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1.1.3 Reactor Information

The selection of a reactor design to be used for this facility is still under consideration. The types of reactors from which the bounding parameters were determined (see SSAR, Table 1.4-1), include:

- Pebble bed modular reactor (PBMR) – 8 modules;
- Advanced boiling-water reactor (ABWR) – 1 unit;
- Advanced pressurized-water reactor (AP1000) – 2 units;
- Economic Simplified Boiling-Water Reactor (ESBWR) – 1 unit;
- Gas turbine-modular helium reactor (GT-MHR) – 4 modules;
- Advanced Canada Deuterium Uranium (CANDU) Reactor (ACR-700) – 2 units; and
- International Reactor Innovative and Secure (IRIS) – 3 units.

Selection of a reactor to be used at the EGC ESP Site will not be limited to those listed above. The final selected reactor may be a future design that is bounded by the surrogate plant design reflected in the Plant Parameters Envelope (PPE), as presented in SSAR Table 1.4-1.

It is estimated that the proposed reactor(s) will be capable of generating up to a core thermal power level of 6,800 megawatts thermal (MWt). For more information on the reactors assessed in the PPE, see Chapter 3.

1.1.4 Cooling System Information

Waste heat will be dissipated by a cooling tower(s), which will draw cooling water makeup from Clinton Lake. The cooling water makeup will be withdrawn from Clinton Lake through a new intake structure. The approach velocity to the intake will be limited to a maximum velocity of 0.50 feet per second (fps) at the normal lake elevation of 690 ft above mean sea level (msl). The normal raw water requirement is estimated to be 48,288 gallons per minute (gpm). A breakdown of the usage of the raw water supply can be seen in Table 3.3-2. The total discharge from the cooling tower(s) will normally be 12,000 gpm, with a maximum discharge of 49,000 gpm. For more information on the cooling system, see Section 3.4.

1.1.5 Transmission System Information

The existing transmission system is insufficient to handle the load of an additional large generation source. If EGC decides to construct generation up to the maximum load specified in the PPE, it will be necessary to increase the capacity of the existing transmission facilities as described below.

A double circuit line will connect the facility to an interconnect point at the Brokaw substation near Bloomington, Illinois, about 23-mi north of the site. A second double circuit line will connect the site to the Oreana substation, which is about 8-mi south of the site. Based on regional transmission operator (RTO) construction practices, it is anticipated that four wood pole H-Frames will be constructed to carry the lines to their destinations. The H-Frame structures will carry the double circuit lines that consist of six phases of two or three

TABLE 1.2-1
Federal, State, and Local Authorizations

Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
IEPA	Environmental Protection Act (415 ILCS 5)	Operating Permit	--[a]	--[a]	Operation of temporary sewage treatment unit for construction phase only
IEPA	Environmental Protection Act (415 ILCS 5)	Operating Permit	--[a]	--[a]	Treatment of waste water discharge
DeWitt County Zoning Board of Appeals	Illinois Zoning Act	Approvals	--[a]	--[a]	Construction of the plant
Circuit Court of DeWitt County	Eminent Domain Act	Petition for Condemnation	--[a]	--[a]	Exercise right of eminent domain

[a] Data not available. Applicable permits may not be applied for until the COL phase. Applications for permits will be made before the beginning of construction, as required. Some permits may be combined with existing CPS permits.

[b] To be obtained by the Regional Transmission Operator.

Note: All permits will be applied for before the beginning of construction. Some permits may not be obtained since the area may be combined with some existing CPS permits.

TABLE 1.2-1
Federal, State, and Local Authorizations

Agency	Authority	Requirement	License/ Permit No.	Expiration Date	Authorization Granted
IEPA	CAA	Minor Source Construction Permit	--[a]	--[a]	Construction and operation of facilities generating air emissions
IEPA	Title V	Title V Operating Permit	--[a]	--[a]	Operation of facility generating air emissions
IEPA	General Stormwater Permit	Notice of Termination (NOT) for Industrial Activities	--[a]	--[a]	Termination of coverage under the general permit for stormwater discharge associated with operations activities
IEPA	Environmental Protection Act (415 ILCS 5)	Sanitary Wastewater Hauling Permit	--[a]	--[a]	Transportation of sanitary wastewater
IEPA	Environmental Protection Act (415 ILCS 5)	Sludge Disposal Operating Permit	--[a]	--[a]	Disposal of sludge
IEPA	Environmental Protection Act (415 ILCS 5)	Non-Hazardous Domestic Waste-water or Sludge Transporting Permit	--[a]	--[a]	Transportation of non-hazardous wastewater or sludge
IEPA	IL Adm. Code, Part 170	Emergency Petroleum Storage Tank Permit	--[a]	--[a]	Implementation of storage tanks containing petroleum products
IEPA	Environmental Protection Act (415 ILCS 5)	Open Burning Permit	--[a]	--[a]	Open burning of petroleum products for back-up generators
IEPA	Environmental Protection Act (415 ILCS 5)	Supplemental Waste Stream Permit	--[a]	--[a]	Disposal of waste from additional waste streams
IEPA	N/A	Refrigerant Recovery/Recycling Equipment Certifications	--[a]	--[a]	Recovery and recycling of refrigerants
IEPA	Environmental Protection Act (415 ILCS 5)	Construction Permit	--[a]	--[a]	Construction of waste treating facilities
IEPA	Environmental Protection Act (415 ILCS 5)	Construction Permit	--[a]	--[a]	Construction of temporary sewage treatment unit for construction phase only

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^2. 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^2 (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 2.3-1.

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

2.3.1.1.2 Flow Characteristics

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^2. The station records from October of 1942 to November of 2002 have been evaluated to describe flow characteristics of Salt Creek.

Table 2.3-2 presents the mean monthly runoff, rainfall, and natural lake evaporation data for the Salt Creek Basin at the Rowell gauging station, following the construction of the Clinton Lake Dam (1978 to 2000). The average discharge of Salt Creek for this 21-yr period is 295 cfs, or about 12 in. of runoff per year. 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 postdam runoff to rainfall ratio is about 30 percent (namely 30 percent of the rainfall drains out of the basin).

The discharge data for postdam conditions (namely after 1978) at Rowell gauging station are provided in Table 2.3-3.

2.3.1.1.3 Floods

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 was calculated using a Log-Pearson Type III distribution based on the 25 years of records from Water Year 1979 through 2003. Figure 2.3-

Figure 2.2-3 indicates the transportation network, comprised of highways, railroad (RR) lines, and utility rights-of-way, that cross the site and vicinity. Illinois (IL) Route 54 is approximately 1-mi north of the EGC ESP Site. IL Route 10 is approximately 3-mi south, and IL Route 48 is approximately 5-mi east of the EGC ESP Site (U.S. Census Bureau, 2000). As shown in Figure 2.2-3, access to the site is limited primarily to IL Route 54.

There is one RR line within the vicinity (see Figure 2.2-3). The Canadian National RR runs parallel to IL Route 54 and traverses the vicinity approximately 1-mi north of the CPS. (U.S. Census Bureau, 2000).

There are three private airports within the vicinity of the site. The Martin RLA Airport is located approximately 4-mi south of the site. The Thorp Airport is located approximately 5-mi northwest of the site. The Bakers Strip is located approximately 5-mi southeast of the site (Bureau of Transportation Statistics, 2000).

The waterways within the vicinity include Clinton Lake, Salt Creek, and North Fork of Salt Creek, which branches off Clinton Lake. There is one canoe access area north of the site. In addition, there is one marina with boat access south of the site, and four boat access areas, one in each cardinal direction from the site (IDNR, 2002).

There are no known significant mineral resources (e.g., sand and gravel, coal, oil, natural gas, and ores) within the vicinity (Masters et al., 1999).

DeWitt County published a comprehensive plan in 1992 to guide overall development in the area. The EGC ESP Site will not conflict with the proposed zoning for the site, since the facility will be constructed within the CPS Site, which is already designated for transportation and utilities. The 1992 *DeWitt County Comprehensive Plan* states that DeWitt County should encourage new spin off development or related expansion at the CPS (University of Illinois, 1992).

2.2.2 Transmission Corridors and Off-Site Areas

The anticipated transmission corridor for the EGC ESP Facility is an existing corridor used to transmit power generated from the CPS. The transmission corridor is divided into two sections. Based on Geographic Information System (GIS) analysis, the northern section is approximately 23-mi long with a width of 250 ft (an area of 710 ac). The southern section is approximately 8-mi long with a width of 250 ft (an area of 238 ac). The northern section runs north of the EGC ESP Site, and then turns west and runs toward Bloomington, Illinois. The southern section runs southeast of the EGC ESP Site past Clinton Lake, and then turns south and runs toward the southern boundary of DeWitt County. Figure 2.2-4 depicts the anticipated transmission line corridor.

Table 2.2-2 describes the percentage and actual area devoted to the major land use classifications that were confirmed with a review of aerial photographs (USGS, 2000). The area that comprises the anticipated transmission corridor is predominantly agricultural land, 88.2 percent or 836 ac. A significant portion of the southern transmission corridor crosses Clinton Lake, which accounts for the fact that approximately 10.7 percent of the land use is recreational. A small portion of the land use of the transmission corridor is classified as industrial, 1.1 percent. This consists primarily of the CPS Site, RR crossings, and highway crossings.

3 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 are also shown in Table 2.3-4. 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 3,300 cfs (recurrence interval of 2.33 years). The maximum post-dam discharge of 7,810 cfs (April of 1994) has a recurrence interval of about 25 years (USGS, 2004).

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 6,000 cfs. The 100-yr recurrence flood flow is reduced from 29,900 cfs to 9,800 cfs (see Table 2.3-4).

2.3.1.1.4 Droughts

Since construction of the dam in 1977, there have been significant dry periods. The most significant dry period was in 1988. The monthly runoff values at the Rowell gauging station in 1988 are provided in Table 2.3-5. The minimum postdam flow of 3.7 cfs was recorded at the Rowell gauging station on September 8, 1988 (USGS, 2002).

A rank-order method was used to analyze low-flow frequency for the Rowell gauging station under postdam conditions. The magnitudes and frequencies of low flows with a one-day duration at the gauging station are summarized in Table 2.3-6 and graphically depicted in Figure 2.3-4.

2.3.1.1.5 Wetlands and Floodplains

According to the USFWS, wetlands, including forested, emergent, and scrub-shrub communities, exist within 6 mi of the location of the EGC ESP Facility (USFWS, 2002). These wetlands are generally associated with small tributaries to Salt Creek and North Fork of Salt Creek.

2.3.1.2 Lakes and Impoundments

There are many small lakes and ponds, both man-made and natural, scattered around the Salt Creek Basin, particularly along the creeks. The main lake/impoundment features are related to the CPS and include Clinton Lake and the ultimate heat sink (UHS). Clinton Lake provides the cooling water for the CPS. The UHS is a submerged impoundment located within Clinton Lake that provides cooling water for the safe shutdown equipment. Clinton Lake, the existing UHS, and other area lakes are described in the following sections.

2.3.1.2.1 Clinton Lake

Clinton Lake was formed by the construction of an earthen dam across Salt Creek, 1,200-ft downstream from the confluence of North Fork of Salt Creek with Salt Creek (see Figure 2.3-1). The dam construction was completed in 1977 and the lake was filled by early 1978. The CPS is approximately 3.5-mi northeast of the dam, located between the two fingers of the lake, at an approximate grade elevation of 736 ft. The drainage area to the dam is 296 mi^2. The lake elevation area capacity curves are presented in Figure 2.3-5. In addition, the lake normal pool elevation is 690 ft, with a surface area of 4,895 ac (7.65 mi^2, 2.6 percent of the drainage area), and a storage capacity of 74,200 ac-ft at normal pool (CPS, 1982).

Clinton Lake was designed to provide cooling water to the CPS and remove the design heat load from the circulating water before the water circulates back into the plant. The CPS

Springfield are located within 50 mi of Clinton Lake. Lake Bloomington had a drainage area of 61 mi^2 and an average annual sedimentation rate of 0.5 ac-ft / mi^2 during the observed period of 26 years from 1929 to 1955. Lake Decatur had a drainage area of 906 mi^2 and an average annual sedimentation rate of 0.18 ac-ft / mi^2 during the observed period of 44 years from 1922 to 1966. Lake Springfield had a drainage area of 265 mi^2 and an average annual sedimentation rate of 0.53 ac-ft / mi^2 during the observed period of 31 years from 1934 to 1965 (CPS, 1982).

In 1972, Illinois Power Company established five surface water sampling locations at the site of Clinton Lake. The water quality data at the sampling locations are discussed in Section 2.3.3. The average turbidity observed was estimated to contribute an average rate of sedimentation of less than 0.5 ac-ft / mi^2 per year (CPS, 1982).

On the basis of the studies and turbidity observations, a sedimentation rate of 0.5 ac-ft / mi^2 per year was used in the lake sedimentation analysis (CPS, 1982). The results of the sediment studies are summarized in Table 2.3-8.

With the lake impoundment completed in 1978, the sediment deposition to date (2003, a 25-yr period) is estimated to be 3,710 ac-ft or 5.0 percent of the initial lake volume at normal pool. Extending the sedimentation relationship out to 30 years and 60 years from dam construction results in 4,450 ac-ft and 8,880 ac-ft of sediment accumulation or 6.0 percent and 12.0 percent, respectively, of the initial lake volume at normal pool. A summary of the capacities and depths in the lake before and after deposition of sediments for a period of 60 years is presented in Table 2.3-9. Recently, the IDNR has identified shore erosion as a significant source of sediment to the lake. The cause is attributed to wind and wave action from recreational boating that has prevented aquatic vegetation from becoming established along the lake shore. The expansion of programs and work to minimize shoreline erosion, establish aquatic vegetation beds, and reduce agricultural runoff and siltation were identified as priorities in the lake management plan that is an addendum to the December 16, 2002 lease agreement with IDNR (IDNR, 2002).

Sediment distribution in Clinton Lake was analyzed for a period of 50 years using the *Empirical Area - Reduction Method*. Figure 2.3-10 presents the reduction in lake surface area and capacity. Previously deposited sediments in the upper reaches of the lake are expected to move toward the lower reaches during severe floods due to the steep gradients of the streambed. The average bed gradient of Salt Creek is 1 in 2,100 (2.5 ft / mi). However, the upper reaches of Salt Creek, between Iron Bridge and the bridge on U.S. Highway 150, have a very steep gradient of 1 in 670 (7.9 ft / mi). The average bed gradient of North Fork of Salt Creek is 1 in 1,140 (4.6 ft / mi) (CPS, 1982).

The effect of flood levels after 50 years of sedimentation in the lake was also analyzed. Backwater computations indicate that there has been no appreciable rise of lake level in the upper reaches of the reservoir due to sediment deposition (CPS, 1982).

2.3.1.2.1.5 Lake Temperature

Table 2.3-10 provides a representative sample of the natural surface temperatures expected from the cooling lake in the absence of a power plant. These values were computed using the LAKET computer program developed by Sargent & Lundy.

2.3.3 Water Quality

This section describes the water quality conditions in the surface water and groundwater that may potentially affect, or be affected by the construction or operation of the EGC ESP Facility. The potential construction or operational impacts on water quality are discussed in Chapters 4 and 5, respectively.

2.3.3.1 Freshwater Streams

The water quality of Salt Creek was monitored by the ISWS at the Rowell gauging station, 12-mi downstream of the Clinton Lake Dam, from 1950 to 1956. Water quality sampling for Salt Creek at Rowell was resumed with measurements beginning in 1964 through 1997. Water quality information is also available, beginning in 1972 (prior to construction of the dam), at five other sampling locations established by Illinois Power Company on Salt Creek and North Fork of Salt Creek in the vicinity of the then proposed Clinton Lake. The sampling procedure and the water quality analyses are discussed in the CPS ER, Chapter 2, Section 6.1.1 (CPS, 1982). Detailed summer maximum, minimum, and average temperatures were also measured between 1994 and 2000 at a point on Salt Creek 100-ft downstream of the Clinton Lake Dam (CPS, 1994, 1995, 1996, 1997, 1998, 2000, and 2001a).

