area	44	134
Spillway Access Area	103	303
Weldon Boat Access	126	744
Westside Boat Access	201	820
<b>TOTAL</b>	<b>1,253</b>	<b>4,813</b>

**TABLE 2.1-8**  
Peak Recreational Usage Clinton Lake State Recreation Area

<b>Sector</b>	<b>0-2 km</b>	<b>2-4 km</b>	<b>4-6 km</b>	<b>6 - 8 km</b>	<b>0-8 km</b>
N	0	0	0	73	73
NNE	0	0	0	0	0
NE	0	0	0	0	0
ENE	0	0	261	0	261
E	0	0	744	0	744
ESE	0	0	0	0	0
SE	0	1848	0	0	1848
SSE	0	0	0	0	0
S	0	630	0	0	630
SSW	0	0	0	0	0
SW	0	0	134	303	437
WSW	0	0	820	0	820
W	0	0	0	0	0
WNW	0	0	0	0	0
NW	0	0	0	0	0
NNW	0	0	0	0	0
<b>TOTAL</b>	0	2,478	1,959	376	4,813

Note: Some facilities in Clinton Lake State Recreation Area are not included in the 8 km (5 mi) radius

**TABLE 2.1-9**  
 2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

<b>Local</b>	<b>Place Name</b>	<b>Total Population in 2000</b>	<b>Distance (mi)</b>	<b>Direction</b>
Vicinity	DeWitt	188	2.6	ENE
	Weldon	440	5.6	SE
	Clinton	7,485	7.0	W
Region	Wapella	651	7.6	WNW
	DeLand	475	10.6	ESE
	Maroa	1,654	11.3	SW
	Farmer City	2,055	11.3	ENE
	Le Roy	3,332	12.1	NNE
	Cisco	264	12.2	SSE
	Heyworth	2,431	12.5	NW
	Argenta	921	12.8	S
	Kenney	374	14.3	WSW
	Downs	776	16.0	N
	Waynesville	452	16.2	WNW
	Oreana	892	16.3	S
	Monticello	5,138	16.9	SE
	Mansfield	949	17.3	E
	Forsyth	2,434	18.4	SSW
	Bellflower	408	20.0	NE
	Ellsworth	271	20.2	NNE
	Cerro Gordo	1,436	20.2	SSE
	McLean	808	20.4	WNW
	Warrensburg	1,289	20.5	SW
Arrowsmith	298	21.9	NNE	
Atlanta	1,649	22.0	WNW	
Bement	1,784	22.0	SE	
Bloomington	64,808	22.4	NNW	
Decatur	81,860	22.4	SSW	
Latham	371	22.5	SW	
Mahomet	4,877	23.3	E	
	Saybrook	764	24.0	NE

**TABLE 2.1-9**  
2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

Local	Place Name	Total Population in 2000	Distance (mi)	Direction
	Lake of the Woods	3,026	24.5	E
	Bondville	455	24.9	E
	Foosland	90	25.0	ENE
	Long Creek	1,364	25.2	S
	Ivesdale	288	25.3	SE
	Normal	45,386	25.4	NNW
	Harristown	1,338	25.7	SSW
	Cooksville	213	26.4	NNE
	Mount Pulaski	1,701	26.4	WSW
	Mount Zion	4,845	27.1	S
	Towanda	493	27.3	N
	Stanford	670	27.4	NW
	Fisher	1,647	27.5	ENE
	Armington	368	28.0	WNW
	Niantic	738	28.1	SW
	Lincoln	15,369	28.4	W
	Hammond	518	28.7	SSE
	Sadorus	426	29.5	ESE
	Colfax	989	29.6	NNE
	Champaign	67,518	30.2	E
	Danvers	1,183	30.6	NW
	Illiopolis	916	31.2	SW
	Hudson	1,510	31.2	NNW
	Minier	1,244	31.2	NW
	Dalton City	581	31.4	S
	Gibson City	3,373	31.4	NE
	Anchor	175	31.5	NNE
	Savoy	4,476	31.7	ESE
	Atwood	1,290	32.3	SE
	Carlock	456	32.5	NNW
	Hartsburg	358	32.6	WNW
	Lexington	1,912	32.7	N

**TABLE 2.1-9**  
 2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

<b>Local</b>	<b>Place Name</b>	<b>Total Population in 2000</b>	<b>Distance (mi)</b>	<b>Direction</b>
	Tolono	2,700	32.7	ESE
	Broadwell	169	33.1	WSW
	Macon	1,213	33.2	SSW
	Lovington	1,222	33.3	SSE
	Garrett	198	33.7	SE
	Urbana	36,395	33.9	E
	Thomasboro	1,233	34.5	E
	Pesotum	521	34.6	ESE
	Emden	515	35.6	WNW
	Hopedale	929	35.6	WNW
	Elliott	341	35.7	ENE
	Blue Mound	1,129	35.8	SSW
	Elkhart	443	35.9	WSW
	Kappa	170	36.0	NNW
	Mount Auburn	515	36.1	SW
	Congerville	466	36.5	NNW
	Bethany	1,287	36.6	S
	Arthur	2,203	37.0	SSE
	Rantoul	12,857	37.0	ENE
	Mackinaw	1,452	37.4	NW
	Sibley	329	37.4	NE
	Philo	1,314	37.5	ESE
	Buffalo	491	37.8	SW
	Goodfield	686	39.0	NW
	Tuscola	4,448	39.0	SE
	Mechanicsburg	456	39.0	SW
	Moweaqua	1,923	39.1	SSW
	Gridley	1,411	39.6	N
	New Holland	318	39.7	W
	Chenoa	1,845	40.0	N
	Dawson	466	40.0	WSW
	Delavan	1,825	40.1	WNW

**TABLE 2.1-9**  
2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

<b>Local</b>	<b>Place Name</b>	<b>Total Population in 2000</b>	<b>Distance (mi)</b>	<b>Direction</b>
	Ludlow	324	40.1	ENE
	El Paso	2,695	40.3	NNW
	Strawn	104	40.3	NE
	Middletown	434	40.5	W
	Williamsville	1,439	40.9	WSW
	Deer Creek	605	41.2	NW
	Melvin	465	41.4	NE
	Stonington	960	41.4	SSW
	Sullivan	4,326	41.4	SSE
	Villa Grove	2,553	41.5	ESE
	Sidney	1,062	41.6	ESE
	San Jose	696	41.8	WNW
	St. Joseph	2,912	42.3	E
	Secor	379	42.4	NNW
	Tremont	2,029	42.4	NW
	Fairbury	3,968	43.1	NNE
	Spaulding	559	43.3	WSW
	Panola	33	43.5	NNW
	Paxton	4,525	43.5	ENE
	Camargo	469	43.7	SE
	Arcola	2,652	43.8	SE
	Gifford	815	43.8	ENE
	Riverton	3,048	43.9	WSW
	Eureka	4,871	44.2	NNW
	Findlay	723	45.0	S
	Allenville	154	45.1	SSE
	Longview	153	45.2	ESE
	Morton	15,198	45.3	NW
	Royal	279	45.5	E
	Sherman	2,871	45.5	WSW
	Forrest	1,225	45.7	NNE
	Mason City	2,558	45.8	W

**TABLE 2.1-9**  
 2000 Population of Cities and Communities Within an 80 km (50 mi) Radius

<b>Local</b>	<b>Place Name</b>	<b>Total Population in 2000</b>	<b>Distance (mi)</b>	<b>Direction</b>
	Green Valley	728	45.8	WNW
	Roberts	387	45.9	NE
	Edinburg	1,135	46.2	SW
	Clear Lake	267	46.2	WSW
	Loda	419	46.5	ENE
	Assumption	1,261	46.5	SSW
	Ogden	743	46.6	E
	Homer	1,200	47.3	ESE
	Roanoke	1,994	47.4	NNW
	Humboldt	481	47.7	SE
	Cantrall	139	47.7	WSW
	Rochester	2,893	47.8	SW
	Broadlands	312	47.9	ESE
	Grandview	1,537	48.3	WSW
	Greenview	862	48.5	W
	Washington	10,841	48.5	NW
	Flanagan	1,083	48.7	N
	South Pekin	1,162	48.8	WNW
	Chatsworth	1,265	49.1	NE
	Benson	408	49.2	NNW
	Athens	1,726	49.5	WSW
	Pontiac	11,864	49.7	NNE
	Hindsboro	361	50.0	SE

Source: U.S. Census Bureau, 2001.

**TABLE 2.2-1**

Military Armories Within 50 Miles - Illinois Air/Army National Guard Units

<b>Location</b>	<b>No. of Units</b>	<b>Distance and Direction</b>
<b>Air National Guard</b>		
Decatur (AASF)	4	25 mi SSW
Springfield	3	49 mi WSW
<b>Army National Guard</b>		
Bloomington Armory	2	23 mi NNW
Champaign Armory	1	30 mi E

**TABLE 2.2-2**

Industries Within Five Miles and Industries that May Impact the EGC ESP Site

<b>Industry</b>	<b>Number of Employees (approx.)</b>	<b>Product(s)</b>
Cornbelt FS (DeWitt)	Not Available	Propane storage
Van Horn – DeWitt	7 FT; 4-5 PT	Agricultural chemicals and fertilizers
Weldon Fertilizer and Lumber Co.	8 FT	Agricultural chemicals and fertilizers; lumber products

FT = Full Time  
PT = Part Time

**TABLE 2.2-3**  
**Chemical and Material Storage at CPS**

<b>Chemical</b>	<b>Nominal Quantity</b>
Caustic (50% & 25% Solution)	10,000 gal
Sulfuric Acid	10,500 gal
Polyacrylamide	165 gal
Trisodium Phosphate	1,000 lb
Sodium Nitrite	500 lb
Fuel Oil	148,350 gal
Lubrication Oil	42,000 gal
Glycol	1,000 gal
Hydrogen	73,000 ft <sup>3</sup>
Carbon Dioxide	34,000 lb (3 tanks)
Acetylene	3,000 ft <sup>3</sup> (20 tanks)
Oxygen	7,000 ft <sup>3</sup> (23 tanks)
Nitrogen	11,300 ft <sup>3</sup> (50 tanks)
Argon	9,000 ft <sup>3</sup> (30 tanks)
Halon 1301	2,200 lb
Polymer/Coagulant	500 gal
Scale Inhibitor	2,700 gal
Sodium Bisulfite	2,850 gal
Sodium Hypochlorite	5,500 gal

Source: CPS, 2002

**TABLE 2.2-4**  
Pipelines Within Five Miles of EGC ESP Site

<b>Pipeline Company</b>	<b>Pipe Diameter (inches)</b>	<b>Material Carried</b>	<b>Year Pipe Installed</b>	<b>Operating Pressure (psi)</b>	<b>Depth of Burial (inches)</b>	<b>Location and Type of Isolation Valve</b>	<b>Approximate Distance (ft)</b>
Equilon Oil Company	14	Refined petroleum products	1976	1000-1100	> 36	Manual control both sides of Clinton Lake	4,000
Illinois Power Co.	2	Natural Gas	1966	450	36	None	12,000
Explorer Pipeline Company	24	Refined petroleum products	1976	750-900	> 36	Manual control both sides of Clinton Lake	13,700
Phillips Pipeline Company	2 8-in. pipes	Refined petroleum products	1976	750-1100	> 36	Manual control both sides of Clinton Lake	13,700

Source: CPS, 2002

**TABLE 2.2-5**  
 Hazardous Materials Shipments on Gilman Rail Line

<b>Description of Commodity</b>	<b>Carloads</b>	<b>Tons</b>
Butane	443	31,146
Propylene	801	57,132
Liquefied Petroleum Gas (butene gas, liquefied)	345	24,459
Isobutane	793	57,001
Propane	164	11,559
Liquefied Petroleum Gas	885	61,816
Sulfuric Acid	156	13,831
Monoethanolamine	44	3,391
Corrosive Liquid, N.O.S.	34	2,621
Sodium Nitrate	34	1,980
Propylene Oxide	77	5,164
Vinyl Acetate	137	10,769
Carbon Tetrachloride	185	16,560
Petroleum Naphtha	47	3,468
Formaldehyde (or) formalin solution (in containers over 100 gallons)	38	3,227
Denatured Alcohol	56	3,874
Alcohol, N.O.S. (ethyl alcohol, anhydrous, denatured in part with petroleum products and/or chemicals not to exceed 5%t)	60	4,817
Anhydrous Ammonia	37	3,119
Bromine	34	1,340

Source: CPS, 2002

Note: Hazardous Materials Shipments with a Frequency of 30 or More Cars Per Year Over the Illinois Central Gulf-Gilman Line from December 1, 1981 to November 30, 1982.

**TABLE 2.3-1**  
Climatological Data from Peoria and Springfield, Illinois

Parameter	Station	
	Peoria	Springfield
<b>Location</b>		
Distance (mi)	55	49
Direction from CPS	Northwest	West-Southwest
<b>Temperature</b>		
Annual (°F)	51.1	53.2
Maximum (°F)	105 (July 1988)	112 (July 1954)
Minimum (°F)	-25 (January 1977)	-22 (February 1963)
Degree days (heating)	6,226	5,654
Degree days (cooling)	948	1,165
<b>Relative Humidity (%)</b>		
Annual average at 6 A.M.	83	82
Annual average at Noon	61	61
<b>Wind</b>		
Annual average speed (mph)	10.1	11.2
Prevailing direction	South	South Southwest
Fastest mile:		
Speed (mph)	75 (July 1953)	75 (June 1957)
Direction	Northwest	Southwest
<b>Peak gust</b>		
Speed (mph)	69 (April 1989)	69 (August 1987)
Direction	North	West
<b>Precipitation (in)</b>		
Annual average	34.89	33.78
Monthly maximum	13.09 (September 1961)	10.76 (July 1981)
Monthly minimum	0.03 (September 1979)	Trace amount (September 1979)
24-hour maximum	5.06 (April 1950)	6.12 (December 1982)
Maximum Annual	55.35 (1990)	52.67 (1990)
<b>Snowfall (in)</b>		
Annual average	25.1	23.9
Monthly maximum	24.7 (January 1979)	22.7 (December 1973)
Maximum 24-hour	12.2 (January 1979)	10.9 (December 1973)

**TABLE 2.3-1**  
 Climatological Data from Peoria and Springfield, Illinois

Parameter	Station	
	Peoria	Springfield
<b>Mean Annual (number of days)</b>		
Precipitation > 0.01 in	113	113
Snow, sleet, hail > 1.0 in	8	8
Heavy fog (visibility 0.25 mi or less)	21	17
Maximum temperature > 90°F	20	31
Minimum temperature < 32°F	129	117

Source: Gale Research Company, 1985, 1992a, 1992b

Notes: These statistics are based on periods of record ranging from 22 to 50 years in length. The ranges span the years 1941 to 1990.

**TABLE 2.3-2**  
Summary of Illinois Tornado Occurrences

<b>Tornado Intensity (Fujita Tornado Scale)</b>	<b>Number of Reported Occurrences January 1, 1950 – April 30, 2002</b>
≥ F0	1716
> F1	1016
≥ F2	509
≥ F3	164
≥ F4	43
F5	3

Source: NOAA, 2002b

Notes:

F0: 40-72 mph  
 F1: 73 – 112 mph  
 F2: 113 – 157 mph  
 F3: 158 – 206 mph  
 F4: 207 – 260 mph  
 F5: 261 – 318 mph

**TABLE 2.3-3**  
Reported Tornado Occurrences in DeWitt and Surrounding Counties

County	No. of Reported Tornadoes (1950 – 2002)
DeWitt	11
Piatt	19
Macon	41
Logan	33
McLean	84

Source: NOAA, 2002b

**TABLE 2.3-4**  
Measures of Ice Glazing in Various Severe Winter Storms for the State of Illinois

Storm Date	Radial Thickness of Ice on Wire (in)	Ratio of Ice Weight to Weight of 0.25-in Twig	Weight of Ice (oz) on 1 ft of Standard (No. 12) Wire	City	State Section
2 – 4 February 1883	--- <sup>a</sup>	--- <sup>a</sup>	11	Springfield	WSW
20 March 1912	0.5	--- <sup>a</sup>	--- <sup>a</sup>	Decatur	C
21 February 1913	2.0	--- <sup>a</sup>	--- <sup>a</sup>	La Salle	NE
12 March 1923	1.6	--- <sup>a</sup>	12	Marengo	NE
17 – 19 December 1924	1.2	15:1	8	Springfield	WSW
22 – 23 January 1927	1.1	--- <sup>a</sup>	2	Cairo	SE
31 March 1929	0.5	--- <sup>a</sup>	--- <sup>a</sup>	Moline	NW
7 – 8 January 1930	1.2	--- <sup>a</sup>	--- <sup>a</sup>	Carlinville	WSW
1 – 2 March 1932	0.5	--- <sup>a</sup>	--- <sup>a</sup>	Galena	NW
7 – 8 January 1937	1.5	--- <sup>a</sup>	--- <sup>a</sup>	Quincy	W
31 Dec 1947 – 1 January 1948	1.0	--- <sup>a</sup>	72	Chicago	NE
10 January 1949	0.8	--- <sup>a</sup>	--- <sup>a</sup>	Macomb	W
8 December 1956	--- <sup>a</sup>	--- <sup>a</sup>	--- <sup>a</sup>	Alton	WSW
20 – 22 January 1959	0.7	12:1	--- <sup>a</sup>	Urbana	E
26 – 27 January 1967	1.7	17:1	40	Urbana	E

Source: Changnon, 1969

<sup>a</sup> Data not available

Notes: C=Central, E=East, N=North, S=South, W=West

**TABLE 2.3-5**  
Wind-Glaze Thickness Relations for Five Periods of Greatest Speed and Greatest Thickness

Rank	Five Periods When Five Fastest 5-minute Speeds Were Registered		Five Periods When Five Greatest Ice Thicknesses Were Measured	
	Speed (mph)	Ice Thickness (in)	Ice Thickness (in)	Speed (mph)
1	50	0.19	2.87	30
2	46	0.79	1.71	18
3	45	0.26	1.50	21
4	40	0.30	1.10	28
5	35	0.78	1.00	18

Source: Changnon, 1969

Notes: From data collected throughout the United States during period 1926-1937.

**TABLE 2.3-6**  
Seasonal Frequencies of Inversions Below 500 ft in Central Illinois

Season	Inversions Below 500 ft	
	Percent of Total Hours	Percent of 24-Hour Periods with at Least 1 Hour of Inversion
Winter	29%	53%
Spring	29%	67%
Summer	33%	81%
Fall	39%	82%

Source: Hosler, 1961

**TABLE 2.3-7**  
Seasonal Values of Mean Daily Mixing Depth in Central Illinois

Season	Mean Daily Mixing Depths (m)	
	Morning	Afternoon
Winter	400	690
Spring	490	1,500
Summer	330	1,600
Fall	390	1,200

Source: Holzworth, 1972

**TABLE 2.3-8**  
 Frequency of Occurrence of Wind Speed in the Site Area

Wind Speed (m/sec)	Percent of Occurrence	
	1972 – 1977	2000 – 2002
< 0.3 (calm)	0.3	0.03
0.3 to 1.4	7.7	13.83
1.5 to 3.0	28.2	40.40
3.1 to 5.0	30.7	31.41
5.1 to 8.0	23.7	12.21
> 8.0	9.4	2.16

Source: CPS, 2002; Campbell, 2002

**TABLE 2.3-9**  
 Summary of 10 m Ambient Temperature Measurements at CPS Facility (1972-1977)

	Average Daily	Average Daily Maximum	Average Daily Minimum	Absolute Maximum	Absolute Minimum
January	-5.1	-1.3	-8.9	15.5	-28.8
February	-1.3	1.9	-4.4	15.8	-23.6
March	5.9	10.5	1.6	25.5	-15.1
April	11.4	16.7	6.1	29.3	-6.5
May	16.4	21.2	11.2	32.1	0.0
June	21.2	26.1	16.0	33.0	5.0
July	23.6	28.4	18.5	35.2	8.1
August	22.1	26.8	17.4	23.2	9.1
September	17.7	22.8	12.7	33.3	0.8
October	11.9	17.1	6.9	30.0	-4.8
November	4.5	8.4	0.8	23.0	-15.8
December	-2.3	1.3	-5.9	17.8	-23.8
Period of Record	10.5	15.0	6.0	35.2	-28.8

Source: CPS, 2002  
 Notes: Temperatures in °C.