Stream water quality data were evaluated for two time periods:

- Postdam and preoperational period (1978 through 1986 after filling of the lake and before the operation of the CPS); and
- Postdam and operational period (1987 to present).

The postdam and preoperational period consists of a nine-year period of time following the construction of the dam and before the operation of the CPS.

Temperature, suspended solids, and phosphorus were evaluated for the three time periods. Figure 2.3-11 shows the temperature plot measured at the Rowell gauging station. Generally there is little change from one period to the next. The dominant summer high temperature during the three periods is generally in the 85 degrees Fahrenheit (°F) range. The dominant low winter temperature is 32°F. Even the transition between preoperation and postoperation of the power plant shows similar temperature values.

Water temperature was also monitored at a point 100-ft downstream of the dam (National Pollutant Discharge Elimination System [NPDES] Permit Order 92-142) during CPS operation. These data were compared to water temperature measured at Rowell gauging station during the same time period. A comparison of stream temperatures measured 100-ft downstream of the dam and at Rowell gauging station for June, July, and August of 1994, 1995, and 1996 are presented in Figure 2.3-20, Figure 2.3-21, and Figure 2.3-22.

Values for suspended solids measured as turbidity at the Rowell gauging station are presented on Figure 2.3-23. Postdam high turbidity values generally range from 30 to 120 Nephelometric Turbidity Units. The transition between before operation of CPS and postoperation at CPS indicates unremarkable changes in turbidity.

Values for phosphorus at the Rowell gauging station are presented on Figure 2.3-24. Recorded postdam values indicate relatively low phosphorus levels generally less than

General groundwater chemistry of the Glasford sand and gravel aquifer, within the Illinoian deposits of southwest McLean and southeast Tazewell counties, has been summarized by the ISWS (Herzog, et al., 1995) and is provided in Table 2.3-22.

2.3.3.3.3 Kansan Outwash in Buried Mahomet Bedrock Valley Aquifer

The Mahomet Bedrock Valley aquifer is one of the most highly productive, nonalluvial sand and gravel aquifers in southern Illinois (Kempton et. al., 1991). In 1974, a test well drilled to total depth of 358 ft was installed about 1 mi from the site in order to establish the groundwater quality of the buried Mahomet Bedrock Valley aquifer. Analytical data for that test well are summarized in Table 2.3-23. The analytical results for the groundwater from the test well were relatively consistent with regional levels measured in the Illinoian and Kansan aquifers (see Table 2.3-21). Burnable gas was detected in the groundwater during pumping of the test well. Results of two gas analyses indicated that methane comprised more than 80 percent of the total gas sample. This volume of gas is similar to that reported for other gas producing water wells in DeWitt County (CPS, 1982).

Regional water quality data from DeWitt County, collected as part of the Mahomet Aquifer Study being conducted by the ISWS, and for the Sankoty-Mahomet Sand aquifer of southwest McLean and southeast Tazewell counties (Herzog et al., 1995) are presented in Table 2.3-24 and Table 2.3-25, respectively. The groundwater quality of the Mahomet Aquifer in DeWitt County falls in the middle of the range observed regionally for this aquifer (see Table 2.3-21 and Table 2.3-25). The total dissolved solid, hardness, and calcium concentrations in the water samples from the Mahomet Bedrock Valley aquifer in DeWitt County are not indicative of the highly mineralized water that have been observed at depth in some areas (see Table 2.3-25).

2.3.3.3.4 Pennsylvanian Bedrock Aquifer

Pronounced increases in the concentrations of dissolved solids due to increased sodium and chloride occur with depth in these deposits. However, the water can be somewhat softened by ion exchange between the water and minerals in the shales and clays. Water yielding sandstone and limestone are thin and interlayered with low permeability deposits of shale and coal. Water from the freshwater parts of the Pennsylvanian aquifers is moderately hard and of a sodium bicarbonate type with a median dissolved solids concentration greater than 500 mg/L (USGS, 1995).

2.3.3.3.5 Mississippian Bedrock Aquifer

The USGS summarized chemical analyses of water from this aquifer with the exception of Greene County, Indiana, on the eastern side of the Illinois Basin. The water is moderately hard and is a sodium calcium bicarbonate type. The TDS concentrations typically increase as the depth of the well increases. Mississippian-aged rocks in this part of Illinois typically contain water with dissolved solids concentrations of greater than 1,000 mg/L (USGS, 1995).

2.3.3.3.6 Silurian-Devonian Bedrock Aquifer

The USGS indicates that concentrations of dissolved solids and iron exceed secondary maximum contaminant levels established by the USEPA in more than 50 percent of the studied samples. The water is also hard, and sulfate concentrations exceed 250 mg/L in many samples (USGS, 1995).

2.5 Socioeconomics

The socioeconomic characteristics of the site, vicinity, and region are discussed in this section. Socioeconomic characteristics include:

- Population information;
- Community characteristics;
- Historical property information; and
- Environmental justice.

2.5.1 Demography

This section discusses population within the vicinity and region, projected populations for the vicinity and region, transient and migratory population, and demographic characteristics, which include sex, race, age, and income. Data on population were gathered using U.S. Census Bureau 2000 data (U.S. Census Bureau, 2001). Projected population was determined based upon projection data provided by Illinois State University (ISU) (ISU, 2002).

2.5.1.1 Population Within 16 km (10 mi)

The 2000 total residential population within 16 km (10 mi) of the site is 12,358 (U.S. Census Bureau, 2001). Figure 2.5-1 depicts the population groupings (i.e., towns and cities) within 16 km (10 mi) of the site. Figure 2.5-1 also includes 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 2.5-1 presents the population and transient population within the sectors depicted in Figure 2.5-1. The table indicates that the majority of the population lives in the west sector, 10 km to 16 km (6.2 mi to 10 mi) from the site. The west sector includes the City of Clinton, which has a population of over 7,000. 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 mi^2. Comparatively, suburban communities around Springfield have a population density of 500 to 2,500 people per mi^2 in previous sections (U.S. Census Bureau, 2001). A GIS system, in conjunction with the U.S. Census Bureau data from 2000, was used to determine the population by sector. Data were 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 assumed that the 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.

In order to determine the total 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 judgement, 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 business were estimated to have three or less employees, for a total of 390 (Clinton Chamber of Commerce [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 judgement, it were assumed that one person occupied each room on any given day.
- Recreation Areas – Data were obtained from the IDNR on the number of visitors to state parks including Clinton Lake State Recreation Area. These visitors were considered transients. Data were 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 were obtained from the CCC on the attendees at the annual Apple and Pork Festival 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, see Table 2.5-1.
- Migrant Workers – Based on average statewide statistics on the percentage of migrant farmers supplied by the Illinois Agricultural Statistics Service (IASS), 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 were obtained by the county from the Bureau of Economic Analysis (USDOC, 2002). The migrant workers were considered transients.

Table 2.5-2 presents population projections for the facility starting with 2010, and for 10-yr increments up to 60 years from the latest decennial census (i.e., 2060). The ISU provided population projections for 2010 and 2020 for each county (ISU, 2002). Based on these data, the expected population change rates (percent change) between 2000 and 2010 and between 2010 and 2020 was 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.

2.5.1.2 Population Between 16 km and 80 km (10 mi 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 live outside of a 40-km (25-mi) radius from the site (U.S. Census Bureau, 2001). Figure 2.5-2 indicates the location of communities and cities within 80 km (50 mi) of the site, as well as a 16- to 80-km (0- to 50-mi) sector chart, which is used as a key for the population distribution tables described below.

Table 2.5-3 presents the population within the sectors depicted in Figure 2.5-2. The most heavily populated sector within 16 km and 80 km (10 mi 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 2000 population of 67,518 and 36,395, respectively. The northeast sector has the lowest population. The average population density within 80 km (50 mi) of the site is 97 people per mi^2. The area between 40 and 60 km (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 mi^2 (U.S. Census Bureau, 2001). A GIS system, in conjunction with U.S. Census Bureau data, as described in Section 2.5.1.1, was used to determine the population by sector.

In order to determine the total transient population, the following categories of transient population were estimated:

- Seasonal Population – The same methodology was used that is described in Section 2.5.1.1.
- 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 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-km to 80-km (10-mi to 50-mi radius). It was then assumed, based on data collected for the 0-16 km radius and surveys of selected hotels and motels within the 80-km 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 were obtained from the IDNR on the number of visitors to state parks, which were then used to estimate transient population. Visitors to local 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 the area encompassed by a 80-km (50-mi) radius.
- Migrant Workers – The same methodology was used that is described in Section 2.5.1.1.

Table 2.5-4 presents population projections for the region starting with 2010, and for 10-yr increments up to 60 years from the latest decennial census (i.e., 2060). The methodology used to forecast the population in the 16- to 80-km (10- to 50-mi) radius is the same that was used for the 0- to 16-km (0- to 10-mi) radius, see Section 2.5.1.1.

2.5.1.3 Demographic Characteristics of the Population Within 80 km (50 mi)

Demographic characteristics were prepared for the low population zone (the area within a 2.5-mi radius centered on the EGC ESP Facility footprint), the emergency planning zone (EPZ) (the area within approximately a 10-mi radius of the EGC ESP Site), and the region (the area within a 50-mi radius of the EGC ESP Site).

2.5.1.3.1 Age and Sex Distribution of Population

A summary of age and sex distribution by low population zone, EPZ, and region is shown in Table 2.5-5. In general, the population within the region of the site has the same or a greater percentage of adults than the national average (U.S. Census Bureau, 2001). In addition, the male and female population within a 50-mi radius of the site is about equal (U.S. Census Bureau, 2001).

2.5.1.3.2 Racial and Ethnic Distribution

A summary of racial and ethnic distribution by low population zone, EPZ, and region is shown in Table 2.5-6. Minority populations include people who identified themselves in the U.S. Census as African-American, Asian, Hawaiian, Hispanic, Native American, other, or having two or more races.

Within the low population zone, the minority population is 4.3 percent. Within the EPZ, the minority population is 3.6 percent. Within the region, the minority population is 13 percent (U.S. Census Bureau, 2001). The national average for minority population is 37 percent. Therefore, minority population in the region is well below the national average.

2.5.1.3.3 Income Distribution

Within the low population zone, 3.4 percent of the population had a 1999 income below the poverty level. Within the EPZ, 8 percent of the population had a 1999 income below the poverty level. Within the region, 10 percent of the population had a 1999 income below the poverty level (U.S. Census Bureau, 2001 and 2002b). The national average of population below the poverty level is 11.3 percent (U.S. Census Bureau, 2001a). Other income distributions for the exclusion area, low population zone, EPZ, and region is provided in Table 2.5-7.

Clinton Lake State Recreation Area comprises 9,300 ac of land and is managed by the IDNR. This recreation area is used year-round and offers snowmobiling, ice-fishing, ice-skating, boating, fishing, water-skiing, picnicking, camping, swimming, hiking, and hunting (IDNR, 2002). Clinton Lake State Recreation Area is less than 1 mi from the site.

Weldon Springs State Recreation Area is also managed by the IDNR, and is located 5.5-mi southwest of the site. This 370-ac park offers fishing, picnicking, boating, and hiking during the summer, and sledding, tobogganing, ice-fishing, and cross-country skiing during the winter (IDNR, 2002).

Allerton Park is a 1,517-ac park located approximately 20-mi southeast of the site. The park offers formal gardens, outdoor sculpture parks, and nature trails. The park also contains a Georgian manor house formerly owned by Robert Allerton, who donated the land and house to the University of Illinois (University of Illinois, 2003).

Eagle Creek Recreation Area / Wolf Creek State Park encompasses 11,100 ac of water with 250 mi of shoreline, which is managed by the IDNR. This recreation area offers camping, hiking, horseback riding, snowmobiling, fishing, water-skiing, pontoon boating, and windsurfing (IDNR, 2002). This area is 45-mi south of the site.

Edward R. Madigan State Fish and Wildlife Park is located west of the site, and comprises 723 ac of land. Activities include picnicking, fishing, canoeing, hiking, and hunting. This park is the home of the largest sycamore tree in Illinois, and is located 29-mi west of the site (IDNR, 2002).

Lincoln Trail Homestead is the site of Abraham Lincoln's first home, and is located 29-mi south-southwest of the site. The site comprises 162 ac of land. A memorial commemorating the beginning of Lincoln's life is present on the property. Activities available include camping, fishing, hiking, and picnicking (IDNR, 2002).

Moraine View State Recreation Area encompasses 1,687 ac of land with a 158-ac lake. This area offers many different activities including boating, camping, fishing, hiking, horseback riding, hunting, picnicking, swimming, snowmobiling, and other winter sports (IDNR, 2002). Moraine View State Recreation Area is located 16-mi north-northeast of the site.

Sangchris Lake State Recreation Area is located east of Springfield, Illinois, and is 48-mi southwest of the site. There is a total of 3,022 ac of land with 120 mi of shoreline available for boating, camping, fishing, hiking, hunting, and picnicking. There is also a dog training area for seasonal use. The park is closed in the winter (IDNR, 2002).

Shelbyville State Fish and Wildlife Area is 37-mi south of the site and contains over 6,000 ac of mixed habitat land with a 39,000-ac lake, Lake Shelbyville. This area offers some of the best hunting, river fishing, and nature study opportunities in the state. However, no camping, picnicking, or day use facilities are available due to hunting activities (IDNR, 2002).

Spitler Woods State Natural Area is southeast of Decatur, Illinois, and is located 27-mi south of the site. This park offers 202 ac of land for camping, picnicking, and hiking. It also includes a large nature preserve (IDNR, 2002).

Figure 2.2-8 presents the location of the parks and recreation areas within the region.

2.5.2.7 Public Services and Facilities

Public services and facilities consist of schools, public utilities, police and fire departments, hospitals, and churches. They are typically located within municipal boundaries and near population centers. Schools are described in Section 2.5.2.5. The remaining services are described below.

Public utilities include facilities for distributing energy, such as electricity and natural gas, as well as water supplies and wastewater treatment plants (WWTP). In the vicinity of the site, drinking water in DeWitt County is primarily obtained from groundwater extracted from wells, with only a small number of residents that have private well systems. The Clinton Sanitary District Sewage Treatment Plant serves the wastewater needs of the City of Clinton. In the region, rural communities generally have private well water and septic systems. Larger communities in the region obtain water from public groundwater extraction wells, and are served by public sewer systems. Figure 2.5-5 shows the locations of public water supply sources, and also water and wastewater treatment plants in the region. A survey was performed for water and water facilities in the region, and the facilities have excess capacity to accommodate a potential increase in population in the region.

Within the vicinity, there is one fire department and two police departments that serve the City of Clinton. In the region, there are 89 fire departments and 75 police departments. Outside of the four regional centers (Bloomington-Normal, Champaign-Urbana, Decatur, and Springfield), communities typically share fire fighting services. Figure 2.5-6 presents the locations of fire protection and law enforcement locations within the region.

In the vicinity, there are two nursing homes and one hospital serving the City of Clinton. In the region, there are 52 hospitals and 84 nursing homes. Figure 2.5-7 presents the locations of hospitals and nursing homes within the region.

The projected capacity of public services is adequate and is expected to expand modestly to meet the demands of a slight population growth in the region.

2.5.2.8 Transportation Facilities

The EGC ESP Site is located close to major road and RR transportation systems that support the CPS. IL Route 54 serves the entrance to the existing facility site. This two-lane roadway is a rural highway with sufficient capacity to serve future traffic related to the construction and operation of the EGC ESP Site. Additionally, IL Route 10 is an east-west highway (2-lane), located south of the EGC ESP Site. Both IL Route 54 and IL Route 10 have continuity through the area and connect to an interstate highway to the east and the west. Although traffic is typical of low volume rural highways, weekend recreational use does result in traffic volume increases. U.S. Highway 51, a major north-south route, is located about 5-mi west of the site. This 4-lane divided highway is relatively low volume, with sufficient capacity to accommodate future traffic. U.S. Highway 51 connects to Interstate 74 about 20-mi north of the site and connects to Interstate 72 about 20-mi south of the site. IL Route 54 also connects to Interstate 74 about 12-mi east of the site. Figure 2.2-3 and Figure 2.2-6 show the vicinity and regional transportation network. Public transit systems, such as bus or rail, are not available within the vicinity of the site.

The EGC ESP Site falls within IDOT's District 5. According to the *FY 2002-2006 Proposed Highway Improvement Program*, approximately 438 million dollars are budgeted for road

The scope of the review includes an analysis of impacts on low income and minority populations, the location and significance of any environmental impact during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation.

U.S. Census Bureau data from 2000 were used to accurately identify low income or minority populations in the region, information on racial, ethnic, and income population characteristics. Based on environmental justice guidelines, each census block within the region (community of comparison) was examined for racial composition and median household income in comparison to the potential impact area as a whole.

2.5.4.1 Racial, Ethnic, and Special Groups

According to the U.S. Census Bureau data from 2000, 97.1 percent of DeWitt County is white, 0.5 percent is African American, 0.2 percent is American Indian, 1.3 percent is of Hispanic origin, and 0.9 percent is classified as other races. Figure 2.5-8 identifies the minority populations in the region (U.S. Census Bureau, 2002b).

As stated in Section 2.5.2.3, the only special group within the region is an Amish community located around the towns of Arthur and Arcola, which are 37-mi and 44-mi southeast of the site, respectively. The U.S. Census Bureau does not track and consider the Amish separately. The Amish tend to be fairly homogeneous, largely white, and not dominated by a particular ethnic group. According to the Town of Arthur's website, the Amish population is about 3,500 (Town of Arthur, 2002). According to the Town of Arcola's website, the Amish population is about 4,200 (Town of Arcola, 2002).

2.5.4.2 Income Characteristics

A block census evaluation of household income was performed to identify low income populations, as defined by the Department of Health and Human Services.[1] Within the vicinity, 8 percent of the population had a 1999 income below the poverty level. Within the region, 10 percent of the population had a 1999 income below the poverty level. In DeWitt County, 8 percent of the population is considered low income. For perspective, the national average of low income population is 11.3 percent (U.S. Census Bureau, 2001a). Figure 2.5-9 shows the population below the poverty level within each census block (U.S. Census Bureau, 2001 and 2001a).

[1] The Department of Health and Human Services defines "low income" as those residents living below the defined poverty guideline; the U.S. Census Bureau defines families whose income falls below the poverty threshold as "poor." (See www.census.gov for more information.) For a family of four, the poverty thres hold for the year 2001 is $17,960.

2.7 Meteorology and Air Quality

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. In addition, this section documents the range of meteorological conditions that will exist during the construction and operation of the proposed facility. The information contained in this section is also used to establish the range of conditions that are considered in the design of the facility. A climatological summary of normal and extreme values of several meteorological parameters is presented for the "first order" National Weather Service (NWS) Stations in Peoria, Illinois and Springfield, Illinois. Further information regarding regional climatology was derived from pertinent documents, which are referenced in the text.

2.7.1 General Climate

2.7.1.1 General Description

The EGC ESP Site is located near the geographical center of Illinois, approximately 55-mi southeast of the NWS Station in Peoria, and 49-mi east-northeast of the NWS Station in Springfield. 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-hr period, midnight to midnight.

General climatological data for the region surrounding the site area were 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 observation 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, 1992), 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 the central Illinois climate is due to its location in a confluence zone, particularly during the cooler months, between different air masses. The air masses that 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 in the 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

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

	2-yr	5-yr	10-yr	20-yr	30-yr	50-yr
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

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

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 a 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 yrs. Statewide statistics indicate that during the 61-yr period from 1900-1960, there were 92 recorded glaze storms defined either by the occurrence of glaze damage or by the 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 yr is six (1951); in 2 yrs is nine (1950-1951); in 3 yrs is ten (1950-1952); and in 5 yrs is 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 it disappeared after 3 to 5 days; in eight storms it disappeared after 6 to 8 days; in four storms it disappeared after 9 to 11 days; and in three storms it disappeared after 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-yr 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 2.7-5. The list reveals that severe glaze storms that deposit ice of moderate to large radial thickness may occur in any part of Illinois. An average of one storm every 3 yrs 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. Moderate wind speeds (10 to 24 mph) occurring after glaze storms are most prevalent, although wind speeds greater than 25 mph are not unusual. Observations of 5-minute winds in excess of 40 mph with a glaze thickness of 0.25 in. or more have been reported by Changnon (1969). Table 2.7-6 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. 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 has been 5-minute winds in excess of 40 mph with a glaze thickness of 0.25 in. or more (Changnon, 1969). Table 2.7-6 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.

The 100-yr return period snowpack, as obtained from the American Society of Civil Engineers (ASCE) building code requirements (ASCE, 2000), is 24.4 pounds per square foot (psf), which corresponds to approximately 24 in. of snowpack.

The weight of the accumulation of winter precipitation from a single storm is 15.6 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 yrs. The maximum recorded monthly snowfall in the area is 26.5 in. (Peoria, February of 1900), 24.4 in. (Springfield, February of 1900), and 30.5 in. (Decatur, March of 1906). The maximum of 30.5 in. translates to the equivalent of about 3 in. 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 that could have occurred (based on actual observations) after a worst case winter storm event is calculated to be 40 psf (i.e., 24.4 psf + 15.6 psf).

2.7.3.4 Hurricanes

The site area has never been affected by tropical cyclones or hurricanes.

2.7.3.5 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 (Hosler, 1961 and Holzworth, 1972). The seasonal frequencies of inversions based below 500 ft for the general area of the EGC ESP Site are shown in Table 2.7-7.

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 provided by Holzworth and presented in Table 2.7-8. In general, when daytime (maximum) mixing depths are shallow (i.e., 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-yr period of 1960-1964, the region, including the EGC ESP Site, did not experience any episodes of 2 days or longer with mixing depths less than 500 meters (m) and winds less than 2 meters per second (mps). There were two episodes with winds remaining less than 4 mps. For mixing heights less than 1,000 m and winds less than 4 mps, there were approximately nine episodes in the 5-yr period that lasted 2 days or more.

2.7.7.2 Calculations

The calculations were made using the MIDAS© suite of software programs that is licensed and installed at the CPS (CPS, 2002). 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 hrs.

The calculations of Chi/Q and D/Q were made by program XDCALC using hourly on-site meteorological data. Hourly meteorological data were obtained using the 15-minute 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: January 1, 2000 to August 31, 2002
- Wind Reference Level: 10 m
- Stability Calculation: Delta temperature (10-m 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 2.7-53 to represent undepleted Chi/Q calculations from the EGC ESP Facility. Table 2.7-54 represents Chi/Q calculations that account for deposition effects. Table 2.7-55 contains estimates that include radioactive decay with an overall half-life of 2.26 days for short-lived noble gases. Table 2.7-56 contains estimates that include an 8-day half-life for iodines released to the atmosphere.

CHAPTER 2

Tables

TABLE 2.2-1
Land Use in the Site and Vicinity

USGS Land Use Classification	Percent of Site Area	Area within Site (ac)	Percent of Vicinity Area	Area within Vicinity (ac)
Recreation	0%	0	16.6%	12,076
Agricultural	0%	0	82.1%	59,870
Industrial	100%	461	0.7%	512
Residential	0%	0	0.7%	512

Source: USGS, 1992

Note: Entire area within site boundary is zoned industrial. Actual land cover within the site boundary varies.

TABLE 2.2-2
Land Use within the Transmission Corridors

USGS Land Use Classification	Percent of Region Area	Area within Region (ac)
Recreation	10.7%	101
Agricultural	88.2%	836
Industrial	1.1%	10
Residential	0%	0

Source: USGS, 1992

TABLE 2.2-3
Land Use in the Region

USGS Land Use Classification	Percent of Region Area	Area within Region (ac)
Recreation	5.4%	269,258
Agricultural	92.5%	4,580,167
Industrial	0.6%	27,530
Residential	1.5%	71,843

Source: USGS, 1992

TABLE 2.3-7
Standard Dam Operating Procedures

Lake Elevation	Gate (12 in x 12 in @ 686 ft)	Gate (12 in x 12 in @ 684 ft)	Gate (24 in x 36 in @ 650.88 ft)
> 687	Open	Closed	Closed
685 – 687	Open	Open	Closed
≤ 685 (Drought condition)	Open	Open	Open with Management Approval

Source: IDOT, 1984

Notes: Operational activities will be performed by CPS Personnel. Gates will be opened and/or closed by use of a manual crank. Operator activities are based on lake level elevation; therefore, as a result of "periodic surveillance" when the lake level approaches 687 ft the Nuclear Station Engineering Department will notify CPS staff of the need to initiate operator involvement.

TABLE 2.3-8
Summary of Lake Sediment Studies

Location	Duration	Volume of Sediment
Salt Creek near Rowell	1950-1956	0.10 ac-ft/yr/mi^2
85 reservoirs in Illinois	---[a]	0.40 ac-ft/yr/mi^2
Lake Bloomington (61 mi^2)	1929-1955	0.50 ac-ft/yr/mi^2
Lake Decatur (906 mi^2)	1922-1966	0.18 ac-ft/yr/mi^2
Lake Springfield (265 mi^2)	1934-1965	0.53 ac-ft/yr/mi^2
Five surface water sampling locations on Salt Creek	1972	<0.50 ac-ft/yr/mi^2

Source: CPS, 1982

[a] Data not available

TABLE 2.3-11
Measured Temperatures 100 ft Below the Clinton Lake Dam (1994-2000)

	Temperature (°F)					
Year	**June**		**July**		**August**	
	Day 1	**Day 15**	**Day 1**	**Day 15**	**Day 1**	**Day 15**
1994	72.7	76.4	79.9	79.6	79.6	76.2
1995	69.8	73.8	78.2	85.5	81.3	86.3
1996	68.4	78	83.8	78	78.9	80.1
1997	62	68.4	78.5	79	78.5	76.3
1998	71.8	71.4	79	81.6	80.1	---[a]
1999	69.9	77.8	78.6	80.2	83.5	78.9
2000	70.4	73.5	78.1	83.8	80.7	80.1

Source: CPS 1994, 1995, 1996, 1997, 1998, 2000, 2001a

[a] Data not available

TABLE 2.3-12
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 discon-tinuous 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, 1995

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 2.5-6
Racial and Ethnic Distribution within the Region

	African-American	Asian	Hawaiian	Hispanic	Native American	Caucasian	Other	Two or More Races
Low Population Zone 2.5-mi radius	0%	0.35%	0%	0%	0.67%	95.74%	0.64%	2.61%
Emergency Planning Zone 10-mi radius	0.59%	0.35%	0.02%	1.52%	0.22%	96.40%	0.15%	0.74%
Region 50-mi radius	7.75%	2.15%	0.02%	1.84%	0.17%	86.86%	0.10%	1.10%

Source: U.S. Census Bureau, 2002b

TABLE 2.5-9
Major Employers (Employers with 500 Employees or Greater)

Employer	City	Employees
Agricultural		
A.E. Staley Manufacturing Co.	Decatur	720
Archer Daniels Midland	Decatur	3,300
Grain Systems Inc.	Taylorville	850
Distribution		
Hobbico	Champaign	700
Supervalu	Urbana	625
Education		
Bloomington School District 87	Bloomington	708
Champaign School District	Champaign	1,305
Decatur Public Schools	Decatur	1,325
Illinois Central College	East Peoria	1,400
Illinois State University	Normal	3,400
Illinois Wesleyan University	Bloomington	550
Millikin University	Decatur	590
Normal School Unit 5	Normal	1,343
Parkland College	Champaign	1,200
SIU School of Medicine	Springfield	1,200
Springfield School District 186	Springfield	2,112
University of Illinois	Urbana	20,571
Urbana School District	Urbana	887
Government		
City of Decatur	Decatur	583
City of Springfield	Springfield	1,707
Federal Bureau of Prisons	Pekin	3,130
Illinois National Guard	Springfield	2,700
McLean County Government	Bloomington	942
Pontiac Correctional Center	Pontiac	800
State of Illinois	Springfield	21,600
Health Care		
BroMenn	Normal	1,860
Carle Clinic	Urbana	2,918

TABLE 2.5-9
Major Employers (Employers with 500 Employees or Greater)

Employer	City	Employees
Carle Foundation	Urbana	2,100
Christie Clinic Association	Champaign	800
Decatur Memorial Hospital	Decatur	2,200
Memorial Health Systems	Springfield	3,500
OSF/St. Joseph Medical Center	Bloomington	1,000
Pekin Memorial Hospital	Pekin	680
Provena Covenant	Urbana	1,200
Springfield Clinic	Springfield	1,100
St. John’s Hospital	Springfield	3,588
St. Mary’s Hospital	Decatur	1,200
Manufacturing		
Bell Sports/Bell Racing	Rantoul	561
Bridgestone/Firestone	Normal	575
Caradco	Rantoul	510
Caterpillar, Inc.	Decatur	2,000
Caterpillar	Morton	1,800
Caterpillar, Inc.	Pontiac	1,170
Caterpillar Tractor – Earth	East Peoria	4,000
Eagle Wings Ind.	Rantoul	513
Eaton Cutler Hammer	Lincoln	625
Interlake, Inc.	Pontiac	530
Kraft Foods	Champaign	1,300
Mitsubishi Motor Manufacturing of America	Normal	3,200
Morton Metalcraft – Sheet	Morton	950
Nestle USA	Bloomington	625
Plastipak Packaging Inc.	Champaign	600
Solo Cup	Urbana	700
Textron Auto Co, Rantoul Products	Rantoul	1,211
Verizon	Bloomington	750
Retail		
Meijer	Champaign	584
Walmart	East Peoria	500

TABLE 2.5-9
Major Employers (Employers with 500 Employees or Greater)

Employer	City	Employees
Services		
Anderson Financial Network	Bloomington	1,118
Boyd Gaming	East Peoria	1,100
Country Companies Insurance	Bloomington	2,118
Horace Mann Insurance Company	Springfield	1,310
Lincoln Developmental Center	Lincoln	683
Pekin Insurance	Pekin	650
R.R. Donnelley and Sons, Inc.	Pontiac	710
Roman Catholic Diocese	Springfield	1,600
State Farm Insurance	Bloomington-Normal	15,889
Transportation		
G & D Transportation – Trucking	Morton	755
Norfolk Southern Corp.	Decatur	600
Star Transport	Morton	1,150
Utilities		
Illinois Power Company	Decatur	1,250

Source: IDCCA, 2002

Notes: Last updated 6/2001 for Bloomington, 3/2002 for Champaign, 3/2002 for Decatur, 10/2001 for East Peoria, 9/2001 for Lincoln, 3/2001 for Morton, 6/2001 for Normal, 8/2001 for Pekin, 5/2001 for Pontiac, 8/2001 for Rantoul, 6/2002 for Springfield, 2/2001 for Taylorville, 3/2002 for Urbana, and 12/2001 for Washington.

TABLE 2.7-15
Summary of 10-m Dew Point Measurements at Clinton Power Station Facility (1972-1977)

	Average Daily	Average Daily Maximum	Average Daily Minimum	Absolute Maximum	Absolute Minimum
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	25.0	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 2.7-19
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	.5	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 2.7-23

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at Clinton Power Station Facility

Wind Level: 10 m (33 ft)

Stability Category: B (Delta Temperature Range = -1.8 to -1.7°C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (mps)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
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	1,455
(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) 1,456 hrs on this page, with 1 hr (0.1 percent) at less than 0.3 mps (0.0 percent of all hours).