**TABLE 2.3-10**  
Hourly Temperature Distribution at CPS Facility (1972-1977)

	> 32.2 °C		< 0.0 °C		< -12.2 °C		< -17.8 °C	
	Hrs	Percent	Hrs	Percent	Hrs	Percent	Hrs	Percent
January	0	0.0%	2,628	72.5%	730	20.1%	225	6.2%
February	0	0.0%	2,019	60.5%	203	6.1%	48	1.4%
March	0	0.0%	808	21.9%	19	0.5%	0	0.0%
April	0	0.0%	188	4.7%	0	0.0%	0	0.0%
May	0	0.0%	1	0.0%	0	0.0%	0	0.0%
June	8	0.2%	0	0.0%	0	0.0%	0	0.0%
July	67	1.9%	0	0.0%	0	0.0%	0	0.0%
August	0	0.0%	0	0.0%	0	0.0%	0	0.0%
September	3	0.1%	0	0.0%	0	0.0%	0	0.0%
October	0	0.0%	82	2.3%	0	0.0%	0	0.0%
November	0	0.0%	948	26.4%	28	0.8%	0	0.0%
December	0	0.0%	2,414	65.9%	302	8.2%	56	1.5%
Period of Record	78	0.2%	9,088	21.0%	1,282	3.0%	329	0.8%

Source: CPS, 2002

**TABLE 2.3-11**  
 Daily Temperature Distribution at CPS Facility (1972-1977)

	> 32.2 °C		< 0.0 °C		< -12.2 °C		< -17.8 °C	
	Days	Percent	Days	Percent	Days	Percent	Days	Percent
January	0	0.0%	132	86.3%	55	35.9%	24	15.7%
February	0	0.0%	116	82.3%	21	14.9%	6	4.3%
March	0	0.0%	65	41.9%	2	1.3%	0	0.0%
April	0	0.0%	27	16.2%	0	0.0%	0	0.0%
May	0	0.0%	1	0.6%	0	0.0%	0	0.0%
June	3	2.0%	0	0.0%	0	0.0%	0	0.0%
July	15	10.0%	0	0.0%	0	0.0%	0	0.0%
August	0	0.0%	0	0.0%	0	0.0%	0	0.0%
September	1	0.7%	0	0.0%	0	0.0%	0	0.0%
October	0	0.0%	15	9.9%	0	0.0%	0	0.0%
November	0	0.0%	73	48.7%	3	2.0%	0	0.0%
December	0	0.0%	129	83.8%	29	18.8%	8	5.2%
Period of Record	19	1.0%	558	30.5%	110	6.0%	38	2.1%

Source: CPS, 2002

**TABLE 2.3-12**  
 Summary of Relative Humidity Measurements at CPS Facility (1972-1977)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period of Record
Average	85.94	82.04	77.29	68.01	64.44	68.24	70.00	74.04	72.15	67.15	77.58	85.71	68.28
Average Daily Max.	92.10	89.77	87.75	83.96	80.77	83.26	85.13	86.04	85.33	80.75	86.61	90.47	79.01
Average Daily Min.	71.04	65.71	56.91	46.43	43.89	47.52	49.03	53.84	49.40	45.57	60.44	71.64	50.63
Absolute Max.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Absolute Min.	38.34	14.11	22.26	16.80	15.78	19.22	27.20	23.93	15.91	14.86	23.13	21.40	14.11
<b>Average by Hour of Day</b>													
00	83.15	80.78	74.30	69.75	68.25	70.72	69.96	76.71	73.91	67.56	76.45	82.07	68.35
03	84.00	81.27	75.53	74.31	73.88	75.17	75.54	80.02	78.10	71.51	78.10	82.49	71.15
06	84.88	82.23	79.17	77.55	75.88	76.23	77.75	82.62	80.27	74.87	79.87	83.10	73.04
09	84.31	79.85	71.60	66.35	61.19	64.77	66.22	73.67	73.38	68.40	77.39	82.10	66.35
12	78.10	75.28	63.31	54.95	52.41	53.97	55.67	61.81	59.77	56.74	67.48	77.51	57.85
15	74.32	71.11	59.83	53.07	49.43	50.32	50.25	56.39	51.12	49.93	63.62	74.12	53.79
18	78.53	75.99	64.18	54.48	52.14	52.18	54.35	61.51	56.89	53.79	69.04	79.07	57.52
21	81.66	78.76	63.76	63.76	61.91	61.11	65.27	70.98	67.38	62.08	74.42	81.32	64.26

Source: CPS, 2002

Notes: Period of Record: 4/14/72-4/30/77.

**TABLE 2.3-13**  
 Summary of Wet Bulb Temperature Measurements at CPS Facility (1972-1977)

	<b>Average Daily</b>	<b>Average Daily Maximum</b>	<b>Average Daily Minimum</b>	<b>Absolute Maximum</b>	<b>Absolute Minimum</b>	<b>57% Wet Bulb Value</b>
January	-4.13	0.27	-7.98	16.67	-28.35	-- <sup>a</sup>
February	0.43	4.31	-3.16	17.76	-20.42	-- <sup>a</sup>
March	8.67	13.36	3.6	27.7	-13.7	-- <sup>a</sup>
April	13.74	19.21	7.16	32.13	-6.05	-- <sup>a</sup>
May	18.84	23.52	12.27	33	2.25	-- <sup>a</sup>
June	23.19	27.32	16.69	34.17	5.52	-- <sup>a</sup>
July	25.49	29.28	19.1	35.59	9.64	-- <sup>a</sup>
August	23.64	27.61	17.67	32.41	9.64	-- <sup>a</sup>
September	19.95	24.79	13.75	33.15	1	-- <sup>a</sup>
October	14.1	19.38	7.95	33.13	-4.16	-- <sup>a</sup>
November	6.23	10.42	1.8	24.67	14.95	-- <sup>a</sup>
December	-1.22	2.65	-5	18.67	-23.32	-- <sup>a</sup>
Period of Record	11.34	15.41	6.33	35.59	-28.35	28.17

Source: CPS, 2002

Notes: Temperatures in °C. Period of Record: 4/14/72-4/30/77.

--<sup>a</sup> - Data not available

**TABLE 2.3-14**  
Summary of 10-m Dew Point Measurements at CPS Facility (1972-1977)

	<b>Average Daily</b>	<b>Average Daily Maximum</b>	<b>Average Daily Minimum</b>	<b>Absolute Maximum</b>	<b>Absolute Minimum</b>
January	-7.8	-4.4	-11.1	14.1	-29.5
February	-4.0	-0.7	-7.5	13.6	-24.1
March	1.8	5.4	-1.2	17.7	-17.8
April	4.2	7.4	1.3	19.0	-10.0
May	8.1	11.0	5.2	22.7	-9.0
June	13.5	16.4	10.6	25.6	-0.3
July	16.5	19.3	14.0	25.	3.5
August	15.9	18.1	13.6	24.5	2.5
September	11.4	14.0	8.5	23.3	-7.1
October	4.2	7.1	1.4	9.1	-11.3
November	-0.1	2.8	-2.7	16.3	-17.5
December	-5.2	-2.1	-8.3	13.1	-25.7
Period of Record	4.7	7.8	1.9	25.6	-29.5

Source: CPS, 2002

Notes: Temperatures in °C. Period of Record: 4/14/72-4/30/77.

**TABLE 2.3-15**  
 Hourly Dew Point Temperature at CPS Facility (1972-1977)-Percent of Hours with Dew Point

	> 18.3 °C	> 12.8 °C	> 7.2 °C	> 0.0 °C
January	0.0	0.1	2.0	16.5
February	0.0	0.2	3.5	27.9
March	0.0	5.9	21.7	58.9
April	0.1	9.9	32.8	73.7
May	3.0	22.1	59.1	89.5
June	19.3	54.1	89.0	99.9
July	38.1	79.3	98.1	100.0
August	37.7	73.9	94.3	100.0
September	20.3	41.1	73.0	96.2
October	0.4	13.5	34.1	72.5
November	0.0	4.6	15.0	47.3
December	0.0	0.1	2.5	17.9
Period of Record	9.5	24.9	43.3	66.3

Source: CPS, 2002

Notes: Period of Record: 4/14/72-4/30/77.

**TABLE 2.3-16**

Summary of Dew Point Variability at CPS Facility (1972-1977)-Percent of Hours with Dew Point Spread

	<b>0.0 to 0.7 °C</b>	<b>0.8 to 2.2 °C</b>	<b>2.3 to 4.4 °C</b>	<b>≥ 4.5 °C</b>
January	15.8%	33.0%	37.3%	14.0%
February	20.1%	20.7%	26.8%	32.3%
March	6.6%	18.0%	29.0%	46.5%
April	3.4%	14.2%	21.1%	61.2%
May	1.4%	9.0%	22.7%	66.9%
June	3.0%	11.1%	20.5%	65.4%
July	2.6%	8.3%	22.0%	67.1%
August	3.0%	16.3%	25.9%	54.8%
September	5.0%	16.8%	23.5%	54.7%
October	4.5%	14.9%	16.2%	64.4%
November	7.6%	20.8%	31.1%	40.6%
December	12.7%	26.7%	31.8%	18.8%
Period of Record	7.0%	18.4%	25.8%	48.8%

Source: CPS, 2002

Notes: Period of Record: 4/14/72-4/30/77.

**TABLE 2.3-17**  
Summary of Precipitation Measurements at CPS Facility (1972-1977)

	Average Monthly and Annual	Maximum 1 hr	Maximum 1 Day	Percent Hours With Precipitation		Percent Days With Precipitation		Max. Consecutive Hours		Max. Consecutive Days	
				0.01 or More	1.00 or More	0.01 or More	1.00 or More	With Precip.	Without Precip.	With Precip.	Without Precip.
January	1.40	0.50	2.53	3.4%	0.0%	21.3%	0.6%	14	356	5	14
February	1.15	0.26	0.97	3.3%	0.0%	19.9%	0.0%	9	470	3	19
March	3.44	0.69	1.29	5.9%	0.0%	23.3%	1.9%	10	408	3	16
April	1.67	0.69	1.63	3.4%	0.0%	25.1%	0.6%	14	455	5	18
May	1.80	0.52	0.62	3.6%	0.0%	26.0%	0.0%	6	293	5	12
June	4.16	1.15	2.72	4.7%	0.0%	31.3%	3.3%	14	545	5	22
July	2.27	0.43	1.74	3.1%	0.0%	25.2%	0.6%	7	365	4	14
August	2.52	0.80	1.34	2.9%	0.0%	21.9%	0.6%	8	476	3	21
September	2.44	0.81	1.26	3.8%	0.0%	28.0%	2.0%	11	372	8	15
October	1.53	0.45	0.94	3.7%	0.0%	20.6%	0.0%	12	332	3	13
November	1.83	0.40	1.06	4.4%	0.0%	22.0%	0.7%	11	620	5	25
December	1.33	0.34	0.93	3.7%	0.0%	21.9%	0.0%	8	406	8	16
Period of Record	25.47	1.15	2.72	3.8%	0.0%	24.6%	0.9%	14	807	8	33

Source: CPS, 2002

Notes: Precipitation is measured in inches. Period of Record: 4/14/72-4/30/77.

**TABLE 2.3-18**  
Average Number of Days of Fog Occurrence at Peoria and Springfield, Illinois

	Average Number of Days of Fog (Observed)	
	Springfield, IL	Peoria, IL
January	2	3
February	3	3
March	2	2
April	1	1
May	1	1
June	1/2	1
July	1	1
August	1	1
September	1	1
October	1	1
November	2	2
December	3	3
Year	18.5	20
Period of Record	1951-1961; 1963-1970	1949-1951; 1957-1971

Source: CPS, 2002

Notes: Originally obtained from NOAA, Local Climatological Data Summaries for Peoria and Springfield, Illinois.

**TABLE 2.3-19**  
 Monthly Frequency of Fog Occurrence, Hours of Maximum and Minimum, and Fog Persistence for Peoria, Illinois  
 (1949-1951; 1957-1971)

Month	Percent Total Frequency of Occurrences	Daily Maximum		Daily Minimum		Number of Times In 15 Years Fog Persisted For At Least:		
		Hour	Percent	Hour	Percent	12 Hours	24 Hours	Max.
January	17.8%	8 AM	25.1%	6 PM	14.0%	38	15	95
February	17.1%	8 AM	26.8%	3 PM	11.6%	32	8	42
March	14.9%	6 AM	24.1%	3 PM	9.5%	33	8	74
April	8.2%	6 AM	18.0%	2 PM	4.1%	10	4	36
May	7.4%	6 AM	17.2%	5 PM	2.5%	11	2	34
June	5.7%	5 AM	17.4%	6 PM	0.9%	3	1	42
July	7.3%	5 AM	27.6%	5 PM	0.7%	7	0	15
August	8.6%	6 AM	35.7%	4 PM	0.4%	5	0	19
September	9.1%	6 AM	27.3%	2 PM	1.9%	10	1	33
October	10.3%	7 AM	23.3%	3 PM	5.4%	15	3	34
November	13.8%	8 AM	23.0%	1 PM	8.5%	25	7	43
December	15.5%	9 AM	21.5%	4 PM	10.0%	38	9	48

Source: CPS, 2002

**TABLE 2.3-20**

Monthly Frequency of Fog Occurrence, Hours of Maximum and Minimum, and Fog Persistence for Springfield, Illinois (1951-1961; 1963-1970)

Month	Percent Total Frequency of Occurrences	Daily Maximum		Daily Minimum		Number of Times In 15 Years Fog Persisted for at Least:		
		Hour	Percent	Hour	Percent	12 Hours	24 Hours	Max.
January	17.2%	7 AM	25.1%	3 PM	13.4%	49	17	90
February	15.0%	7 AM	23.9%	3 PM	10.8%	39	15	53
March	12.7%	6 AM	21.4%	3 PM	8.7%	36	8	36
April	6.4%	6 AM	16.1%	4 PM	2.3%	16	2	26
May	5.5%	5 AM	14.6%	4 PM	1.5%	8	1	27
June	3.7%	6 AM	12.4%	5 PM	0.8%	1	1	29
July	5.0%	5 AM	22.3%	3 PM	0.2%	6	0	19
August	6.1%	6 AM	27.0%	4 PM	0.2%	2	0	13
September	5.5%	6 AM	23.9%	4 PM	0.3%	3	0	22
October	6.7%	6 AM	15.8%	4 PM	4.0%	14	3	47
November	9.4%	7 AM	17.4%	2 PM	4.9%	25	5	51
December	15.4%	8 AM	20.8%	2 PM	12.2%	37	17	75

Source: CPS, 2002

**TABLE 2.3-21**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category A (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: A (Delta-T Less Than -1.8 °C per 100 m)

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
0.3- 1.4	1	4	3	2	2	7	9	5	5	6	2	3	4	3	4	5	65
(1)	0.06	0.23	0.17	0.11	0.11	0.40	0.51	0.28	0.28	0.34	0.11	0.17	0.23	0.17	0.23	0.28	3.68
(2)	0.00	0.01	0.01	0.00	0.00	0.02	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.05	0.16
1.5- 3.0	23	24	12	14	8	19	34	41	31	37	13	24	30	27	18	24	379
(1)	1.30	1.36	0.68	0.79	0.45	1.08	1.93	2.32	1.76	2.10	0.74	1.36	1.70	1.53	1.02	1.36	21.46
(2)	0.06	0.06	0.03	0.03	0.02	0.05	0.08	0.10	0.08	0.09	0.03	0.06	0.07	0.07	0.04	0.06	0.93
3.1- 5.0	39	43	26	19	8	17	38	61	40	65	32	44	37	57	24	29	579
(1)	2.21	2.43	1.47	1.08	0.45	0.96	2.15	3.45	2.27	3.68	1.81	2.49	2.10	3.23	1.36	1.64	32.79
(2)	0.10	0.11	0.06	0.05	0.02	0.04	0.09	0.15	0.10	0.16	0.08	0.11	0.09	0.14	0.06	0.07	1.42
5.1- 8.0	28	59	27	8	4	10	22	46	38	52	46	71	65	48	49	26	594
(1)	1.59	3.34	1.25	0.45	0.23	0.57	1.25	2.60	2.15	2.94	2.60	4.02	3.68	2.72	2.77	1.47	33.64
(2)	0.07	0.15	0.05	0.02	0.01	0.02	0.05	0.11	0.09	0.13	0.11	0.17	0.16	0.12	0.12	0.06	1.46
8.1-10.4	4	2	2	0	0	0	1	9	6	11	13	19	8	5	13	6	104
(1)	0.23	0.11	0.11	0.00	0.00	0.00	0.06	0.51	0.34	0.62	1.02	1.08	0.45	0.28	0.74	0.34	5.89
(2)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.03	0.04	0.05	0.02	0.01	0.03	0.01	0.26
OVER 10.4	0	12	1	1	2	0	1	0	2	2	3	7	2	4	2	5	44
(1)	0.00	0.68	0.06	0.06	0.11	0.00	0.06	0.00	0.11	0.11	0.17	0.40	0.11	0.23	0.11	0.28	2.49
(2)	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.01	0.00	0.01	0.11
All Speeds (4)	95	144	66	44	24	53	105	162	122	173	114	168	146	144	110	95	1765
(1)	5.38	8.15	3.74	2.49	1.36	3.00	5.95	9.17	6.91	9.80	6.46	9.51	8.27	8.15	6.23	5.38	99.94
(2)	0.23	0.35	0.16	0.11	0.06	0.13	0.26	0.40	0.30	0.43	0.28	0.41	0.36	0.35	0.27	0.23	4.34

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West (4) 1,766 hrs on this page, with 1 hrs (0.1 percent) at less than 0.3 m/s (0.0 percent of all hrs).

**TABLE 2.3-22**

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category B (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: B (Delta-T Range = -1.8 to -1.7 °C per 100 m)

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
0.3- 1.4	0	4	5	1	0	1	1	2	1	6	2	5	4	2	2	0	36
(1)	0.00	0.27	0.34	0.07	0.00	0.07	0.07	0.14	0.07	0.41	0.14	0.34	0.27	0.14	0.14	0.00	2.47
(2)	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.09
1.5- 3.0	12	24	8	13	10	10	14	22	13	36	22	15	18	15	13	15	260
(1)	0.82	1.65	0.55	0.89	0.69	0.69	0.96	1.51	0.69	2.47	1.51	1.03	1.24	1.03	0.89	1.03	17.86
(2)	0.03	0.06	0.02	0.03	0.02	0.02	0.03	0.05	0.03	0.09	0.05	0.04	0.04	0.04	0.03	0.04	0.64
3.1- 5.0	35	32	18	14	17	24	29	41	45	61	40	46	40	43	28	27	541
(1)	2.40	2.20	1.24	0.96	1.17	1.72	1.99	2.82	3.09	4.19	2.75	3.16	2.75	2.95	1.92	1.85	37.16
(2)	0.09	0.08	0.04	0.03	0.04	0.06	0.07	0.10	0.11	0.15	0- .10	0.11	0.10	0.11	0.07	0.07	1.33
5.1- 8.0	20	34	16	20	6	16	31	27	35	46	42	40	47	47	22	26	475
(1)	1.37	2.34	1.10	1.37	0.41	1.10	2.13	1.85	2.40	3.16	2.88	2.76	3.23	3.23	1.51	1.79	32.62
(2)	0.05	0.08	0.04	0.05	0.01	0.04	0.08	0.07	0.09	0.11	0.10	0.10	0.12	0.12	0.05	0.06	1.17
8.1-10.4	3	0	0	1	0	0	2	7	5	5	9	24	16	4	3	3	82
(1)	0.21	0.00	0.00	0.07	0.00	0.00	0.14	0.48	0.34	0.34	0.62	1.65	1.10	0.27	0.21	0.21	5.63
(2)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.02	0.06	0.04	0.01	0.01	0.01	0.20
Over 10.4	2	1	0	2	6	2	1	6	3	4	5	8	15	1	0	5	61
(1)	0.14	0.07	0.00	0.14	0.41	0.14	0.07	0.41	0.21	0.27	0.34	0.55	1.03	0.07	0.00	0.34	4.19
(2)	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.04	0.00	0.00	0.01	0.15
All Speeds (4)	72	95	47	51	39	54	78	105	102	158	120	138	140	112	68	76	1455
(1)	4.95	6.52	3.23	3.50	2.68	3.71	5.36	7.21	7.01	10.85	8.24	9.48	9.62	7.69	4.67	5.22	99.93
(2)	0.18	0.23	0.12	0.13	0.10	0.13	0.19	0.26	0.25	0.39	0.30	0.34	0.34	0.28	0.17	0.19	3.58

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West  
(4) 1,766 hrs on this page, with 1 hrs (0.1 percent) at less than 0.3 m/s (0.0 percent of all hrs).