TABLE 2.7-25

Joint Frequency Distribution of Wind Speed, Wind Direction, and Atmospheric Stability at Clinton Power Station Facility

Wind Level: 10 m (33 ft)

Stability Category: D (Delta Temperature Range = -1.4 to -0.5°C per 100 m)

Period of Record: 4/14/72-4/30/77

	Direction (3)																
Speed (mps)	**NNE**	**NE**	**ENE**	**E**	**ESE**	**SE**	**SSE**	**S**	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**N**	**Total**
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	32.694
(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 mps (0.0 percent of all hours).

TABLE 2.7-53
Long-Term Average Chi/Q (sec/m^3) Calculations for Routine Releases

	Actual Site Boundary		Exclusion Area Boundary		Low Population Zone		Nearest Cow Milk		Nearest Goat Milk		Nearest Garden	
Downwind Sector	**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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	8.42E-08
All		8.694E-06		2.436E-05		3.146E-06		4.479E-06		1.206E-06		4.168E-06

- Preparation of the site for construction of the facility (such as clearing, grading, and construction of temporary access roads and borrow areas).
- Installation of temporary construction support facilities (such as warehouse and shop facilities, utilities, concrete mixing facilities, docking and unloading facilities, and construction support buildings).
- Excavation for facility structures.
- Construction of service facilities (such as roadways, paving, RR spurs, fencing, exterior utility and lighting systems, transmission lines, and sanitary sewage treatment facilities).
- Construction of structures, systems, and components, which do not prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public.
- Drilling of sample/monitoring wells or additional geophysical borings.
- Construction of facility cooling tower structure(s) that are not safety-related.
- Construction of facility intake structures that are not safety-related.
- Installation of non-safety-related fire detection and protection equipment.
- Expansion of the CPS switchyard to accommodate the construction of the proposed EGC ESP Facility.
- Expansion of the CPS transmission system and substation (will not be performed by EGC).
- Modification of the CPS discharge flume to accommodate the EGC ESP Facility outflow (will not be performed by EGC and modification to the CPS NPDES permit may be required).

3.1.3 Station Layout and Appearance

The EGC ESP Facility will be a large industrial facility similar in general appearance to the CPS. The EGC ESP Facility may consist of a single reactor (unit) or multiple reactors (modules). As stated in the introduction, the EGC ESP Facility will be essentially independent of the CPS. With the exception of using the CPS UHS as a source of makeup water, no CPS safety-related systems or equipment will be shared or cross-connected. Clinton Lake will be used as a source of makeup water for the cooling water system. The CPS discharge flume will also be used for the EGC ESP Facility. Additional facilities, such as offices, a water intake structure, non-safety-related cooling tower structure(s), a security building, and miscellaneous storage buildings will also be constructed (see Figure 2.1-4). The structures will be made of concrete, wood, and wood with metal siding. In addition, it will be made at a maximum height of approximately 234-ft above grade. Some structures, such as warehouse and training buildings and parking lots, may be shared with the CPS. Some support facilities, such as domestic water supply and sewage treatment, may also be shared.

The total amount of anticipated discharges from the chemical waste treatment system and plant drains to Clinton Lake is presented in Table 3.6-3 and was obtained from Table 1.4-1 of the SSAR.

Plant stormwater drainage control systems will be presented at the COL phase. Erosion and sedimentation controls for preconstruction and construction activities are discussed in Section 4.6.

3.6.3.2 Gaseous Effluents

Bounding estimates of other gaseous effluents and the total quantity of sulfur oxides (SO_x), nitrogen oxides (NO_x), hydrocarbons, and suspended particulates to be discharged annually during station operations (e.g., from diesel engines, gas-turbines, heating facilities), and elevation of the release points are provided in Table 3.6-4 and Table 3.6-5. These estimates were obtained from Tables 1.4-1, 1.4-6, 1.4-7, and 1.4-8 of the SSAR.

3.8.2.3 Table S-4 Conditions

As discussed previously, 10 CFR 51.52(a) lists several conditions that need to be addressed by the new reactor technologies for the use of Table S-4. These conditions are reactor core thermal power; fuel form; fuel enrichment; fuel encapsulation; average fuel irradiation; time after discharge of irradiated fuel before shipment; mode of transport for unirradiated fuel; mode of transport for irradiated fuel; and mode of transport for radioactive waste other than irradiated fuel. Two other conditions in S-4 require that radioactive waste, with the exception of irradiated fuel, be packaged and in solid form.

10 CFR 51.52(a)(1) requires that the reactor have a core thermal power level not exceeding 3,800 MWt. The gas-cooled reactors being considered meet this condition. The GT-MHR has a core thermal power level of 600 MWt per module for a total of 2400 MWt. The PBMR has a core thermal power level of 400 MWt per module for a total of 3200 MWt.

10 CFR 51.52(a)(2) requires that the reactor fuel be in the form of sintered UO_2 pellets. The fuel forms for the gas-cooled reactors being considered are blocks of TRISO coated uranium oxycarbide fuel kernels for the GT-MHR and spheres of TRISO coated uranium dioxide fuel kernels for the PBMR.

10 CFR 51.52(a)(2) requires that the reactor fuel have a uranium-235 enrichment not exceeding 4 percent by weight. The NRC has subsequently concluded that enrichments up to 5 percent are also bounded by the environmental impacts considered in Table S-4. These evaluations are documented in the "NRC Assessment of the Environmental Effects of Transportation Resulting From Extended Fuel Enrichment and Irradiation" as provided in 53 FR 30555 and 53 FR 32322, and in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. The PBMR has an enrichment of 12.9 percent while the GT-MHR enrichment is 19.8 percent.

10 CFR 51.52(a)(2) requires that the reactor fuel pellets be encapsulated in Zircaloy rods. 10 CFR 50.44 also allows use of ZIRLO™. USNRC license amendments for operating reactors approving the use of ZIRLO have repeatedly indicated that the use of ZIRLO rather than Zircaloy does not involve a significant increase in the amounts or significant change in the types of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. However, the gas-cooled reactors being considered have a different reactor fuel configuration. The gas-cooled reactor fuel kernels are coated with layers of pyrolytic carbon and silicone carbide. These coatings are considered the equivalent of the fuel cladding. For the GT-MHR these TRISO fuel particles are blended and bonded together with a carbonaceous binder and are stacked within a graphite block. For the PBMR, the fuel unit is a 6-cm diameter graphite sphere containing approximately 15,000 TRISO fuel particles.

10 CFR 51.52(a)(3) requires that the average burnup is not to exceed 33,000 MWd/MTU. The NRC has subsequently concluded that average burnup up to 62,000 MWd/MTU for the peak fuel rod is also bounded by the environmental impacts considered in Table S-4. These evaluations are documented in the "NRC Assessment of the Environmental Effects of Transportation Resulting From Extended Fuel Enrichment and Irradiation" as provided in 53 FR 30555 and 53 FR 32322, and in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. The gas-cooled reactors have an expected burnup of 133,000 MWd/MTU for the PBMR and 112,742 MWd/MTU for the GT-MHR.

RI and TVI can occur from corona, electrical sparking and arcing between two pieces of loosely fitting hardware or burrs or edges on hardware. RI is typically experienced as static on radio reception while TVI is a snow or hold problem on a television. Problems with TVI have diminished in recent years with the increased use of cable and satellite TV, where shielded coaxial cables and shielded receivers protect against the interference. This noise occurs at discrete points and can be minimized with good design and maintenance practices. Design practices for the proposed transmission lines include the use of extra high voltage (EHV) conductors, corona resistant line hardware, and grading rings at insulators. The effect of corona on radio and television is dependent on the radio/television signal strength, distance from the transmission line, and the transmission line noise level. In a 1972 field study, in support of the CPS ER, RI and TVI were measured at existing 345 kV lines with similar construction to those proposed here (CPS, 1973). No new transmission lines have been built in the vicinity, and the CPS ER provides the most recent available data for RI and TVI. The results were summarized as follows:

- No audible noise caused by the 345-kV power lines near Baldwin Station could be measured above prevailing ambient background noise level.
- RI measurements made on the existing 345-kV lines indicated that little or no interference would be experienced in radio receivers located outside the typical 132-ft right-of-way, providing that the strength of signal from the radio stations exceeded 500 micro volts per meter, a value that is accepted by the Federal Communications Commission as the minimum for providing good reception.
- No electrical interference was experienced in a portable television receiver having a standard rod antenna when operating near lines of similar construction to those proposed here.

3.7.4 Electro Magnetic Fields

The EMF are produced by the electrical devices including transmission lines. Electric fields are produced by voltage and are typically measured in kilo volts per meter (kV/m), while magnetic fields are produced by current and are measured in gauss (G). Some epidemiological studies have suggested a link between power-frequency EMF and some types of cancer, while others have not. Although there is no scientific consensus on the topic, the presence of EMF, especially from transmission lines, has become a greater public concern in recent years. Due to the lack of evidence supporting a health risk from EMF, there are no federal health standards for EMF. However, some states have set standards for electric and magnetic field strength at the edge of transmission right-of-ways (see Table 3.7-1); Illinois is not one of these states. The parameters having the greatest effect on EMF levels near the transmission line are operating voltage, current, conductor height, electrical phasing, and distance from the source. The EMF reduction measures will be incorporated into the line and station designs so that the EMF strengths will be minimized.

3.7.5 Induced or Conducted Ground Currents

Magnetic fields can also induce current or voltage in longer conducting objects, such as fences, RR, or pipelines. Touching the object at a point remote from an electrical ground can result in a shock. To minimize these induced ground currents and distribute ground fault

10 CFR 51.52(a)(3) requires that no irradiated fuel assemblies be shipped until at least 90 days after they are discharged from the reactor. Table S-4 assumes 150 days of decay time prior to shipment of any irradiated fuel assemblies with a condition of not less than 90 days. For the gas-cooled reactor technologies being considered, five years is the expected minimum decay time prior to shipment of irradiated fuel assemblies. The five-year minimum time is supported additionally by two practices. First, five years is the minimum cooling time specified in 10 CFR 961.11, within Appendix E of the standard DOE contract for spent fuel disposal with existing reactors. Second, the USNRC specifies five years as the minimum cooling period when it issues certificates of compliance for casks used for shipment of power reactor fuel (NUREG-1437, Addendum 1, pp 26). In addition to the minimum fuel storage time, NUREG-1555 Environmental Standard Review Plan, Section 3.8 asks for the capacity of the on-site storage facilities to store irradiated fuel. The gas-cooled reactor technologies being considered are designing for on-site storage of spent fuel for up to 60 years including potential modular storage expansions.

10 CFR 51.52(a)(5) requires that the unirradiated fuel be shipped to the reactor by truck. The gas-cooled reactor technologies being considered plan to ship their unirradiated fuel by truck.

10 CFR 51.52(a)(5) allows for truck, rail, or barge transport of irradiated fuel. The gas-cooled reactor technologies being considered plan to allow for irradiated fuel shipment by truck. However, the actual mode of shipment may be determined by DOE and could include barge, rail, or truck shipments.

10 CFR 51.52(a)(5) requires that the mode of transport of low-level radioactive waste is either truck or rail. The gas-cooled reactor technologies being considered plan to ship their radioactive waste by truck.

Finally, 10 CFR 51.52(a)(4) requires that, with the exception of spent fuel, radioactive waste shipped from the reactor is to be packaged and in a solid form. The gas-cooled technologies being considered will solidify and package their radioactive waste. Additionally, existing USNRC (10 CFR 71) and DOT (49 CFR 173,178) packaging and transportation regulations specify requirements for the shipment of radioactive material. The gas-cooled technologies being considered are also subject to these regulations.

In summary, the descriptions provided above indicate that the criteria of 10 CFR 51.52(a) are met with the exceptions of fuel form, cladding configuration, enrichment, and burnup.
10 CFR 51.52(b) states that reactors not meeting the conditions of 10 CFR 51.52(a) shall make a full description and detailed analysis of the environmental impacts for their reactor. As previously indicated, the risk to the environment associated with the transportation of fuel is a function of the number of shipments and the contents of the shipments. Thus, a detailed analysis of these risk contributors is provided discussed in the following sections.

3.8.2.4 Risk Contributors – Shipments

This section discusses the type and number of shipments for the gas-cooled reactor technologies and the values used for the reference LWR. The calculations discussed below for the gas cooled reactors are based on the following assumptions:

- Forty (40) years of operation and Low Level Waste (LLW) generation

71 percent of the Kr-85 reference LWR inventory partly because of the significantly smaller shipments (0.16044 MTU per truck cask versus 0.5 MTU per truck cask for the reference LWR). The PBMR comparison would remain essentially the same.

The kilowatts per MTU at the time of shipment (90 days) for the reference LWR were 27.1. This value is considerably higher than for the gas-cooled reactor technologies. At the time of shipment (five years), the decay heat for the gas-cooled reactor technologies being considered ranges from 6.36 kilowatts per MTU for the GT-MHR to 3.91 kilowatts per MTU for the PBMR. These values are ~24 percent and ~15 percent of the reference LWR value, respectively.

The decay heat (per irradiated fuel truck cask in transit) in kilowatts for the reference LWR was 10. Both the gas-cooled reactor truck casks generate much less heat (1.02 kw and 1.9 kw) per truck cask than the reference LWR. These values are ~10 percent and ~19 percent of the reference LWR value, respectively.

The decay heat (per irradiated fuel rail cask in transit) in kilowatts for the reference LWR was 70. Since the gas-cooled reactor technologies are not planning to ship their spent fuel by rail, no comparison is needed. However, should DOE elect to accept the fuel and transport it by rail, the expected decay heat would be less than 70 kw based on the above comparison for truck shipment decay heat.

At the time of the reference LWR evaluation, the road limit was 73,000 lbs. This has changed slightly through the years. 23 CFR 658.17 “Weight” states that for the Interstate and Defense Highways the maximum gross vehicle weight shall be 80,000 pounds. In all cases for the gas-cooled reactor technologies, the road limit is governed by state and federal regulations.

3.8.2.6 Discussion

Of the close to 30 characteristics/conditions that were examined, there are only eight that were exceeded by the gas-cooled reactor technologies being considered. Three of these characteristics, fuel form, U235 enrichment, and fuel rod cladding, have no direct transportation impact on the health and the environment since these parameters are not used when assessing transportation risks under normal transport conditions. There are operational issues and fuel cycle impact issues associated with these characteristics that are addressed as part of the operating license and as part of the evaluation of Table S-3 “Uranium fuel cycle data”, respectively. Two of these characteristics (number of shipments for initial core loading and number of reload shipments) are part of the overall truck transportation analysis. When one considers the total number of truck shipments (fresh fuel, irradiated fuel, and radioactive waste), the new reactor technologies have many fewer total shipments. For example, on an average annual basis, the new reactor technologies require 56 to 72 fewer total truck shipments. One characteristic, burnup, manifests its impact through other characteristics, including fuel inventory and decay heat at time of shipment, which are addressed separately. In the case of decay heat, both of the gas-cooled reactor technologies will generate fewer watts per MTU at time of shipment, and fewer kW per truck cask at time of shipment. The fuel inventory will be discussed as part of the remaining two characteristics that were exceeded: actinide inventory and Kr-85 inventory.

Section 3.8

10 CFR 50.44. Code of Federal Regulations. "Standards for Combustible Gas Control System in Light-Water-Cooled Power Reactors."

10 CFR 51. Code of Federal Regulations. "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR 71. Code of Federal Regulations. "Packaging and Transportation of Radioactive Material."

10 CFR 961. Code of Federal Regulations. "Standard Contract For Disposal Of Spent Nuclear Fuel And/Or High-Level Radioactive Waste."

23 CFR 658. Code of Federal Regulations. "Truck Size And Weight, Route Designations--Length, Width And Weight Limitations."

49 CFR 173. Code of Federal Regulations. "Shippers – General Requirements for Shipments and Packagings."

49 CFR 178. Code of Federal Regulations. "Specifications for Packagings."

Idaho National Engineering and Environmental Laboratory (INEEL). Engineering Design File # 3747, "Early Site Permit Environmental Report Sections and Supporting Documentation." Revision 0. May 14, 2003.

U.S. Nuclear Regulatory Commission (USNRC). *An Updated View of Spent Fuel Transportation Risk*. Discussion draft summary paper for public meetings. Issued June 30, 2000a.

U.S. Nuclear Regulatory Commission (USNRC). *Assessment of the Environmental Effects of Transportation Resulting From Extended Fuel Enrichment and Irradiation*, Docket No. 50-400, 53 FR 30355. August 11, 1988, and 53 FR 32322. August 24, 1988.

U.S. Nuclear Regulatory Commission (USNRC). *Environmental Effects of Extending Fuel Burnup Above 60 Gwd/MTU*. NUREG/CR-6703. January 2001.

U.S. Nuclear Regulatory Commission (USNRC). *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants*. WASH-1238. December 1972.

U.S. Nuclear Regulatory Commission (USNRC). *Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants*. NUREG-75/038. Supplement 1 to WASH-1238. April 1975.

U.S. Nuclear Regulatory Commission (USNRC). *Final Environmental Impact Statement on the Transportation of Radioactive Material by Air and Other Modes*. NUREG-0170. Vols. 1 and 2. December 1977.

U.S. Nuclear Regulatory Commission (USNRC). *Future Licensing and Inspection Readiness Assessment*. SECY-01-0188. October 12, 2001.

U.S. Nuclear Regulatory Commission (USNRC). *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*. NUREG-1437. Volumes 1 & 2. May 1996.

TABLE 3.3-2
Required Raw Water Supply with Cooling Towers Used for Turbine Cycle and Safety-Related Cooling

Service	Normal	Maximum	Source
Potable/sanitary	90 gpm	198 gpm	SSAR Table 1.4-1/PPE Section 5.2.2/5.2.1
Demineralized Water	550 gpm	720 gpm	SSAR Table 1.4-1/PPE Section 6.2.2/6.2.1
Filtered Water	138 gpm	175 gpm	25% of the demineralized water flow
NHS Cooling Tower makeup from lake	43,500 gpm	43,500 gpm [a]	SSAR Table 1.4-1/PPE Section 2.5.9
UHS Cooling Tower makeup from lake	555 gpm	1,400 gpm	SSAR Table 1.4-1/PPE Section 3.3.9
Fire Protection	10 gpm	2,500 gpm	SSAR Table 1.4-1/PPE Section 7.1.2/7.1.1
Total	**44,843 gpm**	**48,493 gpm**	

[a] The vendor supplied one value for the NHS cooling tower makeup so it was conservatively assumed to be the normal makeup flow rate from Clinton Lake.

Note: The demineralizer water system is completely independent from the filtered water system.

TABLE 3.3-3
Cooling Water, Thermal Discharges to Clinton Lake

Service	Flow	Temperature	Source
NHS turbine cycle cooling tower blowdown	12,000 gpm normal, 49,000 gpm max	100°F	SSAR Table 1.4-1/PPE Section 2.5.4
UHS cooling tower blowdown	144 gpm normal, 700 gpm max	95°F	SSAR Table 1.4-1/PPE Section 3.5.3
Total Discharge from Cooling Towers	12,144 gpm normal, 49,700 gpm max	101°F	

[a] Total discharge does not include UHS Tower blowdown, since the bounding plant does not require a UHS.

TABLE 3.5-2

Comparison of Liquid Releases to 10 CFR 20 Effluent Concentration Limits (ECLs)

Isotope [a]	Release (Ci/yr)[b]	Boundary Concentration (µCi/cc)	Fraction of ECL
Ag-110m	2.10E-03	5.50E-10	9.2E-05
Sb-124	1.78E-03	4.67E-10	6.7E-05
Te-129m	2.40E-04	6.28E-11	9.0E-06
Te-129	3.00E-04	7.85E-11	2.0E-07
Te-131m	1.80E-04	4.71E-11	5.9E-06
Te-131	6.00E-05	1.57E-11	2.0E-07
I-131	2.83E-02	7.40E-09	7.4E-03
Te-132	4.80E-04	1.26E-10	1.4E-05
I-132	3.28E-03	8.59E-10	8.6E-06
I-133	1.34E-02	3.51E-09	5.0E-04
I-134	1.70E-03	4.45E-10	1.1E-06
Cs-134	1.99E-02	5.20E-09	5.8E-03
I-135	9.94E-03	2.60E-09	8.7E-05
Cs-136	1.26E-03	3.30E-10	5.5E-05
Cs-137	2.66E-02	6.97E-09	7.0E-03
Cs-138	1.90E-04	4.97E-11	1.2E-07
Ba-140	1.10E-02	2.89E-09	3.6E-04
L-140	1.49E-02	3.89E-09	4.3E-04
Ce-141	1.80E-04	4.71E-11	1.6E-06
Ce-143	3.80E-04	9.95E-11	5.0E-06
Pr-143	2.60E-04	6.81E-11	2.7E-06
Ce-144	6.32E-03	1.65E-09	5.5E-04
Pr-144	6.32E-03	1.65E-09	2.8E-06
Subtotal (without H-3) Pr-144	**3.81E-01**	**---**	**3.73E-02**
Tritium (H-3) Subtotal (without H-3)	**3.10E+03**	**8.12E-04**	**8.14E-01**
Total (all radionuclides)			
Tritium (H-3)	**3.10E+03**	**---**	**8.50E-01**

[a] Total release based on composite of the highest activity content of the individual isotopes from the AP-1000 (2 units), ABWR/ESBWR (1 unit), ACR-700 (2 units), IRIS (3 units), GT-MHR (4 modules), and the PBMR (8 modules).

[ab] Certain nuclides such as Rh-106, Ag-110, and Ba-137m are released but not included in the table. Water ECLs are not defined for these nuclides due to short half-lives.

TABLE 3.5-5
Composite Principal Radionuclides in Solid Radwaste

Radionuclide	Quantity (Ci/y)r
Fe-55	1.76E+03
Fe-59	2.70E+00
Co-60	3.96E+02
Mn-54	3.47E+02
Cr-51	9.71E+01
Co-58	1.87E+02
Zn-65	5.14E+01
Nb-95	1.62E+02
Ag-110m	2.18E+00
Zr-95	7.65E+01
Ba-137m	1.01E+03
Ba-140	1.06E+00
La-140	1.21E+00
Cs-134	6.28E+02
Cs-136	6.00E-02
Cs-137	1.01E+03
Sr-89	1.77E+00
Sr-90	2.48E+00
Y-90	2.48E+00
I-131	8.19E+01
I-133	4.55E+00
Na-24	4.40E-01
Rh-106	1.20E-01
Ru-103	2.18E+00
Ru-106	1.37E+00
Sb-124	1.13E+01
Ce-141	1.40E-01
Ce-144	1.10E-01
Gd-153	3.09E+00
Other	7.29E+01
Total (rounded to nearest hundred)	5.90E+03

TABLE 3.5-3
Normal Radioactive Gaseous Effluents

Isotope	Maximum Composite Release Ci/yr	Isotope	Maximum Composite Release Ci/yr
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	**Subtotal**	
Zn-65	1.11E-02	**(without H-3)**	**2.40E+04**
Rb-89	4.32E-05	**Tritium (H-3)**	**3.53E+03**
		Total	**2.76E+04**

TABLE 3.6-1
Estimated Bounding Blowdown Constituents and Concentrations

Constituents	Concentration (ppm)[a]		
	River Source	Well (Treated Water)	Bounding Estimate
Chlorine Demand	10.1	---[b]	10.1
Free Available Chlorine	0.5	---[b]	0.5
Copper	---[b]	6	6
Iron	0.9	3.5	3.5
Zinc	---[b]	0.6	0.6
Phosphate	---[b]	7.2	7.2
Sulfate	599	3,500	3,500
Total Dissolved Solids	---[b]	17,000	17,000
Total Suspended Solids	49.5	150	150

[a] Source: SSAR Table 1.4-2, and data supplied by the different reactor vendors (data are not site- specific.)
[b] Data not available

TABLE 3.6-2
Sanitary Discharges to Clinton Lake

Service	Normal	Maximum	Source
Sanitary waste discharge (This is the discharge from the potable/sanitary water system.)	60 gpm	198 gpm	SSAR Table 1.4-1/PPE Section 5.1.1

TABLE 3.6-3
Other Effluent Discharges

Service	Normal	Maximum	Source
Chemical waste discharge: This is the total of the regeneration wastes from the demineralized water system(s).	110 gpm	145 gpm	SSAR Table 1.4-1/PPE Section 6.1.1
Miscellaneous plant drains: This is the discharge from miscellaneous plant sources.	213 gpm	325 gpm	SSAR Table 1.4-1/PPE Section 8.1.1
Total	**323 gpm**	**470 gpm**	

TABLE 3.6-4
Bounding Estimates for Yearly Emissions from Auxiliary Boilers and Standby Diesel Generators for the EGC ESP Facility

Pollutant Discharged	Quantity (lbs)	Exhaust Elevation (ft)	Source
Auxiliary Boilers		110 ft above plant grade	SSAR Table 1.4-1/PPE Section 13.1
Particulates	34,500		SSAR Table 1.4-4
Sulfur Oxides	115,000		SSAR Table 1.4-4
Carbon Monoxide	1,749		SSAR Table 1.4-4
Hydrocarbons	100,200		SSAR Table 1.4-4
Nitrogen Oxides	19,022		SSAR Table 1.4-4
Note: Emissions from the operation of the auxiliary boilers are based on a 30-day/year operation			
Standby Generators		30 ft above plant grade	SSAR Table 1.4-1/PPE Section 16.1.2
Particulates	1,620		SSAR Table 1.4-5
Sulfur Oxides	5,010		SSAR Table 1.4-5
Carbon Monoxide	4,600		SSAR Table 1.4-5
Hydrocarbons	3,070		SSAR Table 1.4-5
Nitrogen Oxides	28,968		SSAR Table 1.4-5
Note: Emissions from the standby generators are based on a 4-hr/month operation for each generator			

TABLE 3.6-5

Bounding Estimates for Yearly Emissions from the Standby Power System Gas-Turbine Flue Gas for the EGC ESP Facility

Fuel: Distillate: LHV = 9,890 Btu/kWh, HHV = 10,480 Btu/kWh

96,960 lbs/hr fuel consumption rate

Release Height is 100 ft above plant grade (Table 1.4-1 of the SSAR/PPE Section 16.2.2)

Emissions are based on a 4-hour/month operating cycle for each generator

Effluent	PPMVD	Quantity (lbs)
NO_x (PPMVD @ 15% 0_2)	95	--
NO_x as NO_2	--	725
CO	25	85
UHC	10	20
VOC	5	10
SO_2	55	470
SO_3	5	30
Sulfur Mist	--	50
Particulates	--	22

Effluent	Exhaust Analysis Percent Volume
Argon	0.86
Nitrogen	72.56
Oxygen	11.2
Carbon Dioxide	5.19
Water	9.87

Source: SSAR Table 1.4-6

TABLE 3.8-2
Gas-Cooled Reactor Transportation Impact Evaluation

Reactor Technology	Reference LWR (Single unit) (1,100 MWe)	GT-MHR (4 Modules) (2,400 MWt total) (1,140 MWe total)	PBMR (8 Modules) (3,200 MWt total) (1,320 MWe total)	Comments
Characteristic				
Capacity	80%	88%	95%	
Normalization factor	1	0.88	0.7	
Reactor Power Level MWt	~ 3,400	2,400 (600 MWt per module, 4 modules per plant)	3,200 (400 MWt per module, 8 modules per plant)	Not exceeding 3,800 MWt per reactor is a condition for use of Table S-4
Fuel Form	Sintered UO_2 pellets	Blocks of TRISO coated uranium oxycarbide (UCO) kernels [a]	Spheres of TRISO Coated UO_2 fuel kernels [a]	Sintered UO_2 pellets is a condition for use of Table S-4
U235 Enrichment	1% - 4%	Fissile particle 19.8%; fertile particle natural uranium [a]	Initial 4.9%; equilibrium 12.9% [a]	Not exceeding 4% is a condition for use of Table S-4; NUREG-1437 concludes that 5% is bounded
Fuel Rod Cladding	Zircaloy	Graphite [a]	Graphite [a]	Zircaloy rods are a condition for use of Table S-4; 10 CFR 50.44 allows use of ZIRLO)
Average burnup MWd/MTU	33,000	112,742 [a]	133,000 [a]	Not exceeding 33,000 is a condition for use of Table S-4; NUREG-1437 concludes 62,000 MWd/MTU for peak rod is bounded
Unirradiated fuel				
Unirradiated fuel transport mode	Truck	Truck	Truck	Shipment by truck is a condition for use of Table S-4
# of shipments for initial core loading	18	51 shipments (1020 fuel elements per module x 4 modules; 80 elements per truck) [a]	44 shipments (260,000 fuel spheres per module x 8 modules, 48,000 spheres per truck) [a]	100 MTU for PWR; 150 MTU for BWR

TABLE 3.8-2
Gas-Cooled Reactor Transportation Impact Evaluation

Reactor Technology	Reference LWR (Single unit) (1,100 MWe)	GT-MHR (4 Modules) (2,400 MWt total) (1,140 MWe total)	PBMR (8 Modules) (3,200 MWt total) (1,320 MWe total)	Comments
Characteristic				
Decay heat (kW) (per irradiated fuel truck cask in transit)	10	1.02 (6.356 kW/MTU x 0.16044 MTU/shipment)	1.9 (3.9 kW/MTU x 0.495 MTU/shipment)	
# of spent fuel shipments by rail	10	0	0	3.2 – 3.5 MT of irradiated fuel per cask
Heat (per irradiated fuel rail cask in transit) kW	70	NA	NA	
# of spent fuel shipments by barge	5	0	0	
Radioactive waste				
Radioactive waste transport mode	Truck or rail	Truck	Truck	Shipment by truck or rail is a condition for use of Table S-4
# of rad waste shipments by truck	46	6 (98 m^3/yr)	9 (800 drums)	Assumed 90% of the waste shipped at 1000 ft^3 per truck, 10% at 200 ft^3 per truck
Weight per truck lbs.	73,000	Governed by state and federal regulations	Governed by state and federal regulations	Interstate gross vehicle limit is 80,000 lbs. (23 CFR 658.17)
# of rad waste shipments by rail	11	0	0	
Weight per cask per rail car tons	100	100	100	
Transport totals				
Traffic density, trucks per day	Less than 1	Less than 1	Less than 1	
Rail density, cars per month	Less than 3	0	0	

Source: 10 CFR 51.52, Table S-4 Environmental Impact of Transportation of Fuel and Waste

[a] Value larger than or different from the reference LWR.

Notes: The results for the reactor technologies have not been adjusted for their larger electrical generation or increased capacity factor.

TABLE 3.8-3
Summary Table S-4-Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor

Normal Conditions of Transport			
Condition		**Value**	
Heat (per irradiated fuel cask in transit)		250,000 Btu/hr	
Weight (governed by Federal or State restrictions)		73,000 lbs per truck; 100 tons per cask per rail car	
Traffic Density:			
Truck		Less than 1 per day	
Rail		Less than 3 per month	
Exposed Population	**Estimated Number of Persons Exposed**	**Range of Doses to Exposed Individuals [a] (per reactor year)**	**Cumulative Dose to Exposed Population (per reactor year) [b]**
Transportation workers	200	0.01 to 300 millirem	4 man-rem.
General public:			
Onlookers	1,100	0.003 to 1.3 millirem	3 man-rem.
Along route	600,000	0.0001 to 0.06 millirem	
Accidents in Transport			
Types of Effects		**Environmental Risk**	
Radiological effects		Small [c]	
Common (nonradiological) causes		1 fatal injury in 100 reactor years	
		1 nonfatal injury in 10 reactor years	
		$475 property damage per reactor year	

Note: Data supporting this table are given in the Commission's "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, December 1972, and Supp. 1 NUREG-75/038 April 1975.