**TABLE 2.3-23**  
Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category C (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: C (Delta-T Range = -1.6 to -1.5 °C per 100 m)

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)																Total
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	
0.3-1.4	0	5	4	1	1	3	7	7	7	4	5	5	6	4	3	2	64
(1)	0.00	0.23	0.18	0.05	0.05	0.14	0.32	0.32	0.32	0.18	0.23	0.23	0.27	0.18	0.14	0.09	2.92
(2)	0.00	0.01	0.01	0.00	0.00	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.16
1.5- 3.0	27	31	31	18	12	25	29	36	29	32	22	28	35	18	28	22	423
(1)	1.23	1.42	1.42	0.82	0.55	1.14	1.32	1.64	1.32	1.46	1.01	1.28	1.60	0.82	1.28	1.01	19.32
(2)	0.07	0.08	0.08	0.04	0.03	0.06	0.07	0.09	0.07	0.08	0.05	0.07	0.09	0.04	0.07	0.05	1.04
3.1- 5.0	42	46	40	31	31	24	51	55	47	83	67	38	62	50	52	27	746
(1)	1.92	2.10	1.83	1.42	1.42	1.10	2.33	2.51	2.15	3.79	3.06	1.74	2.83	2.28	2.38	1.23	34.08
(2)	0.10	0.11	0.10	0.08	0.08	0.06	0.13	0.14	0.12	0.20	0.16	0.09	0.15	0.12	0.13	0.07	1.83
5.1- 8.0	35	34	19	20	20	31	40	33	43	88	62	61	72	55	33	29	675
(1)	1.60	1.55	0.87	0.91	0.91	1.42	1.83	1.51	1.96	4.02	2.83	2.79	3.29	2.51	1.51	1.32	30.84
(2)	0.09	0.08	0.05	0.05	0.05	0.08	0.10	0.08	0.11	0.22	0.15	0.15	0.18	0.14	0.08	0.07	1.66
8.1-10.4	8	3	0	1	0	2	2	9	14	12	17	36	20	13	5	7	149
(1)	0.37	0.14	0.00	0.05	0.00	0.09	0.09	0.41	0.64	0.55	0.78	1.64	0.91	0.59	0.23	0.32	6.81
(2)	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.03	0.04	0.09	0.05	0.03	0.01	0.02	0.37
Over 10.4	1	3	1	8	7	9	10	3	12	9	19	23	12	4	4	5	130
(1)	0.05	0.14	0.05	0.37	0.32	0.41	0.46	0.14	0.55	0.41	0.87	1.05	0.55	0.18	0.18	0.23	5.94
(2)	0.00	0.01	0.00	0.02	0.02	0.02	0.02	0.01	0.03	0.02	0.05	0.06	0.03	0.01	0.01	0.01	0.32
All Speeds (4)	113	122	95	79	71	94	139	143	152	228	192	191	207	144	125	92	2187
(1)	5.16	5.57	4.34	3.61	3.24	4.29	6.35	6.53	6.94	10.42	8.77	8.73	9.46	6.58	5.71	4.20	99.91
(2)	0.28	0.30	0.23	0.19	0.17	0.23	0.34	0.35	0.37	0.56	0.47	0.47	0.51	0.35	0.31	0.23	5.38

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3)E=East, N=North, S=South, W=West  
(4) 2,189 hrs on this page, with 2 hrs (0.1 percent) at less than 0.3 m/s (0.0 percent of all hrs).

**TABLE 2.3-24**  
Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category D (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: D (Delta-T Range = -1.4 to -0.5 °C per 100 m)

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
0.3-1.4	30	34	31	37	40	25	46	50	46	52	37	36	46	26	35	31	602
(1)	0.18	0.21	0.19	0.23	0.25	0.15	0.28	0.31	0.28	0.32	0.23	0.22	0.28	0.16	0.21	0.19	3.69
(2)	0.07	0.08	0.08	0.09	0.10	0.06	0.11	0.12	0.11	0.13	0.09	0.09	0.11	0.06	0.09	0.08	1.48
1.5- 3.0	126	178	204	197	147	173	250	249	218	229	160	162	190	166	155	135	2,939
(1)	0.77	1.09	1.25	1.21	0.90	1.06	1.53	1.53	1.34	1.40	0.98	0.99	1.16	1.02	0.95	0.83	18.01
(2)	0.31	0.44	0.50	0.48	0.36	0.43	0.61	0.61	0.54	0.56	0.39	0.40	0.47	0.41	0.38	0.33	7.23
3.1- 5.0	269	289	291	286	248	231	302	416	466	396	314	360	450	406	316	294	5,334
(1)	1.65	1.77	1.78	1.75	1.52	1.42	1.85	2.55	2.86	2.43	1.92	2.21	2.76	2.49	1.94	1.80	32.69 4
(2)	0.66	0.71	0.72	0.70	0.61	0.57	0.74	1.02	1.15	0.97	0.77	0.89	1.11	1.00	0.78	0.72	13.11
5.1- 8.0	240	263	138	134	170	193	228	439	515	428	323	535	679	457	319	269	5,330
(1)	1.47	1.61	0.85	0.82	1.04	1.18	1.40	2.69	3.16	2.62	1.98	3.28	4.16	2.80	1.96	1.65	32.67
(2)	0.59	0.65	0.34	0.33	0.42	0.47	0.56	1.08	1.27	1.05	0.79	1.32	1.67	1.12	0.78	0.66	13.10
8.1-10.4	65	63	11	16	16	23	40	152	139	119	137	200	204	102	86	73	1,446
(1)	0.40	0.39	0.07	0.10	0.10	0.14	0.25	0.93	0.85	0.73	0.84	1.23	1.25	0.63	0.53	0.85	8.86
(2)	0.16	0.15	0.03	0.04	0.04	0.06	0.10	0.37	0.34	0.29	0.34	0.42	0.50	0.25	0.21	0.18	3.55
Over 10.4	25	19	13	21	18	22	17	39	58	52	95	132	80	24	24	23	662
(1)	0.15	0.12	0.08	0.13	0.11	0.13	0.10	0.24	0.36	0.32	0.58	0.81	0.49	0.15	0.15	0.14	4.06
(2)	0.06	0.05	0.03	0.05	0.04	0.05	0.04	0.10	0.14	0.13	0.23	0.32	0.20	0.06	0.06	0.06	1.63
All Speeds (4)	755	846	688	691	639	667	883	1,345	1,442	1,276	1,066	1,425	1,649	1,181	935	825	16,313
(1)	4.63	5.18	4.22	4.23	3.92	4.09	5.41	8.24	8.84	7.82	6.53	8.73	10.11	7.24	5.73	5.06	99.98
(2)	1.86	2.08	1.69	1.70	1.57	1.64	26.17	3.31	3.55	3.14	2.62	3.50	4.05	2.90	2.30	2.03	40.10

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West  
(4) 16,317 hrs on this page, with 4 hrs (0.0 percent) at less than 0.3 m/s (0.0 percent of all hrs).

**TABLE 2.3-25**

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category E (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: E (Delta-T Range = -0.4 to +1.5 °C per 100 m)

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)																
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	Total
0.3-1.4	38	42	49	47	33	53	62	69	60	60	48	44	41	28	19	32	725
(1)	0.35	0.39	0.45	0.43	0.31	0.49	0.57	0.64	0.55	0.55	0.44	0.41	0.38	0.26	0.15	0.30	6.70
(2)	0.09	0.10	0.12	0.12	0.08	0.13	0.15	0.17	0.15	0.15	0.12	0.11	0.10	0.07	0.05	0.08	1.78
1.5- 3.0	95	170	188	204	201	255	308	312	299	218	197	173	175	159	113	98	3,165
(1)	0.88	1.57	1.74	1.89	1.86	2.36	2.85	2.88	2.76	2.02	1.82	1.60	1.62	1.47	1.04	0.91	29.26
(2)	0.23	0.42	0.46	0.50	0.49	0.63	0.76	0.77	0.74	0.54	0.48	0.43	0.43	0.39	0.28	0.24	7.78
3.1- 5.0	119	156	162	187	197	246	367	530	518	343	241	242	223	148	116	151	3,946
(1)	1.10	1.44	1.50	1.73	1.82	2.27	3.39	4.90	4.79	3.17	2.23	2.24	2.06	1.37	1.07	1.40	36.49
(2)	0.29	0.38	0.40	0.46	0.48	0.60	0.90	1.30	1.27	0.84	0.59	0.59	0.55	0.36	0.29	0.37	9.70
5.1- 8.0	48	72	33	56	100	148	174	402	386	193	188	197	124	56	42	65	2,284
(1)	0.44	0.67	0.31	0.52	0.92	1.37	1.61	3.72	3.57	1.78	1.74	1.82	1.15	0.52	0.39	0.60	21.12
(2)	0.12	0.18	0.08	0.14	0.25	0.36	0.43	0.99	0.95	0.47	0.46	0.48	0.30	0.14	0.10	0.16	5.61
8.1-10.4	15	10	5	2	21	26	19	56	43	32	46	51	25	9	20	14	394
(1)	0.14	0.09	0.05	0.02	0.19	0.24	0.18	0.52	0.40	0.30	0.43	0.47	0.23	0.08	0.18	0.13	3.64
(2)	0.04	0.02	0.01	0.00	0.05	0.06	0.05	0.14	0.11	0.08	0.11	0.13	0.06	0.02	0.05	0.03	0.97
Over 10.4	4	9	9	17	24	15	20	31	36	24	24	23	13	13	4	9	275
(1)	0.04	0.08	0.08	0.16	0.22	0.14	0.18	0.29	0.33	0.22	0.22	0.21	0.12	0.12	0.04	0.08	2.54
(2)	0.01	0.02	0.02	0.04	0.06	0.04	0.05	0.08	0.09	0.06	0.06	0.06	0.03	0.03	0.01	0.02	0.68
All Speeds (4)	319	459	446	513	576	743	950	1,480	1,342	870	744	730	601	413	314	369	10,789
(1)	2.95	4.24	4.12	4.74	5.33	6.87	8.78	12.94	12.41	8.04	6.88	6.75	5.56	3.82	2.90	3.41	99.76
(2)	0.78	1.13	1.10	1.26	1.42	1.83	2.34	3.44	3.30	2.14	1.83	1.79	1.48	1.02	0.77	0.91	26.52

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West (4) 10,815 hrs on this page, with 26 hrs (0.2 percent) at less than 0.3 m/s (0.1 percent of all hrs).

**TABLE 2.3-26**

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category F (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: F (Delta-T Range = 1.6 To 4.0 °C per 100 m)

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
0.3-1.4	30	50	50	42	36	49	54	59	36	44	35	44	29	25	33	39	655
(1)	0.67	1.12	1.12	0.94	0.80	1.10	1.21	1.32	0.80	0.98	0.78	0.98	0.65	0.56	0.74	0.87	14.64
(2)	0.07	0.12	0.12	0.10	0.09	0.12	0.13	0.15	0.09	0.11	0.09	0.11	0.07	0.06	0.08	0.10	1.61
1.5- 3.0	75	125	134	153	161	197	216	222	248	209	152	139	163	113	63	83	2,453
(1)	1.68	2.79	3.00	3.42	3.60	4.40	4.83	4.96	5.54	4.67	3.40	3.11	3.64	2.53	1.41	1.86	54.83
(2)	0.18	0.31	0.33	0.38	0.40	0.48	0.53	0.55	0.61	0.51	0.37	0.34	0.40	0.28	0.15	0.20	6.03
3.1- 5.0	26	24	22	28	40	56	101	114	148	120	96	73	75	57	24	27	1,031
(1)	0.58	0.54	0.49	0.63	0.89	1.25	2.26	2.55	3.31	2.68	2.15	1.63	1.68	1.27	0.54	0.60	23.04
(2)	0.06	0.06	0.05	0.07	0.10	0.14	0.25	0.28	0.36	0.30	0.24	0.18	0.18	0.14	0.06	0.07	2.53
5.1- 8.0	0	0	0	0	0	5	4	4	8	14	10	16	10	3	4	2	80
(1)	0.00	0.00	0.00	0.00	0.00	0.11	0.09	0.09	0.18	0.31	0.22	0.36	0.22	0.07	0.09	0.04	1.79
(2)	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.02	0.04	0.02	0.01	0.01	0.00	0.20
8.1-10.4	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	0	5
(1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.04	0.00	0.11
(2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Over 10.4	11	21	14	22	9	13	23	18	23	17	15	12	8	5	4	9	224
(1)	0.25	0.47	0.31	0.49	0.20	0.29	0.51	0.40	0.51	0.38	0.34	0.27	0.18	0.11	0.09	0.20	5.01
(2)	0.03	0.05	0.03	0.05	0.02	0.03	0.06	0.04	0.06	0.04	0.04	0.03	0.02	0.01	0.01	0.02	0.55
All Speeds (4)	142	220	220	245	246	320	398	417	463	404	308	285	286	204	130	160	4,448
(1)	3.17	4.92	4.92	5.48	5.50	7.15	8.90	9.32	10.35	9.03	6.88	6.37	6.39	4.56	2.91	3.58	99.42
(2)	0.35	0.54	0.54	0.60	0.60	0.79	0.98	1.03	1.14	0.99	0.76	0.70	0.70	0.50	0.32	0.39	10.93

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West  
(4) 4,474 hrs on this page, with 24 hrs (0.6 percent) at less than 0.3 m/s (0.1 percent of all hrs).

**TABLE 2.3-27**  
Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category G (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: G (Delta-T Greater Than 4.0 °C per 100 m)

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
0.3-1.4	53	73	73	79	52	57	69	98	78	63	58	58	55	49	41	37	993
(1)	1.45	1.99	1.99	2.16	1.42	1.56	1.89	2.68	2.13	1.72	1.58	1.58	1.50	1.34	1.12	1.01	27.13
(2)	0.13	0.18	0.18	0.19	0.13	0.14	0.17	0.24	0.19	0.15	0.14	0.14	0.14	0.12	0.10	0.09	2.44
1.5- 3.0	75	138	94	93	90	160	182	189	216	151	88	94	92	96	43	57	1,858
(1)	2.05	3.77	2.57	2.54	2.46	4.37	4.97	5.16	5.90	4.13	2.40	2.57	2.51	2.62	1.17	1.56	50.77
(2)	0.18	0.34	0.23	0.23	0.22	0.39	0.45	0.46	0.53	0.37	0.22	0.23	0.23	0.24	0.11	0.14	4.57
3.1- 5.0	8	9	9	10	13	19	23	23	55	28	13	17	22	27	12	7	295
(1)	0.22	0.25	0.25	0.27	0.36	0.52	0.63	0.63	1.50	0.77	0.36	0.46	0.60	0.74	0.33	0.19	8.06
(2)	0.02	0.02	0.02	0.02	0.03	0.05	0.06	0.06	0.14	0.07	0.03	0.04	0.05	0.07	0.03	0.02	0.73
5.1- 8.0	6	10	1	5	14	15	4	35	55	13	2	17	14	2	1	3	197
(1)	0.16	0.27	0.03	0.14	0.38	0.41	0.11	0.96	1.50	0.36	0.05	0.46	0.38	0.05	0.03	0.08	5.38
(2)	0.01	0.02	0.00	0.01	0.03	0.04	0.01	0.09	0.14	0.03	0.00	0.04	0.03	0.00	0.00	0.01	0.48
8.1-10.4	1	1	1	0	0	0	0	0	20	4	1	8	6	0	2	3	47
(1)	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.55	0.11	0.03	0.22	0.16	0.00	0.05	0.08	1.28
(2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.01	0.00	0.02	0.01	0.00	0.00	0.01	0.12
Over 10.4	8	30	27	25	15	9	16	27	16	13	16	2	5	5	2	5	221
(1)	0.22	0.82	0.74	0.68	0.41	0.25	0.44	0.74	0.44	0.36	0.44	0.05	0.14	0.14	0.05	0.14	6.04
(2)	0.02	0.07	0.07	0.06	0.04	0.02	0.04	0.07	0.04	0.03	0.04	0.00	0.01	0.01	0.00	0.01	0.54
All Speeds (4)	151	261	205	212	184	260	294	372	440	272	178	196	194	179	101	112	3,611
(1)	4.13	7.13	5.60	5.79	5.03	7.10	8.03	10.16	12.02	7.43	4.86	5.36	5.30	4.89	2.76	3.06	98.66
(2)	0.37	0.64	0.50	0.52	0.45	0.64	0.72	0.91	1.08	0.67	0.44	0.48	0.48	0.44	0.25	0.28	8.88

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West (4) 3,660 hrs on this page, with 49 hrs (1.3 percent ) at less than 0.3 m/s (0.1 percent of all hrs).

**TABLE 2.3-28**

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – All Stability Categories (4/14/72-4/30/77)

Wind Level: 10 m (33 ft)

Stability Category: ALL Stabilities Combined

Period of Record: 4/14/72-4/30/77

Speed (m/s)	Direction (3)															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
0.3-1.4	152	212	215	209	164	195	248	290	233	235	187	195	185	137	137	146	3,140
(1)	0.37	0.52	0.53	0.51	0.40	0.48	0.61	0.71	0.57	0.58	0.46	0.48	0.45	0.34	0.34	0.36	7.72
(2)	0.37	0.52	0.53	0.51	0.40	0.48	0.61	0.71	0.57	0.58	0.46	0.48	0.45	0.34	0.34	0.36	7.72
1.5- 3.0	433	690	671	692	629	839	1,033	1,071	1,054	912	654	635	703	594	433	434	11,477
(1)	1.06	1.70	1.65	1.70	1.55	2.06	2.54	2.63	2.59	2.24	1.61	1.56	1.73	1.46	1.06	1.07	28.21
(2)	1.06	1.70	1.65	1.70	1.55	2.06	2.54	2.63	2.59	2.24	1.61	1.56	1.73	1.46	1.06	1.07	28.21
3.1- 5.0	538	599	568	575	554	618	911	1,240	1,319	1,096	803	820	909	788	572	562	12,472
(1)	1.32	1.47	1.40	1.41	1.36	1.52	2.24	3.05	3.24	2.69	1.97	2.02	2.23	1.94	1.41	1.38	30.66
(2)	1.32	1.47	1.40	1.41	1.36	1.52	2.24	3.05	3.24	2.69	1.97	2.02	2.23	1.94	1.41	1.38	30.66
5.1- 8.0	377	472	229	243	314	418	503	956	1,000	834	673	937	1,011	668	470	420	9,635
(1)	0.93	1.16	0.56	0.60	0.77	1.03	1.24	2.42	2.66	2.05	1.65	2.30	2.49	1.64	1.16	1.03	23.69
(2)	0.93	1.16	0.56	0.60	0.77	1.03	1.24	2.42	2.66	2.05	1.65	2.30	2.49	1.64	1.16	1.03	23.69
8.1-10.4	96	79	19	20	37	51	64	233	227	183	228	339	280	134	131	106	2,227
(1)	0.24	0.19	0.05	0.05	0.09	0.13	0.16	0.57	0.56	0.45	0.56	0.83	0.69	0.33	0.32	0.26	5.47
(2)	0.24	0.19	0.05	0.05	0.09	0.13	0.16	0.57	0.56	0.45	0.56	0.83	0.69	0.33	0.32	0.26	5.47
Over 10.4	51	95	65	96	81	70	88	124	150	121	177	207	135	56	40	61	1,617
(1)	0.13	0.23	0.16	0.24	0.20	0.17	0.22	0.30	0.37	0.30	0.44	0.51	0.33	0.14	0.10	0.15	3.98
(2)	0.13	0.23	0.16	0.24	0.20	0.17	0.22	0.30	0.37	0.30	0.44	0.51	0.33	0.14	0.10	0.15	3.98
All Speeds (4)	1,647	2,147	1,767	1,835	1,779	2,191	2,847	3,944	4,063	3,381	2,722	3,133	3,223	2,377	1,783	1,729	40,568
(1)	4.05	5.28	4.34	4.51	4.37	5.39	7.00	9.70	9.99	8.31	6.69	7.70	7.92	5.84	4.38	4.25	99.73
(2)	4.05	5.28	4.34	4.51	4.37	5.39	7.00	9.70	9.99	8.31	6.69	7.70	7.92	5.84	4.38	4.25	99.73

Source: CPS, 2002

Notes: (1)=Percent of all good observations for this page, (2)=Percent of all good observations for the period, (3) E=East, N=North, S=South, W=West (4) 40,677 good hrs, with 109 hrs (0.3 percent ) at less than 0.3 m/s, 44,208 hrs in the time period, 92.0 pct data recovery.

**TABLE 2.3-29**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category A (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: A (Delta-T Less Than -1.8 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction																Total
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	
≤ 1.5	0	3	6	3	9	12	19	6	4	7	6	3	1	3	1	2	85
1.6 – 3.3	6	59	56	62	82	89	94	128	83	95	38	36	40	40	17	15	940
3.4 – 5.5	28	90	25	22	12	42	32	130	129	113	64	84	77	85	35	34	1,002
5.6 – 8.2	12	22	3	3	0	9	25	67	58	56	38	73	79	51	19	16	531
8.3 – 10.9	0	1	0	0	0	1	2	8	1	2	4	18	20	9	5	1	72
≥ 11.0	0	0	0	0	0	0	1	0	0	0	2	3	0	0	0	0	6
All Speeds	46	175	90	90	103	153	173	339	275	273	152	217	217	188	77	68	2,636

Source: Campbell, 2002

Notes: 2,636 hrs on this page, 2 hrs calm winds (less than 0.3 m/s), 0.1 percent of all hrs.

**TABLE 2.3-30**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility - Stability Category B (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: B (Delta-T Range = -1.8 to -1.7 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
≤ 1.5	0	4	5	6	12	14	7	12	8	9	7	3	4	2	0	2	95
1.6 – 3.3	17	43	28	18	16	38	36	52	49	48	30	37	38	36	14	23	523
3.4 – 5.5	29	28	14	6	1	12	33	43	55	75	55	51	55	57	21	23	558
5.6 – 8.2	5	10	1	2	1	2	17	28	41	17	22	25	23	16	6	12	228
8.3 – 10.9	1	0	0	0	0	0	2	7	2	2	3	8	7	2	3	1	38
≥ 11.0	0	0	0	0	0	0	0	1	0	0	1	4	0	0	0	0	6
All Speeds	52	85	48	32	30	66	95	143	155	151	118	128	127	113	44	61	1,448

Source: Campbell, 2002

Notes: 1,448 hrs on this page, 2 hrs calm winds (less than 0.3 m/s), 0.1 percent of all hrs.

**TABLE 2.3-31**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category C (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: C (Delta-T Range = -1.6 to -1.5 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction																Total
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	
≤ 1.5	2	8	5	5	9	6	9	8	5	10	6	2	7	8	3	2	95
1.6 – 3.3	16	49	34	17	20	34	30	34	24	33	22	30	38	36	35	21	473
3.4 – 5.5	35	27	15	5	8	19	32	57	44	51	41	49	49	36	25	30	523
5.6 – 8.2	16	16	0	1	0	7	10	21	20	16	23	29	51	28	11	15	264
8.3 – 10.9	8	5	0	0	0	0	1	8	4	2	13	5	12	6	1	0	65
≥ 11.0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	3
All Speeds	77	105	54	28	37	66	82	128	97	112	106	116	158	114	75	68	1,423

Source: Campbell, 2002

Notes: 1,423 hrs on this page, 0 hrs calm winds (less than 0.3 m/s), 0.0 percent of all hrs.

**TABLE 2.3-32**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category D (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: D (Delta-T Range = -1.4 to -0.5 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
≤ 1.5	23	32	39	54	71	36	41	22	32	38	20	32	29	26	21	20	536
1.6 – 3.3	131	198	152	145	177	202	227	170	169	143	96	152	137	154	121	124	2,498
3.4 – 5.5	186	206	74	35	57	128	237	347	319	156	156	262	296	244	157	166	3,026
5.6 – 8.2	53	60	4	1	2	25	64	176	177	50	70	187	195	113	36	51	1,264
8.3 – 10.9	9	8	0	0	0	0	3	44	24	9	24	38	35	10	4	1	209
≥ 11.0	1	0	0	0	0	0	0	0	0	1	1	6	0	0	0	0	9
All Speeds	403	504	269	235	307	391	572	759	721	397	367	677	692	547	339	362	7,542

Source: Campbell, 2002

Notes: 7,542 hrs on this page, 0 hrs calm winds (less than 0.3 m/s), 0.0 percent of all hrs.

**TABLE 2.3-33**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category E (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: E (Delta-T Range = -0.4 to +1.5 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
≤ 1.5	35	67	69	82	104	88	69	62	68	53	53	39	30	30	23	15	887
1.6 – 3.3	82	184	137	131	147	204	338	383	300	185	153	147	151	112	91	65	2,810
3.4 – 5.5	29	25	17	10	12	57	148	311	305	125	83	107	89	31	45	22	1,416
5.6 – 8.2	4	1	0	0	0	5	14	99	61	26	17	32	7	10	13	0	289
8.3 – 10.9	0	0	0	0	0	0	2	18	6	0	1	1	2	2	0	0	32
≥ 11.0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
All Speeds	153	280	223	223	263	354	571	873	740	389	307	326	279	185	172	102	5,440

Source: Campbell, 2002

Notes: 5,440 hrs on this page, 0 hrs calm winds (less than 0.3 m/s), 0.0 percent of all hrs.

**TABLE 2.3-34**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category F (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: F (Delta-T Range = 1.6 to 4.0 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
≤ 1.5	43	78	46	52	51	50	49	45	59	44	49	45	38	32	14	19	714
1.6 – 3.3	73	114	61	29	16	79	88	88	106	88	73	72	49	71	23	27	1,057
3.4 – 5.5	7	8	16	11	1	3	10	23	20	17	30	5	12	11	6	1	181
5.6 – 8.2	0	0	1	0	0	0	0	0	0	4	13	2	0	1	4	1	26
8.3 – 10.9	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3
≥ 11.0	1	3	0	0	0	0	0	1	0	0	0	0	0	0	0	4	9
All Speeds	124	203	124	92	68	132	147	157	185	153	168	124	99	115	47	52	1,990

Source: Campbell, 2002

Notes: 1,990 hrs on this page, 3 hrs calm winds (less than 0.3 m/s), 0.2 percent of all hrs.

**TABLE 2.3-35**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – Stability Category G (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: G (Delta-T Greater Than 4.0 °C per 100 m)

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
≤ 1.5	52	88	35	35	31	25	21	20	23	28	39	38	46	41	15	14	551
1.6 – 3.3	50	70	13	15	2	14	13	19	13	22	24	14	22	51	7	7	356
3.4 – 5.5	1	1	5	4	0	0	0	0	0	4	3	0	0	5	2	0	25
5.6 – 8.2	0	0	2	4	0	0	0	0	0	4	4	0	0	0	0	1	15
8.3 – 10.9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
≥ 11.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
All Speeds	103	159	55	58	33	39	34	39	36	58	71	52	68	97	24	25	951

Source: Campbell, 2002

Notes: 951 hrs on this page, 2 hrs calm winds (less than 0.3 m/s), 0.2 percent of all hrs.

**TABLE 2.3-36**

Joint Frequency Distribution Of Wind Speed, Wind Direction, and Atmospheric Stability at CPS Facility – All Stability Categories (01/01/2000-08/31/2002)

Wind Level: 10 m (33 ft)

Stability Category: ALL Stabilities Combined

Period of Record: 01/01/2000-08/31/2002

Hours observed at each indicated wind direction and wind speed

Speed (m/s)	Direction															Total	
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW		N
≤ 1.5	155	280	205	237	287	231	215	175	199	189	180	162	155	142	77	74	2,963
1.6 – 3.3	375	717	481	417	460	660	826	874	744	614	436	488	475	500	308	282	8,657
3.4 – 5.5	315	385	166	93	91	261	492	911	872	541	432	558	578	469	291	276	6,731
5.6 – 8.2	90	109	11	11	3	48	130	391	357	173	187	348	355	219	89	96	2,617
8.3 – 10.9	18	14	0	0	0	1	10	85	37	15	49	70	76	29	13	3	420
≥ 11.0	5	6	0	0	0	0	1	2	0	1	5	14	1	0	0	7	42
All Speeds	958	1,511	863	758	841	1,201	1,674	2,438	2,209	1,533	1,289	1,640	1,640	1,359	778	738	21,430

Source: Campbell, 2002

Notes: 21,430 hrs on this page, 9 hrs calm winds (less than 0.3 m/s), 0.03 percent of all hrs.

**TABLE 2.3-37**  
 Summary of Frequency of Occurrence of Stability Class at CPS Facility

A	B	C	D	E	F	G
<b>1972 – 1977 Period of Record <sup>a</sup></b>						
4.34	3.58	5.38	40.10	26.52	10.93	8.88
<b>Summary</b>						
Unstable (A, B, C) 13.30%						
Neutral (D) 40.10%						
Stable (E, F, G) 46.33%						
<b>2000 – 2002 Period of Record <sup>b</sup></b>						
12.30	6.75	6.64	35.19	25.39	9.29	4.44
<b>Summary</b>						
Unstable (A, B, C) 25.69%						
Neutral (D) 35.19%						
Stable (E, F, G) 39.12%						

<sup>a</sup> Source: CPS, 2002

<sup>b</sup> Source: Campbell, 2002

**TABLE 2.3-38**  
Qualitative Assessment of the Magnitude and Extent of Visible Plumes

<b>Review Element</b>	<b>Wet Cooling</b>	<b>Dry Cooling</b>	<b>Wet/Dry Cooling</b>
Visible Plumes	Visible plumes of significant length can be observed during cold, moist conditions. During moderate to high wind conditions, visible plumes can result in a “fumigation” of the area in the immediate vicinity of the cooling towers.	No visible plume	Similar to the wet cooling option; however, the extent of visible plumes will be directly proportional to the ratio of wet/dry cooling.
Ground level fogging and icing	Fogging can occur during cool/cold weather, high humidity, and light or windy conditions. Icing can occur during sub-freezing conditions, or during high winds when drift droplet deposition can accumulate and freeze at ground level or on nearby structures. Most significant impacts will be in the immediate vicinity of cooling towers.	No fogging or icing impacts	Similar to the wet cooling option; however, the extent of fogging and icing impacts will be directly proportional to the ratio of wet/dry cooling.
Solids deposition	Solids deposition results from the entrainment of suspended solids in the circulated cooling water into the cooling tower plume. Extent will depend on the number of cycles of cooling water concentration prior to blowdown. The majority of deposition typically occurs in the immediate vicinity of the tower(s), but can also occur, to a limited extent, farther downwind.	No solids deposition	Similar to the wet cooling option; however, the extent of solids deposition impacts will be directly proportional to the ratio of wet/dry cooling.
Cloud formation, shadowing and precipitation	Cloud formation and precipitation is a very rare occurrence and only occurs for large cooling towers and during very cool/cold temperatures and high humidity conditions.	No cloud formation	Similar to the wet cooling option; however, the extent of cloud formation potential will be directly proportional to the ratio of wet/dry cooling.
Interaction with existing pollution sources	No significant pollution sources are known to exist in the immediate vicinity of the Exelon ESP Site. Very low potential for plume interaction is anticipated.	None	Similar to the wet cooling option; however, the extent of interaction potential will be directly proportional to the ratio of wet/dry cooling.
Humidity Increase	An increase in humidity levels would only be expected in the immediate vicinity of the towers.	No increase in humidity	Limited local increase in humidity downwind.

**TABLE 2.3-39**  
 CPS Site EAB Accident Chi/Q Calculations  
 1-Hour Averaging Period

<b>Downwind Sector</b>	<b>Exclusion Area Boundary (EAB) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	975	0.163E-03	0.291E-04
NNE	975	0.151E-03	0.311E-04
NE	975	0.154E-03	0.289E-04
ENE	975	0.153E-03	0.279E-04
E	975	0.150E-03	0.254E-04
ESE	975	0.143E-03	0.248E-04
SE	975	0.149E-03	0.258E-04
SSE	975	0.164E-03	0.254E-04
S	975	0.156E-03	0.277E-04
SSW	975	0.182E-03	0.274E-04
SW	975	0.190E-03	0.294E-04
WSW	975	0.210E-03	0.349E-04
W	975	0.211E-03	0.376E-04
WNW	975	0.169E-03	0.361E-04
NW	975	0.177E-03	0.377E-04
NNW	975	0.168E-03	0.350E-04
All Direction Case		0.178E-03	0.305E-04

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-40**  
CPS Site LPZ Accident Chi/Q Calculations  
1-Hour Averaging Period

<b>Downwind Sector</b>	<b>Low Population Zone (LPZ) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	4,018	0.342E-04	0.377E-05
NNE	4,018	0.336E-04	0.425E-05
NE	4,018	0.344E-04	0.374E-05
ENE	4,018	0.354E-04	0.363E-05
E	4,018	0.310E-04	0.315E-05
ESE	4,018	0.282E-04	0.303E-05
SE	4,018	0.331E-04	0.313E-05
SSE	4,018	0.372E-04	0.304E-05
S	4,018	0.367E-04	0.353E-05
SSW	4,018	0.427E-04	0.347E-05
SW	4,018	0.449E-04	0.379E-05
WSW	4,018	0.475E-04	0.488E-05
W	4,018	0.476E-04	0.528E-05
WNW	4,018	0.379E-04	0.505E-05
NW	4,018	0.401E-04	0.527E-05
NNW	4,018	0.379E-04	0.473E-05
All Direction Case		0.415E-04	0.426E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-41**  
 CPS Site EAB Accident Chi/Q Calculations  
 2-Hour Averaging Period

<b>Downwind Sector</b>	<b>Exclusion Area Boundary (EAB) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	975	0.124E-03	0.214E-04
NNE	975	0.115E-03	0.226E-04
NE	975	0.113E-03	0.198E-04
ENE	975	0.101E-03	0.197E-04
E	975	0.982E-04	0.181E-04
ESE	975	0.945E-04	0.177E-04
SE	975	0.102E-03	0.173E-04
SSE	975	0.107E-03	0.169E-04
S	975	0.112E-03	0.200E-04
SSW	975	0.120E-03	0.193E-04
SW	975	0.137E-03	0.223E-04
WSW	975	0.141E-03	0.247E-04
W	975	0.141E-03	0.251E-04
WNW	975	0.118E-03	0.247E-04
NW	975	0.137E-03	0.247E-04
NNW	975	0.131E-03	0.241E-04
All Direction Case		0.126E-03	0.231E-04

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-42**  
CPS Site LPZ Accident Chi/Q Calculations  
2-Hour Averaging Period

<b>Downwind Sector</b>	<b>Low Population Zone (LPZ) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	4,018	0.247E-04	0.279E-05
NNE	4,018	0.246E-04	0.299E-05
NE	4,018	0.247E-04	0.261E-05
ENE	4,018	0.230E-04	0.264E-05
E	4,018	0.217E-04	0.236E-05
ESE	4,018	0.194E-04	0.229E-05
SE	4,018	0.217E-04	0.220E-05
SSE	4,018	0.234E-04	0.216E-05
S	4,018	0.237E-04	0.264E-05
SSW	4,018	0.284E-04	0.256E-05
SW	4,018	0.315E-04	0.287E-05
WSW	4,018	0.317E-04	0.346E-05
W	4,018	0.305E-04	0.366E-05
WNW	4,018	0.248E-04	0.356E-05
NW	4,018	0.294E-04	0.357E-05
NNW	4,018	0.266E-04	0.331E-05
All Direction Case		0.272E-04	0.308E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-43**  
 CPS Site EAB Accident Chi/Q Calculations  
 8-Hour Averaging Period

<b>Downwind Sector</b>	<b>Exclusion Area Boundary (EAB) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	975	0.596E-04	0.108E-04
NNE	975	0.605E-04	0.102E-04
NE	975	0.548E-04	0.890E-05
ENE	975	0.489E-04	0.804E-05
E	975	0.464E-04	0.833E-05
ESE	975	0.490E-04	0.887E-05
SE	975	0.450E-04	0.836E-05
SSE	975	0.431E-04	0.734E-05
S	975	0.488E-04	0.890E-05
SSW	975	0.517E-04	0.891E-05
SW	975	0.660E-04	0.104E-04
WSW	975	0.606E-04	0.113E-04
W	975	0.647E-04	0.124E-04
WNW	975	0.529E-04	0.111E-04
NW	975	0.605E-04	0.111E-04
NNW	975	0.621E-04	0.111E-04
All Direction Case		0.600E-04	0.104E-04

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-44**  
CPS Site LPZ Accident Chi/Q Calculations  
*8-Hour Averaging Period*

<b>Downwind Sector</b>	<b>Low Population Zone (LPZ) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	4,018	0.118E-04	0.147E-05
NNE	4,018	0.117E-04	0.139E-05
NE	4,018	0.112E-04	0.121E-05
ENE	4,018	0.964E-05	0.113E-05
E	4,018	0.946E-05	0.115E-05
ESE	4,018	0.100E-04	0.118E-05
SE	4,018	0.931E-05	0.114E-05
SSE	4,018	0.943E-05	0.101E-05
S	4,018	0.921E-05	0.123E-05
SSW	4,018	0.118E-04	0.123E-05
SW	4,018	0.142E-04	0.147E-05
WSW	4,018	0.129E-04	0.162E-05
W	4,018	0.134E-04	0.179E-05
WNW	4,018	0.104E-04	0.162E-05
NW	4,018	0.125E-04	0.160E-05
NNW	4,018	0.124E-04	0.155E-05
All Direction Case		0.125E-04	0.147E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-45**  
 CPS Site EAB Accident Chi/Q Calculations  
 16-Hour Averaging Period

<b>Downwind Sector</b>	<b>Exclusion Area Boundary (EAB) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	975	0.407E-04	0.771E-05
NNE	975	0.403E-04	0.693E-05
NE	975	0.380E-04	0.580E-05
ENE	975	0.320E-04	0.513E-05
E	975	0.312E-04	0.565E-05
ESE	975	0.342E-04	0.602E-05
SE	975	0.307E-04	0.537E-05
SSE	975	0.289E-04	0.469E-05
S	975	0.290E-04	0.584E-05
SSW	975	0.327E-04	0.588E-05
SW	975	0.403E-04	0.719E-05
WSW	975	0.396E-04	0.714E-05
W	975	0.434E-04	0.859E-05
WNW	975	0.332E-04	0.727E-05
NW	975	0.393E-04	0.725E-05
NNW	975	0.406E-04	0.753E-05
All Direction Case		0.403E-04	0.710E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-46**  
CPS Site LPZ Accident Chi/Q Calculations  
16-Hour Averaging Period

<b>Downwind Sector</b>	<b>Low Population Zone (LPZ) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	4,018	0.797E-05	0.111E-05
NNE	4,018	0.770E-05	0.997E-06
NE	4,018	0.758E-05	0.815E-06
ENE	4,018	0.647E-05	0.736E-06
E	4,018	0.661E-05	0.792E-06
ESE	4,018	0.673E-05	0.841E-06
SE	4,018	0.610E-05	0.740E-06
SSE	4,018	0.596E-05	0.633E-06
S	4,018	0.579E-05	0.810E-06
SSW	4,018	0.712E-05	0.860E-06
SW	4,018	0.869E-05	0.107E-05
WSW	4,018	0.824E-05	0.105E-05
W	4,018	0.905E-05	0.131E-05
WNW	4,018	0.669E-05	0.112E-05
NW	4,018	0.775E-05	0.109E-05
NNW	4,018	0.764E-05	0.113E-05
All Direction Case		0.820E-05	0.100E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-47**  
 CPS Site EAB Accident Chi/Q Calculations  
 72-Hour Averaging Period

<b>Downwind Sector</b>	<b>Exclusion Area Boundary (EAB) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	975	0.185E-04	0.399E-05
NNE	975	0.182E-04	0.370E-05
NE	975	0.157E-04	0.307E-05
ENE	975	0.135E-04	0.244E-05
E	975	0.128E-04	0.269E-05
ESE	975	0.144E-04	0.269E-05
SE	975	0.136E-04	0.228E-05
SSE	975	0.123E-04	0.191E-05
S	975	0.130E-04	0.204E-05
SSW	975	0.125E-04	0.228E-05
SW	975	0.174E-04	0.318E-05
WSW	975	0.148E-04	0.303E-05
W	975	0.162E-04	0.350E-05
WNW	975	0.132E-04	0.305E-05
NW	975	0.151E-04	0.312E-05
NNW	975	0.181E-04	0.358E-05
All Direction Case		0.171E-04	0.320E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-48**  
CPS Site LPZ Accident Chi/Q Calculations  
72-Hour Averaging Period

<b>Downwind Sector</b>	<b>Low Population Zone (LPZ) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	4,018	0.343E-05	0.600E-06
NNE	4,018	0.335E-05	0.575E-06
NE	4,018	0.329E-05	0.457E-06
ENE	4,018	0.268E-05	0.392E-06
E	4,018	0.254E-05	0.391E-06
ESE	4,018	0.277E-05	0.390E-06
SE	4,018	0.262E-05	0.327E-06
SSE	4,018	0.239E-05	0.267E-06
S	4,018	0.246E-05	0.317E-06
SSW	4,018	0.258E-05	0.360E-06
SW	4,018	0.348E-05	0.478E-06
WSW	4,018	0.317E-05	0.489E-06
W	4,018	0.354E-05	0.551E-06
WNW	4,018	0.248E-05	0.487E-06
NW	4,018	0.292E-05	0.521E-06
NNW	4,018	0.356E-05	0.541E-06
All Direction Case		0.330E-05	0.490E-06

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-49**  
 CPS Site EAB Accident Chi/Q Calculations  
 624-Hour Averaging Period

<b>Downwind Sector</b>	<b>Exclusion Area Boundary (EAB) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	975	0.984E-05	0.402E-05
NNE	975	0.886E-05	0.401E-05
NE	975	0.750E-05	0.351E-05
ENE	975	0.706E-05	0.229E-05
E	975	0.654E-05	0.287E-05
ESE	975	0.826E-05	0.275E-05
SE	975	0.568E-05	0.215E-05
SSE	975	0.493E-05	0.152E-05
S	975	0.551E-05	0.153E-05
SSW	975	0.488E-05	0.159E-05
SW	975	0.670E-05	0.229E-05
WSW	975	0.643E-05	0.244E-05
W	975	0.711E-05	0.258E-05
WNW	975	0.584E-05	0.235E-05
NW	975	0.746E-05	0.312E-05
NNW	975	0.888E-05	0.322E-05
All Direction Case		0.810E-05	0.296E-05