[a] The Federal Radiation Council has recommended that the radiation doses from the sources of radiation other than natural background and medical exposures should be limited to 5,000 millirem per year for individuals as a result of occupational exposure and should be limited to 500 millirem per year for individuals in the general population. The dose to individuals due to average natural background radiation is about 130 millirem per year.

[b] Man-rem is an expression for the summation of whole body doses to individuals in a group. Thus, if each member of a population group of 1,000 people were to receive a dose of 0.001 rem (1 millirem), or if 2 people were to receive a dose of 0.5 rem (500 millirem) each, the total man-rem dose in each case would be 1 man-rem.

[c] Although the environmental risk of radiological effects stemming from transportation accidents is currently incapable of being numerically quantified since a specific reactor has not been selected, the risk remains small regardless of whether it is being applied to a single reactor or a multireactor site.

4.1.2.2.1 Long-Term Physical Changes in Land Use

No long-term physical changes in land use will result from construction in the anticipated transmission corridor.

Land uses within the transmission corridor are listed in Table 2.2-2. Highways and RR that will be crossed by the transmission corridor are listed in Section 2.2.2. There are three utility rights-of-way that will be crossed by the transmission lines in the northern section and one utility right-of-way that will be crossed in the southern section (see Figure 2.2-4).

There are no federal, state, or regional land use plans for this area (McLean, 2000). However, DeWitt County published a countywide generalized land use plan in 1992, the DeWitt County comprehensive plan, and McLean County published a countywide regional comprehensive plan in 2002. Details about these land use plans and the effects of the transmission corridors are detailed in Section 2.2.2.

The transmission corridor will not cause long-term changes to special agricultural resources, such as prime or unique farmland, since the transmission corridor will be constructed in existing right-of-way. There are no known significant mineral resources (sand and gravel, coal oil, natural gas, and ores) within the transmission corridor (Masters et al., 1999). No construction activities for the transmission corridor will take place within a coastal zone (USGS, 1990) or wild and scenic river (USFWS, 2002). Clinton Lake is considered a 100-yr floodplain. There are also three other 100-yr floodplains within the transmission corridor (IDNR, 1986). There are minor wetland areas within the vicinity (IDNR, 1987). Careful consideration of these floodplains and wetlands will take place when constructing the transmission corridor. Transmission towers required for the proposed transmission system will be sited in upland areas within the existing utility corridor. Adverse impacts to watercourses, wetlands, and floodplains within the existing right-of-way will be avoided to the greatest extent possible.

4.1.2.2.2 Short-Term Changes in Land Use

Some minor impacts to the land may result from construction of the transmission corridor. These include:

- Temporary access roads, if required;
- Material laydown areas, storage areas, and field offices;
- Right-of-way clearing;
- Temporary improvements, such as culverts and fence openings;
- Minor soil disturbance from erection of H-Frames; and
- Conductor installation.

A detailed description of these minor impacts and mitigation measures are described in Section 4.1.2.1.

If for any reason construction of the EGC ESP Facility license or license application is withdrawn, the procedures and practices described in the Site Redress Plan for the EGC ESP Site may be followed.

4.3 Ecological Impacts

The sections below describe anticipated impacts to the ecological resources, terrestrial and aquatic, existing at the site and within the vicinity surrounding the EGC ESP Site, as described in Section 2.4.

4.3.1 Impacts to Terrestrial Ecosystems from Construction

4.3.1.1 Introduction

The following sections of this document describe the potential impacts to the terrestrial environment and biota of the site and vicinity, and off-site areas likely to be affected by the construction of the EGC ESP Facility. Descriptions of existing terrestrial habitats including important habitats, as defined by the USNRC, are presented in Chapter 2. This portion of the document has been divided into three sections describing the potential impacts to land use, wildlife resources, and important species and habitats found within the site and vicinity.

4.3.1.2 Land Use and Habitats

Staging, laydown, and construction of the EGC ESP Facility will occur adjacent to the CPS. The footprint for the facility and the adjacent staging and laydown areas is mainly comprised of disturbed areas (impervious surfaces, crushed stone, and existing pavement and structures). Within the site boundary, 100 percent (461 ac) has been graded or otherwise developed for operation of the existing nuclear power plant. The EGC ESP Facility will reuse 93 ac of this previously disturbed or developed land.

As a result of the implementation of the proposed project, there will be a loss of some open field habitat located adjacent to the existing facility. Project construction is not anticipated to adversely affect other habitats including forested areas or wetlands at the site or in the vicinity.

Impacts to habitats resulting from transmission line construction can be minimized by the use of approved erosion and sediment control measures to prevent transport of silts and sediments from the area of disturbance, topsoil stripping to avoid mixing and compaction of soils, special construction techniques in wetlands or other sensitive areas, and post-construction restoration measures approved by applicable local, state, and federal agencies. Additionally, impacts to natural resources can be avoided and/or minimized as a result of the proposed corridor being co-located within or adjacent to existing rights-of-way that are approximately 88 percent agricultural lands.

As previously discussed, transmission system improvements will be required to support the EGC ESP Facility. These modifications will be located within or immediately adjacent to the existing substation at the CPS and along the existing transmission corridor. The proposed transmission line improvements will be sited within the existing utility rights-of-way to the greatest extent possible.

Construction of the proposed transmission line improvements will temporarily impact habitats within the existing rights-of-way; however, the agricultural and open field areas will be allowed to revegetate to preconstruction conditions. There will be no significant loss

4.5 Radiation Exposure to Construction Workers

This section presents an assessment of the potential radiological dose impacts to the construction workers of the EGC ESP Facility resulting from the operation of the CPS.

4.5.1 Site Location

The physical location of the EGC ESP Site relative to the layout of various CPS facilities is presented in Figure 2.1-4 and Figure 2.1-5. As shown, with the possible exception of the expansion of the switchyard and the installation of the EGC ESP Facility intake structure, the major construction activities are expected to take place outside the CPS protected area boundary, but inside the restricted area boundary.

4.5.2 Radiation Sources

During the construction of the EGC ESP Facility, the construction workers will be exposed to direct radiation and to the radioactive effluents emanating from the routine operation of the CPS.

The direct radiation exposure has two principal sources: (1) the cycled condensate storage tank located on the northern boundary of the protected area adjacent to the existing switchyard; and (2) the skyshine from the N-16 activity present in the reactor steam in the high pressure and low pressure turbines, the intercept valves, and the associated piping located on the main floor of the turbine building.

The design basis radiation source term for the cycled condensate storage tank is listed in the CPS USAR Table 12.2-8 (CPS, 2002).

The N-16 activity that is present in the reactor steam in the primary steam lines, turbines, and moisture separators provides an air-scattered radiation dose contribution to locations outside the CPS plant structure. The design basis radiation source inventory in these pieces of equipment is listed in the CPS USAR Table 12.2-7 (CPS, 2002). To reduce the turbine skyshine doses, radiation shielding has been provided.

The CPS Facility releases airborne effluents via two gaseous effluent release points to the environment. These are the common station heating, ventilating, and air conditioning stack and the standby gas treatment system vent. The expected radiation sources in the gaseous effluents are listed in the CPS USAR Table 11.3-8 (CPS, 2002).

The CPS Facility has achieved zero liquid radioactivity release from the plant in the past nine years. Therefore, the radiation sources expected to be present in liquid effluents in the future are considered negligible.

4.5.3 Measured Radiation Dose Rates and Airborne Concentrations

Environmental radiological monitoring data obtained from the *Annual Radiological Environmental Operating Report* (Campbell, 2002a) were used to assess any radiological impact upon the surrounding environment due to the operation of the CPS Facility. During 2001, CPS collected over 1,400 environmental samples. These samples represented direct radiation, and also atmospheric, terrestrial, and aquatic environments along with Clinton

Lake surface water and public drinking water samples. Subsequently, more than 1,800 analyses were performed on these environmental samples.

4.5.3.1 Gaseous and Liquid Releases from the Clinton Power Station Facility

As stated in the *Annual Radioactive Effluent Release Report for the CPS Facility* (Campbell, 2002b):

- Gaseous Releases – "The highest calculated off-site dose received by a member of the public due to the release of gaseous effluents from the CPS was less than 0.003 millirem (mrem)."
- Liquid Releases – "There were zero (0) radioactive liquid releases or exposures from liquid radioactive effluents from CPS during 2001."

In addition, the *2001 Annual Radioactive Effluent Release Report* (Campbell, 2002b) calculated total body, skin, and thyroid doses to the public from CPS gaseous effluents. The doses were less than 0.003 mrem per year with the maximum doses resulting from public use of the road in the southeast sector within the CPS Site boundary.

4.5.3.2 Direct Radiation Measurements

Environmental thermoluminescent dosimeters (TLDs) are used to measure the ambient gamma radiation levels at many locations in and around the CPS. A total of 216 TLD measurements were made throughout the year 2001. The average quarterly dose from indicator location(s) was 18.1 mrem. At control locations, the average quarterly dose was 16.9 mrem. These quarterly measurements ranged from 13.1 mrem to 21.9 mrem for indicator TLDs and 15.0 mrem to 19.5 mrem for control TLDs (Campbell, 2002a). From these observations, when factoring in the statistical variances, it is concluded that there was no increase in environmental gamma radiation levels resulting from plant operations at the CPS (Campbell, 2002a). In addition, real time dose rate measurements obtained at the protected area fence line during the third quarter of 2002 varied from 6.2 microrem/hr in the southeastern corner of the protected area to 56 microrem/hr directly west of the Turbine Building.

Table 4.5-1 provides a listing of quarterly TLD readings (net dose in mrem) for each of the 11 protected area fence line TLDs for each of the calendar quarters between the second quarter 2001 through the first quarter 2003 (eight quarters of data). The TLD fence line locations are shown on Figure 4.5-1. The average dose over this period, considering the 11 TLD protected area fence line locations and correcting for average plant capacity factor, is approximately 25 mrem.

Using the average dose rate of the 11 TLD fence line locations over this two year period is considered both reasonable and conservative for estimating the dose to the construction workers, since this operating period is representative of the longer term operation of the CPS. Also, when considering the construction of a future ESP plant at this site, for the majority of the time, the construction workers will be located much farther from the CPS operating radiation sources than reflected in the fence line values. The principal source of radiation from CPS operation is the N-16 radiation emanating from the turbine building. As shown the highest dose rates occur opposite (west) the turbine building at TLD dose points 1 and 11 (Figure 4.5-1). Lowest values occur in the south-southeast direction (dose points 6, 7, and 8) in the direction of the ESP footprint (Power Block Structure Area). The average dose rate at the protected area fence is estimated at 7.2 to 12.1 microrem/hr. The protected area fence line dose rates occur at distances of approximately 100 to 1000 ft from the CPS Turbine Building. The Exelon ESP facilities will be located more than 1000 ft from the CPS sources. Therefore, the above listed average dose rates can be expected to be reduced to background. Skyshine studies for other BWR plants demonstrate that the dose rates may be reduced by a factor of 3 to 5 due to the increased distance.

4.5.4 Annual Construction Worker Doses

Construction worker doses are conservatively estimated based upon the following:

- The estimated exposures to the construction worker resulting from the operation of CPS via the gaseous release pathway described in Section 4.5.3.1 and the direct radiation exposure as presented in Section 4.5.3.2
- An exposure period of 2080 hours per year
- An assumed work force of 3,150 people (see Table 1.4-1, Section 18.4 of the SSAR)
- No credit for the reduction in dose rate due to the distance from the protected area fence line to the EGC ESP construction areas.

As indicated in Section 4.5.3.1 the *Annual Radioactive Effluent Release Report for 2002* reported that the highest calculated doses (total body, skin, and thyroid doses) to a member of the public from the release of gaseous effluents from the operation of CPS was less than 3 µrem per year which was based on an occupancy rate of 243 hr/yr. The dose was based on the public use of a road in the southeast sector of the CPS plant site. Adjusting this exposure for an increase in the worker site occupancy of 2080 hrs/yr during construction results in an estimated dose of (2080/243) * (3 µrem per year) equals 0.03 mrem.

Section 4.5.3.2 indicates that, based on CPS protected area fence line TLD measurements, the annual average dose to construction workers from direct and skyshine radiation exposure is approximately 25 mrem and, based on recent direct survey data, in the range of 6.2 to 56 µrem per hour. Table 4.5-2 presents the estimated doses to construction worker compared to the public dose criteria of 10 CFR 20.1301. This comparison demonstrates compliance with 10 CFR 20.1301 criteria and supports the conclusion that future construction workers would not need to be classified as radiation workers.

The annual collective dose to the construction work force (3150 persons) is estimated to be 80 person-rem based on the 8 quarters of TLD data.

4.6.3.7.2.1 Fresh Water Streams

Although there may be some private users, there are no communities upstream or downstream of Clinton Lake that draw water from Salt Creek or the North Fork of Salt Creek for public water supply. Any users upstream of Clinton Lake will not be impacted by construction-related activities because they are upstream of the construction activity. Any users downstream of Clinton Lake are also not expected to see significant impacts in the quantity or quality of flow in Salt Creek during the construction period. The limited amount of additional sediment in stormwater related to construction activities will be first controlled by sight specific practices identified in the SWPPP and significantly buffered by Clinton Lake before downstream discharge to Salt Creek.

4.6.3.7.2.2 Lakes and Impoundments

The CPS Facility is the only major water user on Clinton Lake. The anticipated short-term construction-related impacts to the CPS are temporary increases in suspended solids. The CPS uses Clinton Lake water for operational cooling and relatively smaller amounts of lake water for potable water and fire protection. The main potential water use impact is short-term, and would consist of temporary increases in the suspended solids concentration of water drawn into the plant water systems.

The limited amount of additional sediment in stormwater related to construction activities will be first controlled by sight specific practices identified in the SWPPP. During construction of the new EGC ESP intake structure, the CPS intake structure will be protected to prevent suspended sediment from entering the cooling system. Special construction techniques, such as watertight sheet piling with dewatering of submerged areas to expose the construction zone, will be implemented where necessary to prevent migration of suspended solids. Water collected from dewatering operations will be settled or filtered before water is allowed to return to the lake. Where appropriate, stormwater runoff and treated dewatering water will be diverted to the discharge side of the lake to reduce CPS impacts.

There are no other industrial, municipal, commercial, or agricultural users of the Clinton Lake water. Recreational facilities adjacent to Clinton Lake either do not provide potable water or do not use wells as a water source. There is the potential for short-term construction-related changes in suspended solids concentrations that may have minor impacts on fishing, swimming, or other recreational uses of the lake. The minor and short-term nature of these impacts, implementation of a site specific construction SWPPP, and the significant distance from recreational access points to the plant site effectively limit exposure to recreational users and potential impacts.

4.6.3.8 Land Use Protection/Restoration

As stated in Section 4.3, construction of the EGC ESP Facility will occur adjacent to the CPS. The footprint for the facility is mainly comprised of disturbed areas (impervious surfaces, crushed stone, and existing structures) and open fields in the vicinity of the CPS.

As a result of the implementation of the EGC ESP Facility, there will be a loss of some open field habitat located adjacent to the existing facility. Project construction is not anticipated to adversely affect other habitats, including forested areas or wetlands, at the site or in the vicinity.