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-50**  
CPS Site LPZ Accident Chi/Q Calculations  
624-Hour Averaging Period

<b>Downwind Sector</b>	<b>Low Population Zone (LPZ) Distance (m)</b>	<b>5 Percent Chi/Q</b>	<b>50 Percent Chi/Q</b>
N	4,018	0.178E-05	0.661E-06
NNE	4,018	0.155E-05	0.664E-06
NE	4,018	0.149E-05	0.605E-06
ENE	4,018	0.139E-05	0.386E-06
E	4,018	0.122E-05	0.491E-06
ESE	4,018	0.153E-05	0.422E-06
SE	4,018	0.104E-05	0.333E-06
SSE	4,018	0.926E-06	0.231E-06
S	4,018	0.103E-05	0.246E-06
SSW	4,018	0.101E-05	0.270E-06
SW	4,018	0.138E-05	0.382E-06
WSW	4,018	0.120E-05	0.402E-06
W	4,018	0.149E-05	0.435E-06
WNW	4,018	0.114E-05	0.391E-06
NW	4,018	0.145E-05	0.533E-06
NNW	4,018	0.167E-05	0.552E-06
All Direction Case		0.155E-05	0.480E-06

Source: CPS, 2002

Notes: Period of Record: May 1972-April 1977, E=East, N=North, S=South, W=West, Chi/Q=sec/m<sup>3</sup>

**TABLE 2.3-51**  
Summary and Comparison of Short-Term Chi/Q Calculations (5% Probability Level)

Averaging Period	Maximum Sector Values (sec/m <sup>3</sup> )							
	CPS USAR Results (1)	PAVAN Results		PAVAN Results		CPS USAR Results <sup>a</sup>	PAVAN Results	
	EAB 975 m		EAB 1025 m		LPZ 4018 m	LPZ 4018 m	LPZ 4018 m	
	Building Wake	No Building Wake	Building Wake	No Building Wake	Building Wake	Building Wake	No Building Wake	
0 - 2 Hr	1.78E-04	1.98E-04	1.85E-04	1.85E-04	4.15E-05	5.47E-05	5.47E-05	
0 - 8 Hr	6.00E-05	9.78E-05	9.09E-05	9.89E-05	1.25E-05	2.36E-05	2.49E-05	
8 - 24 Hr	4.03E-05	6.87E-05	6.37E-05	7.23E-05	8.20E-06	1.55E-05	1.68E-05	
1 - 4 Days	1.71E-05	3.20E-05	2.95E-05	3.66E-05	3.30E-06	6.24E-06	7.18E-06	
4 - 30 Days	0.81E-05	1.06E-05	0.98E-05	1.38E-05	1.55E-06	1.68E-06	2.11E-06	

<sup>a</sup> CPS, 2002

**TABLE 2.3-52**  
Summary of EGC ESP Facility Chi/Q Calculations at EAB and LPZ Distance (50% Probability Level)

Averaging Period	Exelon ESP Site Chi/Q Values (Maximum Sector, 50% Probability Value, (sec/m <sup>3</sup> ))		Source
	EAB Distance	LPZ Distance	
0 - 2 Hr	3.6E-05	5.10E-06	PAVAN Model
0 - 8 Hr	--	3.40E-06	Interpolation
8 - 24 Hr	--	2.85E-06	Interpolation
1 - 4 Days	--	1.85E-06	Interpolation
4 - 30 Days	--	1.00E-06	Interpolation
Annual Average	--	4.72E-07	PAVAN Model

**TABLE 2.3-53**  
 Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations for Routine Releases  
 EGC ESP Facility

Downwind Sector	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q
N	1,767	8.61E-07	1,025	1.96E-06	4,018	2.54E-07	1,500	1.10E-06	8,000	9.47E-08	1,500.0	1.10E-06
NNE	1,527	1.11E-06	1,025	2.04E-06	4,018	2.65E-07	2,050	7.20E-07	8,000	9.90E-08	4,610.0	2.16E-07
NE	1,400	1.12E-06	1,025	1.81E-06	4,018	2.35E-07	5,530	1.47E-07	8,000	8.88E-08	3,460.0	2.93E-07
ENE	1,297	1.07E-06	1,025	1.55E-06	4,018	2.02E-07	7,740	8.06E-08	8,000	7.71E-08	4,210.0	1.89E-07
E	1,710	6.93E-07	1,025	1.52E-06	4,018	1.97E-07	1,670	7.18E-07	8,000	7.52E-08	1,670.0	7.18E-07
ESE	4,540	1.65E-07	1,025	1.54E-06	4,018	1.97E-07	8,000	7.47E-08	8,000	7.47E-08	5,300.0	1.32E-07
SE	3,184	2.66E-07	1,025	1.49E-06	4,018	1.90E-07	8,000	7.22E-08	7,010	8.64E-08	7,010.0	8.64E-08
SSE	3,084	2.02E-07	1,025	1.08E-06	4,018	1.37E-07	8,000	5.17E-08	8,000	5.17E-08	4,450.0	1.18E-07
S	3,032	1.49E-07	1,025	7.76E-07	4,018	9.79E-08	8,000	3.65E-08	8,000	3.65E-08	4,840.0	7.43E-08
SSW	4,353	1.28E-07	1,025	1.12E-06	4,018	1.44E-07	5,470	9.22E-08	8,000	5.50E-08	8,000.0	5.50E-08
SW	4,891	1.82E-07	1,025	1.85E-06	4,018	2.41E-07	5,870	1.42E-07	8,000	9.36E-08	5,870.0	1.42E-07
WSW	3,784	2.39E-07	1,025	1.69E-06	4,018	2.20E-07	5,530	1.39E-07	8,000	8.44E-08	3,620.0	2.55E-07
W	2,277	3.92E-07	1,025	1.32E-06	4,018	1.72E-07	3,310	2.27E-07	8,000	6.53E-08	3,320.0	2.26E-07
WNW	1,934	5.21E-07	1,025	1.37E-06	4,018	1.77E-07	8,000	6.69E-08	8,000	6.69E-08	2,640.0	3.28E-07
NW	1,356	9.73E-07	1,025	1.50E-06	4,018	1.94E-07	3,850	2.07E-07	8,000	7.30E-08	4,700.0	1.54E-07
NNW	2,023	6.18E-07	1,025	1.73E-06	4,018	2.24E-07	2,050	6.06E-07	8,000	8.42E-08	8,000.0	8.42E-08

**TABLE 2.3-53**  
Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations for Routine Releases  
EGC ESP Facility

Downwind Sector	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
	Distance (m)	Chi/Q	Distance (m)	Chi/Q	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
N	1,500.0	1.10E-06	1,500.0	1.10E-06	2.88E-06	9.89E-07	5.42E-07	3.53E-07	2.53E-07	1.93E-07	1.54E-07	1.28E-07
NNE	2,050.0	7.20E-07	1,590.0	1.05E-06	3.00E-06	1.91E-06	5.65E-07	3.68E-07	2.64E-07	2.02E-07	1.60E-07	1.34E-07
NE	5,530.0	1.47E-07	2,070.0	6.24E-07	2.67E-06	1.69E-06	4.96E-07	3.26E-07	2.35E-07	1.80E-07	1.44E-07	1.20E-07
ENE	7,740.0	8.06E-08	2,860.0	3.29E-07	2.30E-06	1.45E-06	4.21E-07	2.78E-07	2.01E-07	1.55E-07	1.24E-07	1.03E-07
E	1,670.0	7.18E-07	1,670.0	7.18E-07	2.25E-06	1.42E-06	4.12E-07	2.72E-07	1.97E-07	1.51E-07	1.21E-07	1.01E-07
ESE	8,000.0	7.47E-08	5,140.0	1.38E-07	2.27E-06	1.44E-06	4.15E-07	2.73E-07	1.97E-07	1.51E-07	1.21E-07	1.01E-07
SE	7,010.0	8.64E-08	4,440.0	1.64E-07	2.20E-06	1.40E-06	3.97E-07	2.62E-07	1.89E-07	1.45E-07	1.16E-07	9.70E-08
SSE	4,890.0	1.03E-07	2,900.0	2.21E-07	1.59E-06	1.01E-06	2.89E-07	1.90E-07	1.37E-07	1.05E-07	8.37E-08	6.97E-08
S	8,000.0	3.65E-08	4,780.0	7.57E-08	1.14E-06	7.26E-07	2.08E-07	1.36E-07	9.77E-08	7.46E-08	5.94E-08	4.93E-08
SSW	5,470.0	9.22E-08	4,680.0	1.15E-07	1.65E-06	1.05E-06	2.99E-07	1.98E-07	1.43E-07	1.10E-07	8.85E-08	7.38E-08
SW	5,870.0	1.42E-07	1,170.0	1.50E-06	2.74E-06	1.73E-06	4.95E-07	3.29E-07	2.40E-07	1.86E-07	1.50E-07	1.25E-07
WSW	4,600.0	1.81E-07	2,520.0	4.28E-07	2.49E-06	1.58E-06	4.56E-07	3.02E-07	2.19E-07	1.69E-07	1.36E-07	1.13E-07
W	3,310.0	2.27E-07	2,630.0	3.17E-07	1.94E-06	1.23E-06	3.59E-07	2.37E-07	1.71E-07	1.31E-07	1.05E-07	8.77E-08
WNW	8,000.0	6.69E-08	2,630.0	3.30E-07	2.01E-06	1.28E-06	3.74E-07	2.45E-07	1.77E-07	1.35E-07	1.08E-07	9.00E-08
NW	3,850.0	2.07E-07	2,650.0	3.58E-07	2.20E-06	1.40E-06	4.11E-07	2.69E-07	1.94E-07	1.48E-07	1.18E-07	9.83E-08
NNW	2,050.0	6.06E-07	2,780.0	3.86E-07	2.54E-06	1.62E-06	4.76E-07	3.11E-07	2.24E-07	1.71E-07	1.36E-07	1.14E-07
All		4.586E-06		7.848E-06	3.582E-05	2.192E-05	6.612E-06	4.347E-06	3.140E-06	2.407E-06	1.924E-06	1.603E-06

**TABLE 2.3-53**  
Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations for Routine Releases  
*EGC ESP Facility*

Downwind Sector	Downwind Distance (mi)												
	4.5	5.0	6.0	8.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	47.5
N	1.09E-07	9.39E-08	7.31E-08	5.01E-08	3.72E-08	2.12E-08	1.44E-08	1.07E-08	8.39E-09	6.86E-09	5.76E-09	4.94E-09	4.60E-09
NNE	1.14E-07	9.82E-08	7.64E-08	5.24E-08	3.89E-08	2.22E-08	1.50E-08	1.12E-08	8.79E-09	7.19E-09	6.04E-09	5.18E-09	4.82E-09
NE	1.02E-07	8.81E-08	6.87E-08	4.73E-08	3.52E-08	2.02E-08	1.37E-08	1.02E-08	8.04E-09	6.58E-09	5.54E-09	4.76E-09	4.43E-09
ENE	8.82E-08	7.65E-08	5.98E-08	4.13E-08	3.09E-08	1.78E-08	1.21E-08	9.05E-09	7.13E-09	5.85E-09	4.93E-09	4.24E-09	3.96E-09
E	8.60E-08	7.46E-08	5.82E-08	4.02E-08	3.00E-08	1.73E-08	1.18E-08	8.75E-09	6.90E-09	5.65E-09	4.76E-09	4.09E-09	3.82E-09
ESE	8.56E-08	7.41E-08	5.78E-08	3.98E-08	2.96E-08	1.70E-08	1.16E-08	8.58E-09	6.75E-09	5.53E-09	4.65E-09	4.00E-09	3.73E-09
SE	8.27E-08	7.16E-08	5.59E-08	3.86E-08	2.88E-08	1.66E-08	1.13E-08	8.38E-09	6.59E-09	5.40E-09	4.55E-09	3.91E-09	3.65E-09
SSE	5.93E-08	5.13E-08	4.00E-08	2.75E-08	2.05E-08	1.17E-08	7.96E-09	5.91E-09	4.64E-09	3.80E-09	3.20E-09	2.75E-09	2.56E-09
S	4.19E-08	3.62E-08	2.81E-08	1.92E-08	1.43E-08	8.13E-09	5.49E-09	4.07E-09	3.20E-09	2.61E-09	2.19E-09	1.88E-09	1.75E-09
SSW	6.29E-08	5.45E-08	4.26E-08	2.94E-08	2.20E-08	1.27E-08	8.62E-09	6.40E-09	5.04E-09	4.13E-09	3.48E-09	2.99E-09	2.79E-09
SW	1.07E-07	9.29E-08	7.28E-08	5.06E-08	3.80E-08	2.21E-08	1.51E-08	1.12E-08	8.85E-09	7.26E-09	6.13E-09	5.28E-09	4.93E-09
WSW	9.66E-08	8.38E-08	6.55E-08	4.53E-08	3.39E-08	1.96E-08	1.34E-08	9.96E-09	7.85E-09	6.44E-09	5.42E-09	4.67E-09	4.35E-09
W	7.47E-08	6.47E-08	5.05E-08	3.48E-08	2.60E-08	1.50E-08	1.02E-08	7.57E-09	5.96E-09	4.88E-09	4.11E-09	3.53E-09	3.29E-09
WNW	7.67E-08	6.64E-08	5.18E-08	3.56E-08	2.65E-08	1.52E-08	1.03E-08	7.67E-09	6.03E-09	4.93E-09	4.15E-09	3.56E-09	3.32E-09
NW	8.37E-08	7.24E-08	5.64E-08	3.88E-08	2.89E-08	1.65E-08	1.12E-08	8.32E-09	6.54E-09	5.35E-09	4.50E-09	3.86E-09	3.60E-09
NNW	9.65E-08	8.35E-08	6.50E-08	4.46E-08	3.32E-08	1.90E-08	1.29E-08	9.57E-09	7.53E-09	6.16E-09	5.17E-09	4.44E-09	4.13E-09

Source: Campbell, 2002

Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m<sup>2</sup>

**TABLE 2.3-54**  
Long-Term Average D/Q (m<sup>-2</sup>) Calculations for Routine Releases  
*EGC ESP Facility*

Downwind Sector	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q	Distance (m)	D/Q
N	1,767	5.08E-09	1,025	1.28E-08	4,018	1.24E-09	1,500	6.76E-09	8,000	3.69E-10	1,500.0	6.76E-09
NNE	1,527	7.47E-09	1,025	1.46E-08	4,018	1.42E-09	2,050	4.47E-09	8,000	4.21E-10	4,610.0	1.13E-09
NE	1,400	6.87E-09	1,025	1.16E-08	4,018	1.12E-09	5,530	6.53E-10	8,000	3.33E-10	3,460.0	1.45E-09
ENE	1,297	6.01E-09	1,025	8.85E-09	4,018	8.59E-10	7,740	2.71E-10	8,000	2.55E-10	4,210.0	7.94E-10
E	1,710	3.86E-09	1,025	9.20E-09	4,018	8.93E-10	1,670	4.02E-09	8,000	2.65E-10	1,670.0	4.02E-09
ESE	4,540	8.17E-10	1,025	1.04E-08	4,018	1.01E-09	8,000	2.98E-10	8,000	2.98E-10	5,300.0	6.29E-10
SE	3,184	1.35E-09	1,025	9.41E-09	4,018	9.13E-10	8,000	2.71E-10	7,010	3.45E-10	7,010.0	3.45E-10
SSE	3,084	9.82E-10	1,025	6.46E-09	4,018	6.27E-10	8,000	1.86E-10	8,000	1.86E-10	4,450.0	5.28E-10
S	3,032	7.50E-10	1,025	4.80E-09	4,018	4.66E-10	8,000	1.38E-10	8,000	1.38E-10	4,840.0	3.40E-10
SSW	4,353	4.67E-10	1,025	5.51E-09	4,018	5.35E-10	5,470	3.17E-10	8,000	1.59E-10	8,000.0	1.59E-10
SW	4,891	5.44E-10	1,025	7.82E-09	4,018	7.59E-10	5,870	3.97E-10	8,000	2.25E-10	5,870.0	3.97E-10
WSW	3,784	7.56E-10	1,025	7.04E-09	4,018	6.83E-10	5,530	3.98E-10	8,000	2.03E-10	3,620.0	8.15E-10
W	2,277	1.30E-09	1,025	5.09E-09	4,018	4.94E-10	3,310	6.86E-10	8,000	1.47E-10	3,320.0	6.82E-10
WNW	1,934	1.71E-09	1,025	5.06E-09	4,018	4.91E-10	8,000	1.46E-10	8,000	1.46E-10	2,640.0	1.00E-09
NW	1,356	4.02E-09	1,025	6.39E-09	4,018	6.21E-10	3,850	6.67E-10	8,000	1.84E-10	4,700.0	4.76E-10
NNW	2,023	2.82E-09	1,025	9.00E-09	4,018	8.74E-10	2,050	2.75E-09	8,000	2.59E-10	8,000.0	2.59E-10

**TABLE 2.3-54**  
 Long-Term Average D/Q (m<sup>-2</sup>) Calculations for Routine Releases  
 EGC ESP Facility

Downwind Sector	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
	Distance (m)	D/Q	Distance (m)	D/Q	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
N	1,500.0	6.76E-09	1,500.0	6.76E-09	1.88E-08	5.98E-09	2.95E-09	1.81E-09	1.24E-09	9.12E-10	7.02E-10	5.50E-10
NNE	2,050.0	4.47E-09	1,590.0	6.96E-09	2.15E-08	1.37E-08	3.36E-09	2.07E-09	1.42E-09	1.04E-09	8.01E-10	6.27E-10
NE	5,530.0	6.53E-10	2,070.0	3.47E-09	1.70E-08	1.08E-08	2.66E-09	1.63E-09	1.12E-09	8.22E-10	6.33E-10	4.96E-10
ENE	7,740.0	2.71E-10	2,860.0	1.53E-09	1.30E-08	8.27E-09	2.04E-09	1.25E-09	8.57E-10	6.30E-10	4.85E-10	3.80E-10
E	1,670.0	4.02E-09	1,670.0	4.02E-09	1.35E-08	8.60E-09	2.11E-09	1.30E-09	8.91E-10	6.54E-10	5.04E-10	3.94E-10
ESE	8,000.0	2.98E-10	5,140.0	6.62E-10	1.52E-08	9.67E-09	2.38E-09	1.46E-09	1.00E-09	7.36E-10	5.67E-10	4.44E-10
SE	7,010.0	3.45E-10	4,440.0	7.71E-10	1.38E-08	8.79E-09	2.16E-09	1.33E-09	9.11E-10	6.69E-10	5.15E-10	4.04E-10
SSE	4,890.0	4.50E-10	2,900.0	1.09E-09	9.50E-09	6.04E-09	1.49E-09	9.13E-10	6.26E-10	4.60E-10	3.54E-10	2.77E-10
S	8,000.0	1.38E-10	4,780.0	3.47E-10	7.05E-09	4.48E-09	1.10E-09	6.78E-10	4.65E-10	3.41E-10	2.63E-10	2.06E-10
SSW	5,470.0	3.17E-10	4,680.0	4.13E-10	8.09E-09	5.15E-09	1.27E-09	7.78E-10	5.33E-10	3.92E-10	3.02E-10	2.36E-10
SW	5,870.0	3.97E-10	1,170.0	6.33E-09	1.15E-08	7.31E-09	1.80E-09	1.10E-09	7.57E-10	5.56E-10	4.28E-10	3.35E-10
WSW	4,600.0	5.43E-10	2,520.0	1.50E-09	1.03E-08	6.58E-09	1.62E-09	9.94E-10	6.82E-10	5.01E-10	3.85E-10	3.02E-10
W	3,310.0	6.86E-10	2,630.0	1.01E-09	7.48E-09	4.76E-09	1.17E-09	7.19E-10	4.93E-10	3.62E-10	2.79E-10	2.18E-10
WNW	8,000.0	1.46E-10	2,630.0	1.01E-09	7.44E-09	4.73E-09	1.16E-09	7.15E-10	4.90E-10	3.60E-10	2.77E-10	2.17E-10
NW	3,850.0	6.67E-10	2,650.0	1.26E-09	9.40E-09	5.98E-09	1.47E-09	9.03E-10	6.19E-10	4.55E-10	3.50E-10	2.74E-10
NNW	2,050.0	2.75E-09	2,780.0	1.63E-09	1.32E-08	8.41E-09	2.07E-09	1.27E-09	8.72E-10	6.40E-10	4.93E-10	3.86E-10

**TABLE 2.3-54**  
Long-Term Average D/Q (m<sup>-2</sup>) Calculations for Routine Releases  
EGC ESP Facility

Downwind Sector	Downward Distance (mi)												
	4.5	5.0	6.0	8.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	47.5
N	4.43E-10	3.65E-10	2.62E-10	1.70E-10	1.19E-10	5.67E-11	3.35E-11	2.23E-11	1.60E-11	1.20E-11	9.36E-12	7.43E-12	6.68E-12
NNE	5.05E-10	4.17E-10	2.98E-10	1.94E-10	1.36E-10	6.47E-11	3.82E-11	2.54E-11	1.82E-11	1.37E-11	1.07E-11	8.48E-12	7.62E-12
NE	3.99E-10	3.29E-10	2.36E-10	1.53E-10	1.08E-10	5.12E-11	3.02E-11	2.01E-11	1.44E-11	1.09E-11	8.44E-12	6.70E-12	6.02E-12
ENE	3.06E-10	2.52E-10	1.81E-10	1.17E-10	8.24E-11	3.92E-11	2.31E-11	1.54E-11	1.10E-11	8.31E-12	6.46E-12	5.13E-12	4.61E-12
E	3.18E-10	2.62E-10	1.88E-10	1.22E-10	8.56E-11	4.07E-11	2.40E-11	1.60E-11	1.14E-11	8.64E-12	6.71E-12	5.33E-12	4.79E-12
ESE	3.58E-10	2.95E-10	2.11E-10	1.37E-10	9.64E-11	4.58E-11	2.70E-11	1.80E-11	1.29E-11	9.72E-12	7.56E-12	6.00E-12	5.39E-12
SE	3.25E-10	2.68E-10	1.92E-10	1.25E-10	8.76E-11	4.16E-11	2.46E-11	1.63E-11	1.17E-11	8.84E-12	6.87E-12	5.46E-12	4.90E-12
SSE	2.23E-10	1.84E-10	1.32E-10	8.57E-11	6.02E-11	2.86E-11	1.69E-11	1.12E-11	8.04E-12	6.07E-12	4.72E-12	3.75E-12	3.37E-12
S	1.66E-10	1.37E-10	9.79E-11	6.36E-11	4.47E-11	2.12E-11	1.25E-11	8.33E-12	5.97E-12	4.51E-12	3.50E-12	2.78E-12	2.50E-12
SSW	1.90E-10	1.57E-10	1.12E-10	7.30E-11	5.13E-11	2.44E-11	1.44E-11	9.56E-12	6.85E-12	5.17E-12	4.02E-12	3.19E-12	2.87E-12
SW	2.70E-10	2.23E-10	1.60E-10	1.04E-10	7.28E-11	3.46E-11	2.04E-11	1.36E-11	9.73E-12	7.34E-12	5.71E-12	4.53E-12	4.07E-12
WSW	2.43E-10	2.01E-10	1.44E-10	9.33E-11	6.55E-11	3.12E-11	1.84E-11	1.22E-11	8.76E-12	6.61E-12	5.14E-12	4.08E-12	3.67E-12
W	1.76E-10	1.45E-10	1.04E-10	6.75E-11	4.74E-11	2.25E-11	1.33E-11	8.84E-12	6.33E-12	4.78E-12	3.72E-12	2.95E-12	2.65E-12
WNW	1.75E-10	1.44E-10	1.03E-10	6.71E-11	4.71E-11	2.24E-11	1.32E-11	8.79E-12	6.30E-12	4.75E-12	3.69E-12	2.93E-12	2.64E-12
NW	2.21E-10	1.82E-10	1.31E-10	8.48E-11	5.95E-11	2.83E-11	1.67E-11	1.11E-11	7.96E-12	6.01E-12	4.67E-12	3.71E-12	3.33E-12
NNW	3.11E-10	2.57E-10	1.84E-10	1.19E-10	8.38E-11	3.98E-11	2.35E-11	1.56E-11	1.12E-11	8.46E-12	6.57E-12	5.22E-12	4.69E-12

Source: Campbell, 2002

Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m<sup>2</sup>

**TABLE 2.3-55**  
 Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations (2.26 Day Decay) for Routine Releases  
 EGC ESP Facility

Downwind Sector	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q
N	1,767	8.58E-07	1,025	1.96E-06	4,018	2.51E-07	1,500	1.10E-06	8,000	9.29E-08	1,500.0	1.10E-06
NNE	1,527	1.11E-06	1,025	2.04E-06	4,018	2.62E-07	2,050	7.16E-07	8,000	9.72E-08	4,610.0	2.14E-07
NE	1,400	1.12E-06	1,025	1.81E-06	4,018	2.33E-07	5,530	1.45E-07	8,000	8.69E-08	3,460.0	2.90E-07
ENE	1,297	1.07E-06	1,025	1.55E-06	4,018	1.99E-07	7,740	7.88E-08	8,000	7.53E-08	4,210.0	1.86E-07
E	1,710	6.90E-07	1,025	1.52E-06	4,018	1.95E-07	1,670	7.15E-07	8,000	7.35E-08	1,670.0	7.15E-07
ESE	4,540	1.63E-07	1,025	1.54E-06	4,018	1.95E-07	8,000	7.31E-08	8,000	7.31E-08	5,300.0	1.30E-07
SE	3,184	2.64E-07	1,025	1.49E-06	4,018	1.88E-07	8,000	7.06E-08	7,010	8.48E-08	7,010.0	8.48E-08
SSE	3,084	2.00E-07	1,025	1.08E-06	4,018	1.36E-07	8,000	5.06E-08	8,000	5.06E-08	4,450.0	1.17E-07
S	3,032	1.47E-07	1,025	7.74E-07	4,018	9.67E-08	8,000	3.56E-08	8,000	3.56E-08	4,840.0	7.33E-08
SSW	4,353	1.26E-07	1,025	1.12E-06	4,018	1.42E-07	5,470	9.08E-08	8,000	5.37E-08	8,000.0	5.37E-08
SW	4,891	1.80E-07	1,025	1.85E-06	4,018	2.38E-07	5,870	1.39E-07	8,000	9.14E-08	5,870.0	1.39E-07
WSW	3,784	2.37E-07	1,025	1.68E-06	4,018	2.17E-07	5,530	1.37E-07	8,000	8.25E-08	3,620.0	2.52E-07
W	2,277	3.89E-07	1,025	1.31E-06	4,018	1.69E-07	3,310	2.25E-07	8,000	6.37E-08	3,320.0	2.24E-07
WNW	1,934	5.18E-07	1,025	1.36E-06	4,018	1.75E-07	8,000	6.52E-08	8,000	6.52E-08	2,640.0	3.25E-07
NW	1,356	9.69E-07	1,025	1.49E-06	4,018	1.92E-07	3,850	2.04E-07	8,000	7.12E-08	4,700.0	1.52E-07
NNW	2,023	6.15E-07	1,025	1.72E-06	4,018	2.22E-07	2,050	6.03E-07	8,000	8.23E-08	8,000.0	8.23E-08

**TABLE 2.3-55**  
Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations (2.26 Day Decay) for Routine Releases  
EGC ESP Facility

Downwind Sector	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
	Distance (m)	Chi/Q	Distance (m)	Chi/Q	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
N	1,500.0	1.10E-06	1,500.0	1.10E-06	2.87E-06	9.86E-07	5.39E-07	3.50E-07	2.51E-07	1.91E-07	1.52E-07	1.26E-07
NNE	2,050.0	7.16E-07	1,590.0	1.05E-06	2.99E-06	1.91E-06	5.62E-07	3.66E-07	2.62E-07	1.99E-07	1.59E-07	1.32E-07
NE	5,530.0	1.45E-07	2,070.0	6.21E-07	2.66E-06	1.69E-06	4.93E-07	3.23E-07	2.32E-07	1.78E-07	1.42E-07	1.18E-07
ENE	7,740.0	7.88E-08	2,860.0	3.27E-07	2.29E-06	1.45E-06	4.18E-07	2.75E-07	1.99E-07	1.53E-07	1.22E-07	1.02E-07
E	1,670.0	7.15E-07	1,670.0	7.15E-07	2.24E-06	1.42E-06	4.09E-07	2.69E-07	1.95E-07	1.49E-07	1.19E-07	9.92E-08
ESE	8,000.0	7.31E-08	5,140.0	1.36E-07	2.27E-06	1.44E-06	4.12E-07	2.70E-07	1.95E-07	1.49E-07	1.19E-07	9.88E-08
SE	7,010.0	8.48E-08	4,440.0	1.62E-07	2.19E-06	1.39E-06	3.95E-07	2.59E-07	1.87E-07	1.44E-07	1.15E-07	9.53E-08
SSE	4,890.0	1.01E-07	2,900.0	2.19E-07	1.58E-06	1.01E-06	2.87E-07	1.88E-07	1.35E-07	1.03E-07	8.24E-08	6.84E-08
S	8,000.0	3.56E-08	4,780.0	7.47E-08	1.13E-06	7.24E-07	2.07E-07	1.35E-07	9.65E-08	7.35E-08	5.85E-08	4.84E-08
SSW	5,470.0	9.08E-08	4,680.0	1.14E-07	1.64E-06	1.04E-06	2.97E-07	1.96E-07	1.42E-07	1.09E-07	8.71E-08	7.24E-08
SW	5,870.0	1.39E-07	1,170.0	1.49E-06	2.73E-06	1.73E-06	4.91E-07	3.26E-07	2.38E-07	1.83E-07	1.47E-07	1.23E-07
WSW	4,600.0	1.79E-07	2,520.0	4.25E-07	2.48E-06	1.57E-06	4.53E-07	2.99E-07	2.17E-07	1.67E-07	1.33E-07	1.11E-07
W	3,310.0	2.25E-07	2,630.0	3.15E-07	1.93E-06	1.23E-06	3.57E-07	2.34E-07	1.69E-07	1.30E-07	1.03E-07	8.60E-08
WNW	8,000.0	6.52E-08	2,630.0	3.27E-07	2.00E-06	1.27E-06	3.71E-07	2.42E-07	1.74E-07	1.33E-07	1.06E-07	8.81E-08
NW	3,850.0	2.04E-07	2,650.0	3.55E-07	2.19E-06	1.40E-06	4.08E-07	2.66E-07	1.91E-07	1.46E-07	1.16E-07	9.64E-08
NNW	2,050.0	6.03E-07	2,780.0	3.83E-07	2.53E-06	1.61E-06	4.73E-07	3.08E-07	2.21E-07	1.69E-07	1.34E-07	1.12E-07

**TABLE 2.3-55**  
Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations (2.26 Day Decay) for Routine Releases  
*EGC ESP Facility*

Downwind Sector	Downwind Distance (mi)												
	4.5	5.0	6.0	8.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	47.5
N	1.07E-07	9.21E-08	7.14E-08	4.86E-08	3.58E-08	2.00E-08	1.33E-08	9.71E-09	7.50E-09	6.02E-09	4.96E-09	4.18E-09	3.86E-09
NNE	1.12E-07	9.64E-08	7.48E-08	5.09E-08	3.75E-08	2.10E-08	1.40E-08	1.02E-08	7.89E-09	6.34E-09	5.23E-09	4.41E-09	4.07E-09
NE	9.98E-08	8.62E-08	6.69E-08	4.57E-08	3.37E-08	1.89E-08	1.26E-08	9.17E-09	7.08E-09	5.68E-09	4.68E-09	3.94E-09	3.64E-09
ENE	8.64E-08	7.47E-08	5.81E-08	3.98E-08	2.95E-08	1.66E-08	1.11E-08	8.07E-09	6.23E-09	5.00E-09	4.12E-09	3.47E-09	3.20E-09
E	8.43E-08	7.29E-08	5.67E-08	3.88E-08	2.87E-08	1.61E-08	1.07E-08	7.82E-09	6.03E-09	4.83E-09	3.98E-09	3.35E-09	3.09E-09
ESE	8.39E-08	7.25E-08	5.63E-08	3.84E-08	2.83E-08	1.59E-08	1.06E-08	7.67E-09	5.91E-09	4.73E-09	3.89E-09	3.27E-09	3.02E-09
SE	8.10E-08	7.01E-08	5.45E-08	3.72E-08	2.75E-08	1.55E-08	1.03E-08	7.50E-09	5.78E-09	4.63E-09	3.82E-09	3.22E-09	2.97E-09
SSE	5.81E-08	5.02E-08	3.89E-08	2.65E-08	1.95E-08	1.09E-08	7.25E-09	5.26E-09	4.05E-09	3.24E-09	2.67E-09	2.24E-09	2.07E-09
S	4.10E-08	3.54E-08	2.73E-08	1.85E-08	1.36E-08	7.56E-09	4.99E-09	3.62E-09	2.77E-09	2.21E-09	1.82E-09	1.52E-09	1.40E-09
SSW	6.16E-08	5.32E-08	4.14E-08	2.83E-08	2.09E-08	1.18E-08	7.83E-09	5.69E-09	4.37E-09	3.50E-09	2.88E-09	2.42E-09	2.24E-09
SW	1.05E-07	9.07E-08	7.08E-08	4.87E-08	3.62E-08	2.06E-08	1.37E-08	9.98E-09	7.70E-09	6.18E-09	5.10E-09	4.29E-09	3.97E-09
WSW	9.46E-08	8.18E-08	6.37E-08	4.37E-08	3.24E-08	1.83E-08	1.22E-08	8.88E-09	6.85E-09	5.50E-09	4.53E-09	3.82E-09	3.52E-09
W	7.31E-08	6.32E-08	4.91E-08	3.35E-08	2.48E-08	1.39E-08	9.23E-09	6.71E-09	5.16E-09	4.13E-09	3.40E-09	2.86E-09	2.63E-09
WNW	7.48E-08	6.46E-08	5.02E-08	3.42E-08	2.52E-08	1.41E-08	9.29E-09	6.73E-09	5.16E-09	4.12E-09	3.38E-09	2.83E-09	2.60E-09
NW	8.18E-08	7.06E-08	5.48E-08	3.73E-08	2.74E-08	1.53E-08	1.01E-08	7.34E-09	5.64E-09	4.50E-09	3.69E-09	3.09E-09	2.85E-09
NNW	9.46E-08	8.17E-08	6.33E-08	4.31E-08	3.18E-08	1.78E-08	1.18E-08	8.56E-09	6.60E-09	5.28E-09	4.35E-09	3.65E-09	3.37E-09

Source: Campbell, 2002

Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m<sup>2</sup>

**TABLE 2.3-56**  
Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations (Depleted and 8-Day Decayed) for Routine Releases  
*EGC ESP Facility*

Downwind Sector	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Milk Cow		Nearest Goat Milk		Nearest Garden	
	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q	Distance (m)	Chi/Q
N	1,767	7.46E-07	1,025	1.77E-06	4,018	2.04E-07	1,500	9.63E-07	8,000	6.96E-08	1,500.0	9.63E-07
NNE	1,527	9.76E-07	1,025	1.84E-06	4,018	2.13E-07	2,050	6.17E-07	8,000	7.28E-08	4,610.0	1.71E-07
NE	1,400	9.86E-07	1,025	1.63E-06	4,018	1.89E-07	5,530	1.14E-07	8,000	6.53E-08	3,460.0	2.39E-07
ENE	1,297	9.50E-07	1,025	1.40E-06	4,018	1.62E-07	7,740	5.95E-08	8,000	5.66E-08	4,210.0	1.51E-07
E	1,710	6.02E-07	1,025	1.37E-06	4,018	1.58E-07	1,670	6.25E-07	8,000	5.52E-08	1,670.0	6.25E-07
ESE	4,540	1.31E-07	1,025	1.39E-06	4,018	1.58E-07	8,000	5.49E-08	8,000	5.49E-08	5,300.0	1.03E-07
SE	3,184	2.19E-07	1,025	1.34E-06	4,018	1.52E-07	8,000	5.30E-08	7,010	6.48E-08	7,010.0	6.48E-08
SSE	3,084	1.67E-07	1,025	9.72E-07	4,018	1.10E-07	8,000	3.80E-08	8,000	3.80E-08	4,450.0	9.37E-08
S	3,032	1.23E-07	1,025	6.98E-07	4,018	7.86E-08	8,000	2.68E-08	8,000	2.68E-08	4,840.0	5.85E-08
SSW	4,353	1.02E-07	1,025	1.01E-06	4,018	1.15E-07	5,470	7.17E-08	8,000	4.04E-08	8,000.0	4.04E-08
SW	4,891	1.43E-07	1,025	1.67E-06	4,018	1.93E-07	5,870	1.09E-07	8,000	6.88E-08	5,870.0	1.09E-07
WSW	3,784	1.93E-07	1,025	1.52E-06	4,018	1.76E-07	5,530	1.08E-07	8,000	6.20E-08	3,620.0	2.07E-07
W	2,277	3.33E-07	1,025	1.18E-06	4,018	1.38E-07	3,310	1.86E-07	8,000	4.79E-08	3,320.0	1.85E-07
WNW	1,934	4.48E-07	1,025	1.23E-06	4,018	1.42E-07	8,000	4.91E-08	8,000	4.91E-08	2,640.0	2.75E-07
NW	1,356	8.59E-07	1,025	1.35E-06	4,018	1.56E-07	3,850	1.67E-07	8,000	5.36E-08	4,700.0	1.22E-07
NNW	2,023	5.31E-07	1,025	1.55E-06	4,018	1.80E-07	2,050	5.20E-07	8,000	6.19E-08	8,000.0	6.19E-08

**TABLE 2.3-56**  
 Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations (Depleted and 8-Day Decayed) for Routine Releases  
 EGR ESP Facility

Downwind Sector	Nearest Meat Animal		Nearest Residence		Downwind Distance (mi)							
	Distance (m)	Chi/Q	Distance (m)	Chi/Q	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
N	1,500.0	9.63E-07	1,500.0	9.63E-07	2.62E-06	8.63E-07	4.59E-07	2.90E-07	2.03E-07	1.52E-07	1.19E-07	9.70E-08
NNE	2,050.0	6.17E-07	1,590.0	9.16E-07	2.73E-06	1.72E-06	4.78E-07	3.03E-07	2.12E-07	1.59E-07	1.24E-07	1.01E-07
NE	5,530.0	1.14E-07	2,070.0	5.35E-07	2.43E-06	1.52E-06	4.20E-07	2.68E-07	1.89E-07	1.42E-07	1.11E-07	9.08E-08
ENE	7,740.0	5.95E-08	2,860.0	2.74E-07	2.09E-06	1.30E-06	3.56E-07	2.28E-07	1.62E-07	1.22E-07	9.60E-08	7.85E-08
E	1,670.0	6.25E-07	1,670.0	6.25E-07	2.05E-06	1.28E-06	3.49E-07	2.23E-07	1.58E-07	1.19E-07	9.37E-08	7.66E-08
ESE	8,000.0	5.49E-08	5,140.0	1.08E-07	2.07E-06	1.30E-06	3.51E-07	2.24E-07	1.58E-07	1.19E-07	9.35E-08	7.63E-08
SE	7,010.0	6.48E-08	4,440.0	1.30E-07	2.00E-06	1.25E-06	3.36E-07	2.15E-07	1.52E-07	1.14E-07	9.01E-08	7.36E-08
SSE	4,890.0	8.09E-08	2,900.0	1.84E-07	1.45E-06	9.07E-07	2.45E-07	1.56E-07	1.10E-07	8.25E-08	6.48E-08	5.29E-08
S	8,000.0	2.68E-08	4,780.0	5.96E-08	1.04E-06	6.51E-07	1.76E-07	1.12E-07	7.84E-08	5.87E-08	4.60E-08	3.74E-08
SSW	5,470.0	7.17E-08	4,680.0	9.11E-08	1.50E-06	9.38E-07	2.53E-07	1.62E-07	1.15E-07	8.69E-08	6.85E-08	5.60E-08
SW	5,870.0	1.09E-07	1,170.0	1.34E-06	2.49E-06	1.55E-06	4.19E-07	2.71E-07	1.93E-07	1.46E-07	1.16E-07	9.49E-08
WSW	4,600.0	1.43E-07	2,520.0	3.61E-07	2.27E-06	1.41E-06	3.86E-07	2.48E-07	1.76E-07	1.33E-07	1.05E-07	8.59E-08
W	3,310.0	1.86E-07	2,630.0	2.66E-07	1.76E-06	1.10E-06	3.04E-07	1.94E-07	1.37E-07	1.03E-07	8.14E-08	6.65E-08
WNW	8,000.0	4.91E-08	2,630.0	2.76E-07	1.83E-06	1.15E-06	3.16E-07	2.01E-07	1.42E-07	1.06E-07	8.36E-08	6.83E-08
NW	3,850.0	1.67E-07	2,650.0	3.00E-07	2.00E-06	1.26E-06	3.48E-07	2.21E-07	1.55E-07	1.17E-07	9.14E-08	7.46E-08
NNW	2,050.0	5.20E-07	2,780.0	3.22E-07	2.31E-06	1.45E-06	4.03E-07	2.56E-07	1.80E-07	1.35E-07	1.06E-07	8.62E-08

**TABLE 2.3-56**  
Long-Term Average Chi/Q (sec/m<sup>3</sup>) Calculations (Depleted and 8-Day Decayed) for Routine Releases  
EGR ESP Facility