TABLE 4.5-2
Comparison of Construction Worker Public Dose to 10 CFR 20.1301 Criteria

Type of Dose	Annual Dose Limits 10 CFR 20.1301	Estimated Dose
Total effective dose equivalent	100 mrem	25 mrem
Maximum dose rate in any hour	2 mrem/hr	< 1 mrem/hr

TABLE 4.5-3
Comparison of Construction Worker Occupational Dose to 10 CFR 20.1201 Criteria

Type of Dose	Annual Dose Limits	Evaluated Dose
Whole body dose equivalent	5 rem	< 0.045 rem
Thyroid dose	50 rem	< 0.045 rem
Dose to the eye	15 rem	< 0.045 rem
Dose to skin or extremities	50 rem	< 0.045 rem

TABLE 4.6-2
Stabilization Control Measures

Control Measure	Location	Description of Control Measure
Temporary Seeding	Disturbed areas where the construction activity has temporarily ceased.	Growing of a short-term vegetative cover on disturbed areas that may be in danger of erosion. Seeding is to be implemented within a reasonable timeframe of the activity ceasing.
Mulching	On slopes steeper than 3:1 or on areas that have been seeded.	Temporary soil stabilization or erosion control practices where materials, such as grass, wood chips, hay, etc., are placed on the soil surface. Mulching is to be implemented within a reasonable timeframe of the activity ceasing.
Preservation of Natural Vegetation	Wherever practical.	Wherever practical, existing vegetation should be retained. It minimizes erosion potential and protects water quality. The preservation of natural vegetation between the silt fence and stream will provide additional water quality improvement prior to the stormwater entering state waters.
Permanent seeding	On appropriate disturbed areas once construction is complete.	Provides stabilization of the soil and reduces erosion. Permanent seeding is to be implemented within a reasonable timeframe of the activity ceasing.

the vicinity. These locations were used because direct monitoring data of the plant intake and discharge water are not available.

Review of the temperature data indicates that average lake temperatures increase from upstream (19.3° C or 66.7°F) to downstream (24.6° C or 76.3°F) of the CPS. Dissolved oxygen decreased from 9.3 mg/L to 8.1 mg/L, as would be expected with an increase in temperature. There appear to be only slight changes in other constituents presented including turbidity, hardness, TDS, magnesium, chloride, orthophosphate, and sulfate.

Other constituents such as hardness and TDS may increase as a result of evaporation if the wet or wet/dry cooling method is selected. For example, the TDS intake water concentration at Site 4 measured in the range of 275 mg/L. Discharge concentrations of TDS from the EGC ESP Facility (see SSAR Table 1.4-2) are estimated to be 17,000 mg/L. The combined discharge will be in the range of 380 mg/L (based on 3,600 gpm) to 620 mg/L (based on 12,000 gpm) of TDS. The discharge will be diluted by lower dissolved solids in the lake and in the base flows from Salt Creek and North Fork of Salt Creek. Dissolved solids will also be passed downstream through the dam. Over time, a rise in ambient lake dissolved solids concentration is expected to a level of equilibrium higher than the ambient level. Further discussion of dissolved solids concentration is included in Section 5.3.

5.2.1.2.4 Lake Levels

A 24-year Period of Record model was developed to determine any change in lake levels with addition of the ESP facility. The Period of Record model was run for the 24-year period of local hydrologic record from June 1, 1978 to April 31, 2002 for three scenarios; 1) with the current 1138.5 MW CPS plant operating at 100 percent power, 2) with the current CPS and new ESP with wet/dry cooling, and 3) with the current CPS and new ESP with wet cooling. The hydrologic conditions for this period of record reflected monitored average daily values from recording stations near the plant. Plant operating conditions for the three scenarios were imposed over the total 24-year period of record.

Note that there are certain model limitations noted in Section 5.2.1.1.1 that limit the use of the daily values simulated. The comparison of changes over the modeled base case are, however, considered representative of actual conditions.

The results of the model simulation are presented in Table 5.2-6. The average water surface elevation of Clinton Lake with the CPS plant only is estimated to be 690.4 ft. With a new ESP facility and wet/dry cooling, the average annual lake level is reduced by 0.2 to 690.20 ft. With a new ESP and wet cooling, the average lake level is reduced by 0.7 to 689.70 ft. The monthly distribution of reduced lake levels range from 0.0 ft in March, April, May, and June to 0.4 ft in October and November for the wet/dry cooling, and from 0.1 ft in April and May to 1.9 ft in November for wet cooling.

5.2.1.3 Groundwater

It is anticipated that surface water (namely Clinton Lake) will be used to meet the operational water requirements of the EGC ESP Facility; groundwater will not be used as a source of water. In addition, based on the planned design of the EGC ESP Facility, no permanent groundwater dewatering system will be implemented. Thus, there are no anticipated hydrologic alteration impacts to groundwater from the operation of the EGC ESP Facility.

5.4 Radiological Impacts of Normal Operations

The following section identifies and describes the environmental pathways and impacts by which radiation and radiological effluents can be transmitted to the living organisms in and around the EGC ESP Facility. The scope of this section encompasses the pathways by which gaseous and liquid radiological effluents can be transported to and expose individual receptors as well as biota. It also assesses exposure to operations to living organisms in and around the station from increased ambient background radiation levels from plant.

5.4.1 Exposure Pathways

A radiological exposure pathway is the vehicle by which a receptor may become exposed to radiological releases from nuclear facilities. The major pathways of concern are those that could cause the highest calculated radiological dose. These pathways are determined from the type and amount of radioactivity released, the environmental transport mechanism, and how the station environs are used (e.g., residence, gardens). The environmental transport mechanism includes the historical meteorological characteristics of the area that are defined by wind speed and wind direction. This information is used to evaluate how the radionuclides will be distributed within the surrounding area. The most important factor in evaluating the exposure pathway is the use of the environment by the residents in the area around the proposed EGC ESP Facility. Factors such as location of homes in the area, use of cattle for milk, and the growing of gardens for vegetable consumption are considerations when evaluating exposure pathways.

Routine radiological effluent releases from the EGC ESP Facility are a potential source of radiological exposure to man and biota. The potential exposure pathways include aquatic (liquid) and gaseous particulate effluents. The radioactive gaseous effluent exposure pathways include direct radiation, deposition on plants and soil, and inhalation by animals and humans. The radioactive liquid effluent exposure pathways include fish consumption and direct exposure from radionuclides that may be deposited in Clinton Lake. An additional exposure pathway is the direct radiation from the facility equipment and structure during normal operation of the EGC ESP Facility.

The description of the exposure pathways and the calculational methods utilized to estimate doses to the maximally exposed individual and to the population surrounding the EGC ESP Site are based on Regulatory Guides 1.109 and 1.111 (USNRC, 1977 and 1977a). The source terms used in estimating exposure pathway doses are based on the bounding values provided in Chapter 3.

5.4.1.1 Liquid Pathways

Small amounts of liquid radioactive effluents (below regulatory limits) may be mixed with the cooling water and discharged to Clinton Lake. It is expected that the EGC ESP Facility will be operated in a similar fashion to the CPS, which in nine years has not discharged any liquid radiological effluents to the environment. However, since the release of small amounts of radioactive liquid effluents is permitted at the CPS and is expected to be permitted at the EGC ESP Facility as long as releases comply with the requirements specified in 10 CFR 20, the following analyses are provided in order to bound the doses from liquid pathways.

reptiles are considered more radiosensitive than aquatic organisms. The permissible dose rates are considered screening levels and higher species-specific dose rates could be acceptable with additional study or data.

The calculated total body doses for biota are compared in Table 5.4-20 to the dose criteria evaluated in the *Effects of Ionizing Radiation on Plants and Animals at Levels Implied by Current Radiation Protection Standards* (ORNL, 1995). The biota doses meet the dose guidelines by a large margin. In these cases, the annual dose to biota is much less than the daily allowable doses to aquatic and terrestrial organisms.

5.4.5 Occupational Radiation Exposures

This section provides a discussion of the anticipated occupational radiation exposure to EGC ESP Facility operating personnel. Estimates of these radiation doses are intended to provide a quantitative basis for the regulatory assessment of the potential risks and health impact to operating personnel.

Similar to current plant designs, occupational exposure from the operation of advanced reactor designs will continue to result from exposure to direct radiation from contained sources of radioactivity and from the small amounts of airborne sources typically resulting from equipment leakages. Past experience demonstrates that, for commercial nuclear power reactors, the dose to operating personnel from airborne activity is not a significant contributor to the total occupational dose. This experience is expected to continue to apply to the EGC ESP Facility.

As indicated in NUREG-1437 (USNRC, 1996), for the purpose of assessing radiological impacts to workers, the Commission has concluded that impacts are of small significance if doses and releases do not exceed permissible levels in the Commission's regulations. The standards for acceptable dose limits are given in 10 CFR Part 20. For any reactor concept selected for deployment at the ESP site, the radiation exposures to operating personnel will be maintained within the limits of 10 CFR 20 and will also satisfy the as low as reasonably achievable (ALARA) guidance contained in Standard Review Plan Chapter 12.1 (USNRC, 1996a) and Regulatory Guide 8.8 (USNRC, 1978a).

Administrative programs and procedures governing Radiation Protection and Health Physics in conjunction with the radiation protection design features of the EGC ESP Facility will be developed with the intent to maintain occupational radiation exposures ALARA. The advanced light water reactor designs being considered have or will incorporate radiation protection features that go beyond the designs provided for plants currently in operation. In addition, gas-cooled reactor design basis source terms and expected operating characteristics exhibit lower radiation levels during normal operation and for abnormal operating occurrences. Consequently, for environmental impact assessment purposes, it is reasonable to expect and conclude that the annual operator exposures for the EGC ESP Facility will be bounded by the operating experience exhibited by existing operating light water reactors (LWR).

The average annual collective occupational dose information for LWR plants operating in the United States between 1973 and 2002 is given in Table 5.4-21, based on data provided in NUREG-0713 (USNRC, 2003). The more recent dose data presented in this report are based on 35 operating BWRs and 69 PWRs. The data show that, historically (since 1974), the average collective dose and average number of workers per BWR type plant have been higher than those for PWRs and that the values for both parameters, in general, continued to rise until 1983. Thereafter (data through 2002), the average collective dose per LWR dropped by 84 percent. The overall decreasing trend in average reactor collective doses since 1983 is indicative of successful implementation of ALARA dose reduction measures at commercial power reactor facilities.

The variation in annual collective dose at operating reactors results from a number of factors such as the amount of required maintenance, the amount of reactor operations and required in-plant surveillances. These factors have varied in the past, but are expected to improve with the advance designs concepts under consideration for the EGC ESP Facility.

The 3-year average collective dose per reactor is one of the metrics that the NRC uses in the Reactor Oversight Program to evaluate the effectiveness of a licensee's ALARA program. Tables 5.4-22 and 5.4-23 show the BWR and PWR commercial reactor sites in operation for at least 3 years as of December 31, 2002 and detail the occupational exposure statistics. As shown in Table 5.4-22, the BWR average annual collective total effective dose equivalent (TEDE) per reactor, average measurable TEDE per worker, and average collective TEDE per MW-yr are 162 person-rem, 0.19 rem, and 0.20 person-rem per MW-yr, respectively. Similarly, as presented in Table 5.4-23, the PWR average annual collective TEDE per reactor, average measurable TEDE per worker, and average collective TEDE per MW-yr are 91 person-rem, 0.15 rem, and 0.11 person-rem per MW-yr, respectively.

Using this metric and the distribution of occupational exposures, a conservative estimate for the EGC ESP Facility is expected to be less than the recent BWR average collective TEDE dose per reactor of 162 person-rem, but could average during any particular 3 year averaging period as much as 2 to 3 times this value over the life of the facility. The average annual dose of about 0.2 rem per nuclear plant worker at operating BWRs and PWRs is well within the limits of 10 CFR 20. These exposures are considered to be of small significance and pose a risk that is comparable to the risks associated with other industrial occupations.

5.7.2.3 Analysis and Discussion

5.7.2.3.1 Fuel Fabrication/Operations

The reference LWR required 35 MTU of new fuel on an annual basis. This is equivalent to 40 MT of enriched UO_2, the annual output needed from the fuel fabrication plant. In comparison, the normalized annual fuel needs for the new gas-cooled reactor technologies ranged from 4.3 MTU to 5.3 MTU, approximately 88 percent to 85 percent lower than the reference plant. Similarly, the annual output needed from the fuel fabrication plant range from a low of 4.89 MT of UO_2 to 6.0 MT of UO_2, again approximately 88 percent to 85 percent lower than the reference plant. The specific breakdowns are shown on Table 5.7-1.

One important distinction is that the fuel form for the gas-cooled reactors is also different. For the GT-MHR, the fuel is a two-phase mixture of enriched UO_2 and UC_2, usually referred to as UCO. For the PBMR, the fuel kernel is UO_2. Both fuels are then TRISO coated. For the GT-MHR these TRISO fuel particles are blended and bonded together with a carbonaceous binder. These fuel compacts are then stacked within a graphite block. For the PMBR, the fuel unit is a 6-cm diameter graphite sphere containing approximately 15,000 fuel particles. As a result, the gas-cooled reactors require a different fuel fabrication process and a different type of fuel fabrication facility. Ideally, to verify that the environmental impacts of this change in the fabrication process are bounded by the reference LWR fuel fabrication process, a comparison of the land use, energy demand, effluents, etc., would be in order. However, because there are no planned or currently operating gas-cooled reactor fuel fabrication plants in the United States, a direct comparison cannot be made at this time. Therefore, we have provided information on the reference fuel fabrication plant along with conceptual design information for a TRISO fabrication plant that was planned for the New Production Reactor and conceptual design information received from one of the gas-cooled reactor vendors.

From WASH-1248, the reference LWR fuel fabrication plant produced fuel for 26 plants (~910 MTU), was located on a site of about 100 acres, required 5.2 million gallons of water per annual fuel requirement of 35 MTU, and required 1,700 MW-hours of electricity per 35 MTU. The WASH-1248 report also states that nearly all of the airborne chemical effluents resulted from the combustion of fossil fuels to produce electricity to operate the fabrication plant. These numbers represented a very small portion of the overall fuel cycle. For example, the electrical usage represented less than 0.5 percent of that needed for the enrichment process, and the water use was less than 2 percent of the overall fuel cycle.

The fuel fabrication facility for the New Production Reactor was for a modular high temperature gas reactor (MHTGR) design and was sized for just one plant. The dimensions for the fuel fabrication building were 230 ft x 150 ft. The annual production was about 2 MTU. The plant required 960 kW of electrical power and 45 liters per minute of water. Effluents consisted of 60 m^3/yr of miscellaneous non-combustible solids and filters; 50 m^3/yr of combustible solids; 50 m^3/yr of process off-gas and HVAC filters; 2.0 m^3/yr of tools and failed equipment; and process off-gases of 900,000 m^3/yr. The process off-gases consisted of 74 percent N_2, 12 percent O_2, 7.2 percent Ar, 6.4 percent CO_2, 0.2 percent CO, and 0.02 percent CH_3CCl_3. The activity associated with this off-gas was 0.01 pCi alpha/m^3, and 0.01 pCi beta/m^3.

Bureau, 2002). Many recreational users of the Clinton Lake State Recreation Area will be able to view the operation areas.

The CPS has a power block structure that is approximately 200-ft tall. The EGC ESP Site will have a power block structure that could be up to 234-ft tall. The heat dissipation system could have a height of up to 550 ft (see SSAR Table 1.4-1). An off-gas structure may be required; however, the height of this structure is unknown. The off-gas structure will likely be the same height as the power block structure and shorter than the height of the heat dissipation system. The CPS Site already exhibits an industrial environment; therefore, the EGC ESP Site will not substantially alter an already visually disturbed site. Any visual impacts from the visible plumes from the EGC ESP Facility will be similar to those associated with the CPS. There is a potential that an additional visible plume will result from the heat dissipation system.

The viewshed of the EGC ESP Facility is limited to only a few residences and recreational users in the vicinity. Based on the fact that the EGC ESP Site will have similar visual impacts as the CPS (with the exception of the new plume from the heat dissipation system), the EGC ESP Site will have a minor impact on aesthetic quality for nearby residences and recreational users of Clinton Lake. Therefore, no mitigation will be provided.

5.8.2 Social and Economic Impacts of Station Operation

Social and economic impacts include impacts to the economy, tax and social structure, housing, educational, recreation, public services and facilities, transportation facilities, distinctive communities, and agriculture.