Downwind Sector	Downwind Distance (mi)												
	4.5	5.0	6.0	8.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0	47.5
N	8.11E-08	6.90E-08	5.22E-08	3.45E-08	2.47E-08	1.29E-08	8.17E-09	5.72E-09	4.26E-09	3.31E-09	2.64E-09	2.16E-09	1.96E-09
NNE	8.47E-08	7.21E-08	5.46E-08	3.61E-08	2.59E-08	1.36E-08	8.57E-09	6.00E-09	4.47E-09	3.47E-09	2.78E-09	2.27E-09	2.06E-09
NE	7.59E-08	6.47E-08	4.91E-08	3.25E-08	2.34E-08	1.23E-08	7.78E-09	5.45E-09	4.06E-09	3.16E-09	2.53E-09	2.06E-09	1.88E-09
ENE	6.58E-08	5.61E-08	4.27E-08	2.84E-08	2.05E-08	1.08E-08	6.88E-09	4.82E-09	3.60E-09	2.80E-09	2.24E-09	1.83E-09	1.67E-09
E	6.42E-08	5.47E-08	4.16E-08	2.76E-08	1.99E-08	1.05E-08	6.67E-09	4.67E-09	3.48E-09	2.70E-09	2.16E-09	1.77E-09	1.61E-09
ESE	6.38E-08	5.44E-08	4.13E-08	2.74E-08	1.97E-08	1.04E-08	6.55E-09	4.58E-09	3.41E-09	2.65E-09	2.12E-09	1.73E-09	1.57E-09
SE	6.16E-08	5.26E-08	3.99E-08	2.65E-08	1.91E-08	1.01E-08	6.39E-09	4.47E-09	3.33E-09	2.59E-09	2.07E-09	1.69E-09	1.54E-09
SSE	4.42E-08	3.77E-08	2.86E-08	1.89E-08	1.36E-08	7.14E-09	4.51E-09	3.15E-09	2.34E-09	1.82E-09	1.45E-09	1.19E-09	1.08E-09
S	3.12E-08	2.66E-08	2.01E-08	1.32E-08	9.46E-09	4.94E-09	3.11E-09	2.17E-09	1.61E-09	1.25E-09	9.94E-10	8.10E-10	7.36E-10
SSW	4.69E-08	4.00E-08	3.04E-08	2.02E-08	1.46E-08	7.70E-09	4.88E-09	3.41E-09	2.54E-09	1.97E-09	1.58E-09	1.29E-09	1.17E-09
SW	7.97E-08	6.82E-08	5.20E-08	3.48E-08	2.52E-08	1.34E-08	8.54E-09	5.98E-09	4.46E-09	3.47E-09	2.78E-09	2.28E-09	2.08E-09
WSW	7.20E-08	6.15E-08	4.68E-08	3.12E-08	2.25E-08	1.19E-08	7.58E-09	5.31E-09	3.96E-09	3.08E-09	2.47E-09	2.02E-09	1.84E-09
W	5.57E-08	4.75E-08	3.61E-08	2.40E-08	1.72E-08	9.09E-09	5.76E-09	4.03E-09	3.00E-09	2.33E-09	1.86E-09	1.52E-09	1.39E-09
WNW	5.71E-08	4.87E-08	3.69E-08	2.45E-08	1.76E-08	9.23E-09	5.83E-09	4.07E-09	3.02E-09	2.34E-09	1.87E-09	1.53E-09	1.39E-09
NW	6.24E-08	5.31E-08	4.03E-08	2.67E-08	1.91E-08	1.00E-08	6.33E-09	4.42E-09	3.29E-09	2.55E-09	2.04E-09	1.66E-09	1.51E-09
NNW	7.20E-08	6.13E-08	4.64E-08	3.07E-08	2.20E-08	1.16E-08	7.30E-09	5.10E-09	3.80E-09	2.95E-09	2.36E-09	1.92E-09	1.75E-09

Source: Campbell, 2002

Notes: Wind Reference Level: 10 m; Stability Type: ΔT (60 – 10 m); Release Type: Ground Level – 10 m; Building Height/Cross Section: 57.2 m/2,090 m<sup>2</sup>

**TABLE 2.4-1**  
 Drainage Characteristics of Salt Creek and its Tributaries

<b>Creek</b>	<b>Length (mi)</b>	<b>Drainage Area (mi<sup>2</sup>)</b>	<b>Maximum Relief (ft)</b>	<b>Average Annual Runoff (in)</b>
North Fork	26	128	270	9.73
Lake Fork	40	280	210	8.88
Deer Creek	25	81	240	10.30
Kickapoo Creek	55	330	380	8.91
Sugar Creek	55	480	380	8.63
Tenmile Creek	19	41	250	10.10
Salt Creek	92	1860	440	9.17

Source: CPS, 1982 and Knapp, 1999

**TABLE 2.4-2**  
 Mean Monthly Runoff, Rainfall, and Natural Lake Evaporation Data for Salt Creek Basin (Post-dam)

<b>Month</b>	<b>Mean Runoff (in)</b>	<b>Mean Rainfall (in)</b>	<b>Percent of Rainfall as Runoff</b>	<b>Mean Lake Evaporation (in)</b>
January	0.80	1.91	41.7%	-- <sup>a</sup>
February	1.01	1.99	50.4%	-- <sup>a</sup>
March	1.99	3.13	63.6%	1.17
April	1.76	4.31	40.8%	3.34
May	1.86	4.50	41.3%	5.19
June	1.21	3.82	31.6%	6.41
July	0.84	4.43	18.9%	6.24
August	0.50	3.78	13.2%	5.26
September	0.21	2.51	8.4%	4.14
October	0.35	3.36	10.5%	2.47
November	0.57	3.63	15.8%	0.52
December	0.87	2.80	31.2%	-- <sup>a</sup>
<b>Total</b>	<b>11.97</b>	<b>40.17</b>		<b>34.74</b>
<b>Average</b>			<b>29.8%</b>	

Source: USGS, 2002; MRCC, 2002a and 2002b;

--<sup>a</sup> Data not available

**TABLE 2.4-3**  
Discharge Data for Salt Creek at Rowell

<b>Discharge</b>	<b>Pre-dam Magnitude (cfs)</b>	<b>Post-dam Magnitude (1978-1999) <sup>a</sup> (cfs)</b>
Mean Annual	241 <sup>b</sup>	295
Highest Mean Monthly	521 <sup>b</sup> (April)	578 (March)
Lowest Mean Monthly (September)	36 <sup>b</sup>	63
Maximum Mean Daily Peak	18,200	6960
Minimum Mean Daily Low	0.9	3.7

<sup>a</sup> USGS, 2002<sup>b</sup> CPS, 1982**TABLE 2.4-4**  
Calculated Peak Flood Magnitudes and Frequencies at Rowell Gauging Station and at Dam Site

<b>Recurrence Interval (year)</b>	<b>Pre-dam Magnitude of Flood <sup>a</sup> (cfs)</b>		<b>Post-dam Flood Magnitude <sup>b</sup> (cfs)</b>	
	<b>Rowell Gage</b>	<b>Clinton Lake Dam</b>	<b>Rowell Gage</b>	<b>Clinton Lake Dam</b>
2.33	4,300	3,800	3,600	3,200
10	11,400	10,100	6,200	5,500
25	17,500	15,500	7,900	7,000
50	23,200	20,500	9,100	8,000
100	29,900	26,400	10,400	9,200

<sup>a</sup> CPS, 1982<sup>b</sup> USGS, 2002

**TABLE 2.4-5**  
 Monthly Probable Maximum Precipitation for 24-Hour Duration for Zone 7

Month	24-Hour PMP For 200 mi <sup>2</sup>	Conversion Factor For Areas <10 mi <sup>2</sup>	24-Hour PMP For Areas <10 mi <sup>2</sup>
All-Season	24	1.3	31.2
January	10.5	1.11	11.66
February	10.8	1.14	12.31
March	11.7	1.18	13.81
April	14.6	1.19	17.37
May	18	1.26	22.68
June	22	1.3	28.6
July	24	1.3	31.2
August	24	1.3	31.2
September	22.8	1.26	28.73
October	20	1.22	24.4
November	14.9	1.14	16.99
December	11.6	1.11	12.88

Source: CPS, 2002

**TABLE 2.4-6**  
 48-Hour Local Probable Maximum Precipitation 6-Hour Increments

6-Hour Time Period	Cumulative Time		Incremental Rainfall Inches	Cumulative Rainfall Inches
	Hour			
1	6		0.09	0.09
2	12		0.33	0.42
3	18		1.88	2.3
4	24		0.1	2.4
5	30		1.2	3.6
6	36		4.32	7.92
7	42		24.48	32.4
8	48		1.2	33.6

Source: CPS, 2002

**TABLE 2.4-7**  
Time Distribution of Maximum 6-Hour Rainfall

Rainfall periods of 30- minutes for 6-hour period	Percent of total 6-hour rainfall
1	3
2	3
3	4
4	5
5	6
6	12
7	43
8	8
9	6
10	4
11	3
12	3

Note: This is for 6-hour interval only with the maximum rainfall of 43% for the seventh 1/2-hour interval of 24.48 inches in 6 hours.

Source: CPS, 2002

**TABLE 2.4-8**  
 Probable Maximum Precipitation Depth - Duration

<b>Duration (hours)</b>	<b>6</b>	<b>12</b>	<b>24</b>	<b>48</b>
<u>Month</u>	<u>Depth of rainfall (inches)</u>			
January	4.3	7.3	10.1	13
February	4.6	7.9	10.7	13.8
March	5.7	9.4	11.4	14.4
April	8.7	11.7	14.2	17.1
May	12.5	15	17.3	21
June	15.4	18.1	21.2	24
July	15.8	19.6	22.4	25
August	16	19.7	22.6	25.2
September	15.5	19.3	21.8	24.2
October	13.1	16.1	19.2	22
November	9.3	12.1	14.2	17.4
December	5.7	8.4	10.6	13.8
All Season	16	19.7	22.6	25.2

Source: CPS, 2002

**TABLE 2.4-9**  
Probable Maximum Precipitation for Various Durations

<b>Duration (hours)</b>	<b>200-mi<sup>2</sup> 24-hr precipitation for August (inches)</b>	<b>Percent of 200-mi<sup>2</sup> 24-hr value</b>	<b>Total precipitation for 296-mi<sup>2</sup> 24-hour incremental precipitation (inches)</b>
6	-- <sup>a</sup>	68	15.98
12	-- <sup>a</sup>	84	19.74
24	23.5	96	22.56
48	-- <sup>a</sup>	107	25.15

Source: CPS, 2002

--<sup>a</sup> Not applicable

**TABLE 2.4-10**  
Probable Maximum Precipitation (PMP) 6-Hour Distribution During a 48-Hour Period

<b>6-hour period</b>	<b>Percentage</b>	<b>1st 24 hours</b>	<b>2nd 24 hours</b>
1	5.3	1.2	0.14
2	13.8	3.11	0.36
3	72.5	16.36	1.87
4	8.4	1.89	0.22
TOTAL	100	22.56	2.59

Source: CPS, 2002

Note: 48-Hour PMP distribution based on USACE Bulletin 52-8 (USACOE, 1952) and USWB procedures (USWB, 1961)

**TABLE 2.4-11**  
Probable Maximum Precipitation (PMP) Distribution for 48-Hour Period

Time hours	6-Hourly Precipitation Of 24-Hour Period (From Table 2.4-10 2 <sup>nd</sup> 24 hours)	2-Hourly Percentage Of Each 6-Hourly Precipitation	Precipitation (in)		Losses (in) Initial loss = 0 Infiltrations=0.1 in/hr	Rainfall Excess (in)	
			Incremental	Cumulative		Incremental	Cumulative
0	0	0	0	0	0	0	0
2		0.26	0.04	0.04	0.2	0	0
4		0.53	0.07	0.11	0.2	0	0
6	0.14	0.21	0.03	0.14	0.2	0	0
8		0.26	0.09	0.23	0.2	0	0
10		0.53	0.19	0.42	0.2	0	0
12	0.36	0.21	0.08	0.5	0.2	0	0
14		0.26	0.49	0.94	0.2	0.29	0.29
16		0.53	0.99	1.98	0.2	0.79	1.08
18	1.87	0.21	0.39	2.37	0.2	0.19	1.27
20		0.26	0.06	2.43	0.2	0	0
22		0.53	0.12	2.55	0.2	0	1.27
24	0.22	0.21	0.05	2.6	0.2	0	1.27
26		0.26	0.31	2.91	0.2	0.11	1.27
28		0.53	0.64	3.55	0.2	0.44	1.82
30	1.2	0.21	0.25	3.8	0.2	0.05	1.87
32		0.26	0.81	4.61	0.2	0.61	2.48
34		0.53	1.65	6.26	0.2	1.45	3.93

**TABLE 2.4-11**  
 Probable Maximum Precipitation (PMP) Distribution for 48-Hour Period

Time hours	6-Hourly Precipitation Of 24-Hour Period (From Table 2.4-10 2 <sup>nd</sup> 24 hours)	2-Hourly Percentage Of Each 6-Hourly Precipitation	Precipitation (in)		Losses (in) Initial loss = 0 Infiltrations=0.1 in/hr	Rainfall Excess (in)	
			Incremental	Cumulative		Incremental	Cumulative
36	3.11	0.21	0.65	6.91	0.2	0.45	4.38
38		0.26	4.26	11.19	0.2	4.06	8.44
40		0.53	8.67	19.84	0.2	8.47	16.91
42	16.36	0.21	3.43	23.27	0.2	3.23	20.43
44		0.26	0.49	23.27	0.2	0.29	20.14
46		0.53	1	24.75	0.2	0.8	21.23
48	1.89	0.21	0.4	25.16	0.2	0.2	21.43

Source: CPS, 2002

Note: 48-Hour PMP distribution based on USACE Bulletin 52-8 (USACOE, 1952) and USWB procedures (USWB, 1961).

**TABLE 2.4-12**  
2-Hourly Antecedent Standard Project Storm for 48-Hour Period  
(Standard Project Storm is 50% of Probable Maximum Precipitation)

Time (hours)	Precipitation (in) <sup>a</sup>		Losses (in)	Rainfall Excess (in)	
	Incremental	Cumulative	Initial Loss = 1.5 in Infiltration = 0.1 in/hr	Incremental	Cumulative
2	0.02	0.02		0	0
4	0.04	0.06		0	0
6	0.02	0.08		0	0
8	0.05	0.13		0	0
10	0.1	0.23		0	0
12	0.04	0.27		0	0
14	0.25	0.52		0	0
16	0.5	1.02	1.5 in initial loss is satisfied.	0	0
18	0.2	1.22		0	0
20	0.03	1.25		0	0
22	0.06	1.31		0	0
24	0.02	1.33		0	0
26	0.16	1.49		0	0
28	0.32	1.81	0.2	0.12	0.12
30	0.12	1.93	0.2	0	0.12
32	0.4	2.33	0.2	0.2	0.32
34	0.82	3.15	0.2	0.62	0.94
36	0.33	3.48	0.2	0.13	1.07
38	2.13	5.61	0.2	1.93	3
40	4.33	9.94	0.2	4.13	7.13
42	1.72	11.66	0.2	1.52	8.65
44	0.25	11.91	0.2	0.05	8.7
46	0.5	12.41	0.2	0.3	9
48	0.2	12.61	0.2	0	9

Source: CPS, 2002      <sup>a</sup> These values are 50% of PMP in Table 2.4-11.

**TABLE 2.4-13**  
 Unit Hydrograph Characteristics Specifications

1	Salt Creek Component Areas	Area Mi <sup>2</sup>	Duration Of Unit Hydrograph (Hr)	Lag Time (Hr)	Duration /Lag Ratio	Form No.	Qs (Cfs) - Intervals	Time Of Peak (Hr)	Peak Discharge (Cfs)	Time Base Tp (Hr)
1.1	Headwater Area	126.8	2	19.1	0.1	80.1	42,000	10.5	4,490	78
1.2	Local Areas									
	I <sub>E</sub>	6.2	1/2	3.1	0.16	80.15	8,600	2.1	1,275	12
	II <sub>E</sub>	5	1/2	2.8	0.179	80.2	5,760	2	1,155	22
	III <sub>W</sub>	16.3	1	5.6	0.179	80.2	9,400	3.9	1,880	22
	IV <sub>W</sub>	<u>8.2</u>	1/2	3.7	0.135	80.15	9,500	2.5	1,410	15
	Total	35.7								
	Local Area	-- <sup>a</sup>	2	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	4	4,260	30
2	North Fork Component									
2.1	Headwater Area	111	2	17.85	0.11	80.1	40,400	10	4,250	55
2.2	Local Area	15	1/2	5.3	0.09	80.1	18,000	2.92	1,890	
	Local Area	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	4	1,718	-- <sup>a</sup>
3	Reservoir Surface Area	8	2	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	-- <sup>a</sup>	2,500	2	-- <sup>a</sup>
4	Salt Creek and North Fork	296	2	32	0.625	500.1	60,000	24	5,690	100

By applying S-Curve method to 1/2 hour and 1 hour unit hydrographs, 2 hour unit hydrographs were developed for local areas.

Summation of the ordinates of these curves gives 2 hour unit hydrographs for local areas. Local area IE is at "SE" side of lake, IIE is located on "NE" side, IIIW is at "NW" side and IVW is at "SW" side of lake. --<sup>a</sup> Not applicable

Source: CPS, 2002

**TABLE 2.4-14**  
Water Usage

<b>Service</b>	<b>Normal usage, GPM</b>	<b>Maximum usage, GPM</b>
Cooling Tower Make-up Water for evaporative losses	31,500	31,500
Cooling Tower Makeup water, for evaporative losses, with wet/dry tower	9,450	9,450
Potable/Sanitary Water	90	198
Demineralized Water	550	720
Filtered Water	140	180
Fire Protection	10	2500

**TABLE 2.4-15**  
Stratigraphic Units and Their Hydrogeologic Characteristics

Geologic System	Stratigraphic Unit	Description	Hydrogeologic System	Hydrogeologic Characteristics
Quaternary	Henry Formation	Clayey silt overlying stratified silt, sand, or gravel	Alluvium	Groundwater occurs in permeable sand and gravel deposits underlying the fine-grained floodplain deposits. Yields are generally suitable for domestic or farm use. Sufficient quantities for municipal use may be available in those areas along the larger streams where thick sand and gravel deposits are present.
	Richland Loess	Clayey silt, trace fine sand	Wisconsinan deposits	Groundwater may be obtained from sand and gravel lenses in the Wisconsinan tills. Groundwater occurs under water table conditions in the Wisconsinan deposits.
	Wedron Formation	Clayey sandy silt till with interbedded discontinuous lenses of stratified silt, sand, or gravel		
	Robien Silt	Silt, some organics, trace clay, and fine sand	Interglacial Zone	
	Glasford Formation	Sandy silt till, with interbedded discontinuous lenses of stratified silt, sand, or sandy silt; upper 10 ft is highly weathered (altered)	Illinoian deposits	Groundwater may be obtained from sand and gravel lenses in the Illinoian tills. Groundwater occurs under artesian conditions in the Illinoian deposits. Yields from wells that intercept good water-yielding sand and gravel deposits are suitable for domestic and farm purposes. Higher yields for small industrial or municipal supply are locally available. Where sand and gravel deposits are thin or absent, small amounts of groundwater may be obtained using large-diameter wells.
	Banner Formation	Complex sequence of stratified silt, sandy clay till, and sand and gravel outwash	Kansan deposits	Groundwater may be obtained from Kansan outwash deposits (Banner Formation) in the buried Mahomet Bedrock Valley. Groundwater occurs under artesian conditions in the Kansan deposits. Kansan sand and gravel deposits in the buried Mahomet Bedrock Valley comprise the major aquifer in the area. Yields of up to 2,000 gpm may be obtained from a suitably constructed well located in the main channel of the valley
Pennsylvanian	Bond Formation	Shale with thin beds of limestone, sandstone, siltstone underclay, and coal	Pennsylvanian bedrock	Groundwater occurs in thin sandstone and fractured limestone beds under artesian conditions. Small quantities of groundwater, suitable only for domestic or farm supply, may be obtained from the upper 50 to 100 ft of the Pennsylvanian formations.
	Modesto Formation			
	Carbondale Formation			
	Spoon Formation			
	Abbott Formation			
Mississippian, Silurian, Devonian	Various Formations	Sandstone, limestone, and dolomite units	Mississippian, Silurian, Devonian bedrock	The best groundwater yields are from wells that intersect bedding planes, fractures, and solution channels.

Source: CPS, 2002; USGS, 1995a

Note: Excavations for the CPS did not extend below the Glasford Formation. CPS borings did not fully penetrate rocks of the Carbondale Formation. The ESP borings did not fully penetrate the Modesto Formation.

**TABLE 2.4-16**  
Water Withdrawals by County

County	Number of Producing Wells	Population/Usage (thousands)				Public Supply Withdrawals (MGD)			Domestic Supply Withdrawals (MGD)		
		Pop. Served by Public Supply Groundwater	Pop. Served by Public Supply Surface Water	Total Pop. Served by Public Supply	Pop. Served by Domestic Supply	Ground-water	Surface Water	Total	Ground-water	Surface Water	Total
Champaign	3,755	166.88	0	166.88	2.22	22.59	0	22.59	0.2	0	0.2
Christian	1,523	13.96	5.08	19.04	15.88	2.13	0.77	2.9	1.43	0	1.43
DeWitt	997	12.38	0	12.38	4.44	1.48	0	1.48	0.4	0	0.4
Douglas	1,114	13.06	0	13.06	6.74	1.26	0	1.26	0.61	0	0.61
Ford	876	9.23	0	9.23	4.9	1.73	0	1.73	0.44	0	0.44
Livingston	1,535	11.02	17.43	28.45	11.95	1.88	2.97	4.85	1.08	0	1.08
Logan	1,360	25.97	0	25.97	5.3	3.2	0	3.2	0.48	0	0.48
Macon	1,575	4.96	95.34	100.3	16.11	1.96	37.74	39.7	1.45	0	1.45
Mason	1,636	8.96	0	8.96	7.73	1.16	0	1.16	0.7	0	0.7
McLean	2,241	42.38	36.79	79.17	60.1	5.64	4.9	10.54	5.41	0	5.41
Menard	780	8.73	0	8.73	3.55	0.76	0	0.76	0.32	0	0.32
Moultrie	714	9.75	0	9.75	4.42	1.16	0	1.16	0.4	0	0.4
Piatt	958	6.58	0	6.58	9.58	1.35	0	1.35	0.86	0	0.86
Sangamon	2,284	13.67	129.45	143.12	41.61	2.27	21.52	23.79	3.74	0	3.74
Shelby	2,003	7.09	6.9	13.99	8.57	1.21	1.18	2.39	0.77	0	0.77
Tazewell	3,051	112.64	0.82	113.46	14.14	14.66	0.11	14.77	1.27	0	1.27
Woodford	1,890	5.28	16.22	21.5	13.08	2.13	6.54	8.67	1.18	0	1.18

Source: USGS, 1995a

**TABLE 2.4-16**  
Water Withdrawals by County

County	Number of Producing Wells	Commercial Withdrawals (MGD)			Industrial Withdrawals (MGD)			Irrigation Withdrawals (MGD)			Total Agricultural Withdrawals <sup>a</sup> (MGD)
		Ground-water	Surface Water	Total	Ground-water	Surface Water	Total	Ground-water	Surface Water	Total	
Champaign	3,755	0.1	0.03	0.13	2.27	0	2.27	5.32	0	5.32	5.57
Christian	1,523	0.01	0	0.01	0	0	0	0.16	0	0.16	0.43
DeWitt	997	0.04	0	0.04	0	0	0	0.38	0	0.38	0.68
Douglas	1,114	0.03	0	0.03	0	3.32	3.32	0.02	0	0.02	0.28
Ford	876	0.09	0	0.09	0.1	0	0.1	0.62	0	0.62	0.88
Livingston	1,535	0	0.21	0.21	0.08	0	0.08	0.29	0	0.29	0.96
Logan	1,360	0	0	0	0	0	0	0.64	0	0.64	1.09
Macon	1,575	0.01	0	0.01	0.6	4.36	4.96	0.26	0	0.26	0.43
Mason	1,636	4.35	9.17	13.52	0	0	0	35.57	0	35.57	42.4
McLean	2,241	0.12	0	0.12	0	0	0	0.26	0	0.26	0.89
Menard	780	0	0	0	0	0	0	0.52	0	0.52	0.85
Moultrie	714	0	0.8	0.8	0	0	0	0.02	0	0.02	0.2
Piatt	958	0.02	0	0.02	0.79	0	0.79	0.15	0	0.15	0.27
Sangamon	2,284	0	0	0	0	0	0	0.49	0	0.49	1.03
Shelby	2,003	0.29	0	0.29	0	0	0	0.25	0	0.25	0.92
Tazewell	3,051	0.02	0	0.02	12.99	22.84	35.83	11.61	0	11.61	12.24
Woodford	1,890	0.01	0	0.01	0.01	0	0.01	0.26	0	0.26	0.88

Source: USGS, 1995a

<sup>a</sup> Total Agricultural Withdrawals is the total of irrigation withdrawals and livestock withdrawals.

**TABLE 2.4-17**  
Historical and Recent Piezometer Data <sup>a</sup>

Historical Data	Piezometer Number	Date of Installation	Surface Elevation (ft, msl)	Tested Interval <sup>c</sup>		Stratigraphic Units Open to Piezometer
				Depth (ft)	Elevation (ft, msl)	
X	D-23B <sup>d</sup>	7-14-72	655.8	11.5–16.0	639.8–644.3	Alluvium
X	D-30B <sup>d</sup>	7-26-72	669.9	3.5–12.0	657.9–666.4	Alluvium
X	D-3B <sup>d</sup>	7-13-72	660.0	10.5–20.5	639.5–649.5	Alluvium
X	D-8B <sup>d</sup>	7-19-72	655.7	1.5–16.0	639.7–654.2	Alluvium
X	P-1B <sup>d</sup>	6-26-72	675.9	10.0?–?	?–665.9?	Alluvium
X	OW-18	7-16-79	656.5	7.0–15.0	641.5–649.5	Alluvium and Fill
X	D-19B <sup>d</sup>	7-13-72	658.9	23.0–30.0	628.9–635.9	Alluvium and Illinoian
X	OW-12	8-2-77	659.2	17.0–25.0	634.2–642.2	Alluvium and Illinoian
X	OW-19	7-16-79	654.5	6.0–18.5	636.0–648.5	Alluvium and Illinoian
	B-1	8-2002	738.6	80-90	658.6-648.6	Illinoian
X	D-19A <sup>d</sup>	7-13-72	658.9	33.0–38.0	620.9–625.9	Illinoian
X	D-23A <sup>d</sup>	7-14-72	655.8	25.0–31.5	624.3–630.8	Illinoian
X	D-30C <sup>d</sup>	7-27-72	669.9	45.0–50.0	619.9–624.9	Illinoian
X	D-3A <sup>d</sup>	7-13-72	660.0	30.0–40.0	620.0–630.0	Illinoian
X	E-2B <sup>d</sup>	7-12-72	746	60–68	678–686	Illinoian
X	E-3B	7-12-72	730	68–75	655–662	Illinoian
X	E-4B	7-6-72	740	80–96	644–654	Illinoian
X	E-5B	7-19-72	750	70–76	674–680	Illinoian
X	OW-1	5-12-76	716.7	60–70	646.7–656.7	Illinoian
X	OW-10	8-2-77	656.0	27.0–35.0	621.0–629.0	Illinoian
X	OW-11	8-2-77	654.5	19.0–27.0	627.5–635.5	Illinoian
X	OW-13	8-2-77	662.1	32.0–40.0	622.1–630.1	Illinoian
X	OW-14	8-2-77	657.1	23.0–31.0	626.1–634.1	Illinoian
X	OW-15	8-3-77	664.5	47.0–55.0	609.5–617.5	Illinoian
X	OW-16	8-3-77	657.9	22.0–30.0	627.9–635.9	Illinoian
X	OW-17	8-3-77	659.5	32.0–40.0	619.5–627.5	Illinoian
X	OW-22A	10-9-79	665.9	23.0–44.5	621.4–642.9	Illinoian
X	OW-9	8-1-77	654.3	16.5–24.5	629.8–637.8	Illinoian
X	P-1A <sup>d</sup>	6-26-72	675.9	66.0 <sup>b</sup> –79.5	596.4–609.9 <sup>b</sup>	Illinoian

**TABLE 2.4-17**  
Historical and Recent Piezometer Data <sup>a</sup>

Historical Data	Piezometer Number	Date of Installation	Surface Elevation (ft, msl)	Tested Interval <sup>c</sup>		Stratigraphic Units Open to Piezometer
				Depth (ft)	Elevation (ft, msl)	
X	P-22B <sup>d</sup>	6-28-72	734.0	55.0–64.0	670.0–679.0	Illinoian
X	P-27 <sup>d</sup>	6-6-72	742.9	57.5	85.4	Illinoian
X	P-31 <sup>d</sup>	9-11-73	736.8	50.0–159.0	577.8–686.8	Illinoian
X	P-39 <sup>d</sup>	8-28-73	740.8	62.0–150.0	590.8–678.8	Illinoian
X	P-7B <sup>d</sup>	7-5-72	737.5	70.0–78.0	659.5–667.5	Illinoian
X	OW-20	7-17-79	658.4	10.0–34.4	624.0–648.4	Illinoian and Fill
X	OW-21	10-8-79	670.0	5.0–55.0	615.0–665.0	Illinoian and Fill
X	OW-23	10-10-79	654.5	5.0–34.5	620.0–649.5	Illinoian and Fill
X	OW-24	10-11-79	654.9	5.0–34.0	620.9–649.9	Illinoian and Fill
X	P-17 <sup>d</sup>	7-10-72	738.3	149.9–240.0	498.3–589.3	Illinoian and Kansan
X	P-20 <sup>d</sup>	6-28-72	738.3	170.0–305.5	432.8–568.3	Illinoian, Kansan, and Bedrock
X	D-31 <sup>d</sup>	6-16-72	667.7	158.0–356.5	311.2–509.7	Illinoian, Mahomet Sand, and Bedrock
X	P-36 <sup>d</sup>	11-6-73	738.2	178.0–223.0	515.2–560.2	Kansan
X	E-3A	7-5-72	730	214–238	492–516	Kansan and Mahomet Sand
X	D-11 <sup>d</sup>	6-21-72	653.8	140.0–343.5	310.3–513.8	Kansan, Mahomet Sand, and Bedrock
	B-2	8-2002	737.2	8-28	729.2-709.2	Wisconsinan
	B-3	8-2002	734.1	16-26	718.1-708.1	Wisconsinan
X	D-50	4-30-73	718.0	2.0–37.0	681.0–716.0	Wisconsinan
X	E-1B <sup>d</sup>	7-13-72	733	30–40	693–703	Wisconsinan
X	OW-22B	10-9-79	665.9	5.5–20.0	645.9–660.4	Wisconsinan
X	OW-3d	5-10-76	735.9	10–40	695.9–725.9	Wisconsinan
X	OW-3s	5-10-76	735.9	5–10	725.9–730.9	Wisconsinan
X	OW-4d	5-7-76	721.0	10–23.5	697.5–711.0	Wisconsinan
X	OW-4s	5-7-76	720.9	2.5–6.5	714.1–718.1	Wisconsinan
X	OW-5d	5-7-76	712.6	10–18.2	694.4–702.6	Wisconsinan
X	OW-5s	5-7-76	712.8	4–8	704.8–708.8	Wisconsinan
X	OW-6d	5-10-76	743.2	10–52	691.2–733.2	Wisconsinan

**TABLE 2.4-17**  
Historical and Recent Piezometer Data <sup>a</sup>

Historical Data	Piezometer Number	Date of Installation	Surface Elevation (ft, msl)	Tested Interval <sup>c</sup>		Stratigraphic Units Open to Piezometer
				Depth (ft)	Elevation (ft, msl)	
X	OW-6s	5-10-76	743.3	2.5–7.5	735.8–740.8	Wisconsinan
X	OW-7d	5-13-76	718.6	10–25	693.6–708.6	Wisconsinan
X	OW-7s	5-13-76	718.6	2–6	712.6–716.6	Wisconsinan
X	P-37 <sup>d</sup>	8-27-73	739.1	16.0–40.0	699.1–723.1	Wisconsinan
X	P-40 <sup>d</sup>	10-19-73	742.1	10.0–38.0	704.1–732.1	Wisconsinan
X	D-46	4-24-73	710.3	2.0–27.0	683.3–708.3	Wisconsinan and Illinoian
X	D-47 <sup>d</sup>	4-24-73	714.8	2.0–38.0	676.8–712.8	Wisconsinan and Illinoian
X	D-48	4-24-73	715.3	2.0–39.0	676.3–713.3	Wisconsinan and Illinoian
X	OW-2 <sup>d</sup>	5-12-76	--	5–20	--	Wisconsinan and Illinoian
X	OW-8	5-12-76	719.2	18–42	677.2–701.2	Wisconsinan and Illinoian
X	E-6B	7-25-72	736	0–151	585–736	Wisconsinan, Illinoian, and Kansan
X	E-7 <sup>d</sup>	7-20-72	712	0–151	560.5–712	Wisconsinan, Illinoian, and Kansan

<sup>a</sup> CPS Historical data as reported in CPS, 2002.<sup>b</sup> Indicates that the exact depth is unknown<sup>c</sup> "Tested Interval" refers to portion of piezometer backfilled with pea gravel and open to stratigraphic unit.<sup>d</sup> Piezometer has been destroyed by construction activities.**TABLE 2.4-18**  
Laboratory Permeability Test Data

Boring Number	Elevation (ft,msl)	Soil Type <sup>a</sup>	Geologic Unit	Type of Test	Field Moisture Content	Field Dry Density (lb/ft <sup>3</sup> )	Average Coefficient of Permeability at 20°C (cm/sec)	Estimated Porosity
<b>Dam Site Borings</b>								

**TABLE 2.4-18**  
 Laboratory Permeability Test Data

Boring Number	Elevation (ft,msl)	Soil Type <sup>a</sup>	Geologic Unit	Type of Test	Field Moisture Content	Field Dry Density (lb/ft <sup>3</sup> )	Average Coefficient of Permeability at 20°C (cm/sec)	Estimated Porosity
D-3	626.2	ML	Illinoian Glacial Till	Falling head	7.5%	144	$3.9 \times 10^{-9}$	16.8%
D-10	627.0	ML	Illinoian Glacial Till	Falling head	7.2%	131	$1.0 \times 10^{-8}$	16.3%
D-13	676.4	SP	Interglacial Zone	Constant head	24.8%	94	$1.8 \times 10^{-4}$	40.0%
D-13	661.4	SP, SW	Interglacial Zone	Constant head	6.4%	105	$4.7 \times 10^{-3}$	14.8%
D-13	632.0	ML	Illinoian Glacial Till	Falling head	7.3%	142	$3.8 \times 10^{-9}$	16.4%
D-24	631.0	ML	Salt Creek Alluvium	Falling head	7.4%	123	$1.8 \times 10^{-8}$	16.5%
D-34	664.8	SP, GP	Interglacial Zone	Constant head	6.2%	112	$2.3 \times 10^{-3}$	14.3%
D-34	649.8	SP, GP	Interglacial Zone	Constant head	17.5%	118	$2.0 \times 10^{-4}$	32.0%
D-34	629.8	ML	Illinoian Glacial Till	Falling head	7.8%	138	$6.5 \times 10^{-9}$	17.4%
D-37	663.7	SP, SW	Interglacial Zone	Constant head	12.2%	116	$3.0 \times 10^{-3}$	24.7%
D-37	643.7	ML, CL	Illinoian Glacial Till	Falling head	11.7%	134	$1.3 \times 10^{-8}$	24.0%
<b>Station Site Borings</b>								
P-14	654.8	ML	Illinoian Glacial Till	Falling head	9.5%	129	$2.5 \times 10^{-8}$	-- <sup>b</sup>
P-14	579.8	ML	Illinoian Glacial Till	Falling head	8.1%	139	$9.5 \times 10^{-9}$	-- <sup>b</sup>
P-18	683.7	ML, SM	Illinoian Glacial Till	Falling head	10.3%	131	$2.3 \times 10^{-7}$	-- <sup>b</sup>

Source: CPS, 2002

<sup>a</sup> Soil Types:

GP = Poorly graded gravels, gravel-sand mixtures, little or no fines.

SW = Well-graded sands, gravelly sands, little or no fines.

SP = Poorly graded sands, gravelly sands, little or no fines.

SM = Silty sands, silt-sand mixtures.

ML = Inorganic silts with very fine sands, rock flour, silty or clayey fine sands or clayey silts, with slight plasticity.

CL = Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.

--<sup>b</sup> Data not available

**TABLE 2.4-19**  
Field Permeability Tests

Boring Number	Ground Surface Elevation (ft, msl)	Zone of Percolation Elevation (ft, msl)	Geologic Unit	Average Coefficient of Permeability (cm/sec)	Estimated Porosity
D-19	658.9	625.0–620.9	Illinoian Till	$1.4 \times 10^{-5}$	26.7%
D-23	655.8	630.8–624.3	Illinoian Till	$6.1 \times 10^{-6}$	24.5%
E-1B	733.0	703.0–693.0	Wisconsinan Till	$1.5 \times 10^{-6}$	-- <sup>a</sup>
P-37	741.5	726.1–701.1	Wisconsinan Till	$2.6 \times 10^{-6}$	25.7%

--<sup>a</sup> Data not available

Source: CPS, 2002

**TABLE 2.4-20**  
Laboratory Permeability for Site Soils

Boring Number	Elevation (ft, msl)	Soil Type	Geologic Unit	Test Type	Remolded Sample		Average Coefficient of Permeability at 20°C (cm/sec)
					Moisture Content	Dry Density (lb/ft <sup>3</sup> )	
S-10	702.6–697.6	Clay	Wisconsinan Glacial Till	Falling head	13.6%	126	$3.2 \times 10^{-9}$
S-10	702.6–697.6	Clay	Wisconsinan Glacial Till	Falling head	12.4%	125	$2.0 \times 10^{-8}$
S-14	727.2–720.2	Clay	Wisconsinan Glacial Till	Falling head	16.8%	109	$1.6 \times 10^{-8}$
S-14	727.2–720.2	Clay	Wisconsinan Glacial Till	Falling head	11.0%	125	$1.0 \times 10^{-8}$

Source: CPS, 2002

**TABLE 2.4-21**  
Relative Density Data for Site Soils

Boring Number	Elevation (ft, msl)	Soil Type	Geologic Unit	Minimum Dry Density (lb/ft <sup>3</sup> )	Maximum Dry Density (lb/ft <sup>3</sup> ) (wet method)
D-11	473.8	Sand and gravel	Mahomet Bedrock Valley Outwash	92	113
D-11	424.8	Sand and gravel	Mahomet Bedrock Valley Outwash	91	118

Source: CPS, 2002

**TABLE 2.5-1**  
 Summary of Soil Properties at the EGC ESP and CPS Sites

Unit	Depth Range at EGC ESP Site Boring B-2 (ft bgs <sup>c</sup> )	General Soil Properties - EGC ESP Site (and CPS Site) <sup>a</sup>					Shear Wave Velocity (fps) at the EGC ESP Site <sup>b</sup>	
		Moist Unit Weight (pcf <sup>d</sup> )	Moisture Content (%)	LL <sup>e</sup>	PL <sup>f</sup>	PI <sup>g</sup>	Range	Average
Loess & Wisconsinan Till	0 - 42	131	16	35	14	14	820 to 1340	975
		<i>(131)</i>	<i>(16)</i>	<i>(25)</i>	<i>(14)</i>	<i>(11)</i>		
Interglacial	42 - 59	116	39	40	26	14	860 to 1970	1343
		<i>(132)</i>	<i>(17)</i>	<i>(26)</i>	<i>(13)</i>	<i>(13)</i>		
Illinoian Till	59 - 163	148	8	18	9	9	1100 to 3250	2188
		<i>(147)</i>	<i>(9)</i>	<i>(18)</i>	<i>(11)</i>	<i>(7)</i>		
Lacustrine	163 - 190	133	13	28	11	17	1390 to 2670	1829
		<i>(140)</i>	<i>(11)</i>	<i>(19)</i>	<i>(12)</i>	<i>(7)</i>		
Pre-Illinoian Till	190 - 269	138	14	29	14	15	1560 to 2800	2068
		<i>(137)</i>	<i>(14)</i>	<i>(27)</i>	<i>(14)</i>	<i>(13)</i>		
Pre-Illinoian Alluvial/ Lacustrine	269 - 292	NA <sup>h</sup>	23	48	17	29	1190 to 3310	2045
		<i>(NA)</i>	<i>(NA)</i>	<i>(NA)</i>	<i>(NA)</i>	<i>(NA)</i>		
Bedrock	292 - 322	NA	NA	NA	NA	NA	3250 to 3880	3420
		<i>(NA)</i>	<i>(NA)</i>	<i>(NA)</i>	<i>(NA)</i>	<i>(NA)</i>		

<sup>a</sup> The first value listed in each cell is the arithmetic mean for all available soil samples from that unit from the EGC ESP Site investigation. (*Italic*) = Numbers in parenthesis and italics below the EGC ESP Site results are the average of applicable data from CPS Site P-Series Soil Samples.

<sup>b</sup> Shear wave velocity data are from the downhole suspension logging test performed at EGC ESP Site Boring B-2.

<sup>c</sup> below ground surface

<sup>d</sup> PCF definition

<sup>e</sup> LL definition

<sup>f</sup> PL definition

<sup>g</sup> LL definition

<sup>h</sup> NA = Results not available

Site Safety Analysis Report for  
the EGC Early Site Permit

**Figure 2.1-1**  
**Site/Region Location Map**