5.8.2.1 Economic Characteristics

Section 2.5.2.1 describes the regional employment by industry (see Table 2.5-8), the construction labor force within the region (see Table 2.5-8), the total regional labor force (see Table 2.5-8), and the regional unemployment levels and future economic outlook (see Table 2.5-10).

The operation workforce will consist of up to 580 people (see SSAR Table 1.4-1). Operation workforce salaries will have a multiplier effect, where money is spent and re-spent within the region. Local businesses in and around Clinton may see an increase in business, especially in the retail and services sector during normal business hours. The additional employment, although not expected to be significant, may help to sustain existing businesses throughout the region, as well as provide opportunities for some new businesses. The effect of the EGC ESP Site may slightly improve the unemployment levels in the area, which in 2000 were at about 5 percent (see Table 2.5-10). In addition, the increase in tax revenue (described in Section 5.8.2.2) and the slight increase in workforce may provide opportunities for further development in the area.

Finally, the EGC ESP Facility will provide a new source of reliable electricity for the region, which may result in the siting of new industries into the region or expansion of existing industries.

5.9 Decommissioning

This section reviews the environmental impacts of decommissioning the EGC ESP Facility. This ER supports an ESP; therefore, USNRC regulations do not require the applicant to inform the USNRC of its plans for decommissioning the facility. Consequently, no definite plan for the decommissioning of the plant has been developed (USNRC, 1999). Additionally, no financial assurances for decommissioning are required at the ESP stage. The general environmental impacts are summarized in this section, since the decommissioning plans and reports (and consequently detailed analyses of alternatives) are not prepared until cessation of operations.

The USNRC defines decommissioning as the safe removal of a nuclear facility from service and the reduction of residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license (10 CFR 50). Decommissioning must occur because regulations do not permit an operating license holder to abandon a facility after ending operations.

Although this section does not evaluate the impacts of decommissioning on the proposed site, studies of social and environmental effects of decommissioning other nuclear generating facilities have not identified any significant impacts beyond those considered in the USNRC's Generic Environmental Impact Statement (GEIS) on decommissioning (USNRC, 2002). According to the USNRC, decommissioning of a nuclear power plant has certain environmental consequences. The impacts on the proposed site will be discussed in detail at the COL stage. Generally, expected impacts may include minor radiological impacts to the public, but are expected to remain ALARA. Experience at decommissioned power plants has shown that the occupational exposures during the decommissioning period are comparable to those associated with refueling and routine maintenance of the plant when it is operational (USNRC, 1996 and 2002). Socioeconomic impacts of decommissioning would result from the demands on, and contributions to, the community by the workers employed to decommission a power plant. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those of power plant construction or operation because the level of activity and the releases to the environment are expected to be smaller during decommissioning than during construction and operation (USNRC, 2002).

The applicant does not anticipate developing decommissioning plans until termination of operations. As decommissioning plans are developed, efforts will be made to minimize or mitigate any adverse impacts from decommissioning. Additionally, large portions of the site may be available for redevelopment under various regulatory schemes (USNRC, 2002).

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10 CFR 51. Code of Federal Regulations. "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

24 CFR 51. Code of Federal Regulations. "Environmental Criteria and Standards."

29 CFR 1910. Code of Federal Regulations. "General Industry Standards."

40 CFR 190. Code of Federal Regulations. "Environmental Radiation Protection Standards for Nuclear Power Operations."

35 Illinois Administrative Code (IAC), Subtitle H. "Noise." 1987.

TABLE 5.2-7
Water Elevation - Surface Area Relationship for Clinton Lake

Water Surface Elevation	Surface Area (Acres)
670	1,600
672	1,900
674	2,100
676	2,400
678	2,700
680	3,100
682	3,550
684	3,930
686	4,250
688	4,520
690 (Normal Pool Elevation)	4,895

Source: Illinois Power. Clinton Power Station Updated Safety Analysis Report. Revision 10. 2002

TABLE 5.2-8
Water Elevation - Volume Relationship for Clinton Lake

Water Surface Elevation	Volume (Acre-feet)
670	10,500
672	14,500
674	18,000
676	23,000
678	28,000
680	33,900
682	40,600
684	48,000
686	56,000
688	64,800
690 (Normal Pool Elevation)	74,200

Source: Illinois Power. Clinton Power Station Updated Safety Analysis Report. Revision 10. 2002

CHAPTER 5

Tables

TABLE 5.2-1
Clinton Power Station Discharge Permit and Plant Cooling Flows

	Intake (gpm)	Discharge (gpm)	Consumptive Use (gpm)
NPDES Permit [a]	-- [d]	670,000	-- [d]
Clinton Power Station (Lake Cooling Loop)	566,000 (summer) 445,000 (winter) [b]	566,000 (summer) 445,000 (winter) [b]	8,292 [b, c]
Capacity Remaining (under current NPDES permit)	-- [d]	104,000 (summer) 225,000 (winter)	-- [d]

[a] IEPA, 2000
[b] CPS, 2002
[c] Evaporative loss in lake cooling loop
[d] Not applicable

TABLE 5.2-2
Water Use Requirements (Consumptive Use) for Plant Options and Cooling Methods

Bounding Plant Requirement	Wet Cooling Tower	Wet/Dry Cooling Tower[a]	Dry Cooling
Maximum	31,500 gpm	16,000 to 9,450 gpm	0 gpm
Minimum	8,000 gpm	8,000 to 2,400 gpm	0 gpm

Source: SSAR Table 1.4-1
[a] Assumes up to 70 percent of cooling is accomplished in the dry cooling process
Note: Additional forced evaporation due to these cooling methods is insignificant

TABLE 5.2-3
Lake Water Available for Use During Drought Events

Water Use	50-yr Drought	100-yr Drought
Total Water Available For Withdrawal	23,400 gpm	17,800 gpm
Water Consumed By Existing Uprated Plant	8,300 gpm	8,300 gpm
Water Available For ESP Use	15,100 gpm	9,500 gpm

TABLE 5.7-3

10 CFR 51.51 Table S-3- of Uranium Fuel Cycle Environmental Data [a]
Normalized to Model LWR Annual Fuel Requirement [WASH-1248] or Reference Reactor Year [NUREG-0116])

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1,000 MWe LWR
Th-234	0.01	From fuel fabrication plants-- concentration 10 percent of 10 CFR 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9E-06	
Solids (buried on site):		
Other than high level (shallow)	11,300	9,100 Ci comes from low level reactor wastes and 15,000 Ci comes from reactor decontamination and decommissioning -- buried at land burial facilities. 600 Ci comes from mills -- included in tailing returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1E+07	Buried at Federal Repository
Effluents-- thermal (billions of British thermal units)	4,063	<5 percent of model 1,000 MWe LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure	22.6	From reprocessing and waste management.

[a] In some cases where no entry appears, it is clear from the background documents that the matter was addressed and that, in effect, the Table should be read as if a specific zero entry had been made. However; there are other areas that are not addressed at all in the Table. Table S-3 does not include health effects from the effluents described in the Table or estimates of releases of Radon-222 from the uranium fuel cycle or estimates of Technetium-99 released from waste management or reprocessing activities. Radiological impacts of these two radionuclides are addressed in NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, May 1996" and it was concluded that the health effects from these two radionuclides pose a small significance.
Data supporting this table are given in the Environmental Survey of the Uranium Fuel Cycle," WASH-1248, April 1974; the "Environmental Survey of Reprocessing and Waste Management Portion of the LWR Fuel Cycle," NUREG-0116 (Supp. 1 to WASH-1248); the "Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle," NUREG-0216 (Supp.2 to WASH-1248): and in the record of final rulemaking pertaining to Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management, Docket RM-50-3. The contributions from reprocessing, waste management and transportation of wastes are maximized for either of the two fuel cycles (uranium only and fuel recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor which are considered in Table S-4 of §51.20(g). The contributions from the other steps of the fuel cycle are given in columns A-E of Table S-3A of WASH-1248.

[b] The contributions to temporarily committed land from reprocessing are not prorated over 30 years, since the complete temporary impact accrues regardless of whether the plant services one reactor for one year or 57 reactors for 30 years.

[c] Estimated effluents based upon combustion of equivalent coal for power generation.

[d] 1.2 percent from natural gas use and process.

of the EGC ESP Facility. These samples will be analyzed for naturally occurring and man-made radioactive materials. Both indicator and control location(s) will be sampled. Indicator samples will be taken from various locations throughout Clinton Lake, whereas, control samples will be obtained from Lake Shelbyville, approximately 50-mi south of the EGC ESP Facility.

6.2.2.3.1 Fish

Various samples of fish will be collected from Clinton Lake and Lake Shelbyville. From both lakes, these samples will consist of largemouth bass, crappie, carp, and bluegill. The selection of these species is based on fish most commonly harvested from the lakes by sport fishermen. Fish ingest sediments during bottom feeding or prey on other organisms that also ingest sediments that may otherwise retain radionuclides. A radiological analysis from fish samples will provide key information on the potential ingestion of radionuclides by humans via this aquatic pathway. These samples will be collected semi-annually and analyzed by gamma spectroscopy.

6.2.2.3.2 Shoreline Sediments

Samples of shoreline sediments will be collected at Clinton Lake and Lake Shelbyville. Radiological analyses of shoreline sediments will provide information on any potential shoreline exposure to humans, determining long-term trends and the accumulation of long-lived radionuclides from the environment. Samples will be collected semi-annually and analyzed for gross beta, gross alpha, Strontium-90, and gamma isotopic activities.

6.2.2.4 Terrestrial Monitoring

In addition to direct radiation, radionuclides that are present in our atmosphere expose receptors when they are deposited on plants and soil, and subsequently consumed. To monitor this food pathway, samples of green leafy vegetables, grass, and milk will be analyzed.

Surface vegetation samples will be collected monthly during the growing season from a number of locations for the purpose of monitoring the potential buildup of atmospherically deposited radionuclides. The radionuclides of interest, relative to facility operations, are already present within our environment as a result of several decades of worldwide fallout or because they are naturally occurring. Therefore, the presence of these radionuclides is anticipated from the samples collected. These samples will be analyzed by gamma spectroscopy.

6.2.2.4.1 Milk

There is no known commercial production of milk for human consumption within a 5-mi radius of the EGC ESP Facility. Milk samples will be collected from a dairy located about 14-mi west southwest of the facility (twice a month during May through October, and once a month during November through April). These samples will be analyzed for Iodine-131, Strontium-90, and gamma isotopic activities.

6.2.2.4.2 Grass

Grass samples will be collected at three indicator locations and at one control location. These samples will be collected twice a month during May through October, and once a

6.3.3 Preoperational Hydrological Monitoring Program

The Preoperational Hydrological Monitoring Program will be designed to provide the baseline for evaluating hydrologic changes arising from the operation of the EGC ESP Facility.

6.3.3.1 Freshwater Streams

The Preoperational Hydrological Monitoring Program for Salt Creek will be a continuation of the monitoring conducted during the Preapplication and Construction Monitoring programs. The program may be modified based upon the evaluation of the preapplication and construction monitoring data collected from Clinton Lake.

6.3.3.2 Lakes and Impoundments

The continued implementation of the preapplication monitoring should provide the data to assess alterations of surface water flow fields in Clinton Lake (namely the cooling loop), sediment transport, floodplains, or wetlands. The program may be modified based upon the evaluation of the preapplication monitoring data and other information collected for the operation of the CPS.

6.3.3.3 Groundwater

The objective of the Preoperational Hydrological Monitoring Program is to provide the baseline for evaluating hydrologic changes arising from the operation of the EGC ESP Facility. Clinton Lake will be used to meet the facility's water requirements and no groundwater will be used; therefore, there should not be a significant impact to the groundwater system from the operation of the EGC ESP Facility. However, preoperational monitoring will be conducted to reestablish the baseline conditions for groundwater levels and flow after the completion of the construction activities. The monitoring will consist of collecting water levels on a monthly basis from piezometers that remain after the construction.

6.3.4 Operational Hydrological Monitoring Program

The Operational Hydrological Monitoring Program will be designed to establish the impacts from the operation of the EGC ESP Facility and detect any unexpected impacts from facility operation. Based on the monitoring data for the CPS, the Operational Hydrological Monitoring Program is anticipated to extend over a five-year period or until conditions appear to have stabilized based on the trend analysis. Modifications to the monitoring program (e.g., changes in monitoring locations or collection procedures) will be assessed regularly over the duration of the monitoring program.

6.3.4.1 Freshwater Streams

The specific procedures of the operational monitoring requirements of Salt Creek are anticipated to be similar to the Preapplication and Preoperational Monitoring programs. The program may be modified based on data collected and consultations with IEPA and the CPS. The data will be evaluated in order to monitor for changes in the discharge from Clinton Lake to Salt Creek.

TABLE 6.7-1
Proposed Site Preparation (Preconstruction) and Construction Monitoring Programs

Category	Monitoring Location	Summary	Instrumentation Used	Sampling Frequency
Thermal	Salt Creek, upstream from furthest CPS monitoring location	Characterize background conditions of Salt Creek before discharging to Clinton Lake	YSI Multiprobe or Multiparameter Instrument	1/day
Thermal	Salt Creek, upstream from discharge canal	Characterize thermal conditions upstream of the discharge flume	YSI Multiprobe or Multiparameter Instrument	1/day
Thermal	Salt Creek, downstream of the Clinton Lake Dam	Monitor conditions in Salt Creek between the dam and the Rowell gauging station	YSI Multiprobe or Multiparameter Instrument	1/day
Thermal	Clinton Lake, offshore from cooling water discharge flume	Characterize lake conditions at the point of thermal discharge to lake	YSI Multiprobe or Multiparameter Instrument	1/day
Thermal	Clinton Lake, along the path of cooling loop between the discharge and intake flumes	Characterize lake conditions between intake and discharge	YSI Multiprobe or Multiparameter Instrument	1/day
Thermal	Clinton Lake, near the CPS screen house	Characterize lake conditions at intake	YSI Multiprobe or Multiparameter Instrument	1/day
Thermal	Clinton Lake, near the dam	Characterize the conditions of water being discharged to Salt Creek	YSI Multiprobe or Multiparameter Instrument	1/day
Hydrologic (Freshwater streams)	Rowell gauging station	Characterize flow conditions of Salt Creek	Marsh McBirney Flowmeter (or equivalent instrument)	Continuous
Hydrologic (Lakes and Impoundments)	Stations at Parnell Road Bridge and DeWitt County Highway 14 Bridge	Measures sediment thickness to determine annual sedimentation rates	Sediment thickness will be measured with a survey rod (or equivalent instrument)	1/year
Hydrologic (Lakes and Impoundments)	Clinton Lake at the dam	Monitoring of lake water levels as described in the dam operating procedures	Lake levels will be measured with a Miltronics Ultrasonic Level Meter and recorder (or equivalent instrument)	Continuous

TABLE 6.7-1
Proposed Site Preparation (Preconstruction) and Construction Monitoring Programs

Category	Monitoring Location	Summary	Instrumentation Used	Sampling Frequency
Hydrologic (Lakes and Impoundments)	Discharge flume (Outfall 002) Sewage treatment facility (Outfall A02) Water treatment wastes (Outfall 003)	Flow measurements	Marsh McBirney Flowmeter (or equivalent instrument)	1/week
Hydrologic (Lakes and Impoundments)	Outfall C02 Outfall A03	Flow measurements of activated carbon treatment systems effluent	Marsh McBirney Flowmeter (or equivalent instrument)	1/month
Hydrologic (Lakes and Impoundments)	Outfall 015	Estimated total flow for UHS heat sink dredge pond discharge	Marsh McBirney Flowmeter (or equivalent instrument)	Continuous
Hydrologic [a] (Groundwater)	Immediate vicinity of the EGC ESP Site Downstream of dam In Clinton Lake	Location and survey of previously installed CPS piezometers that have not been identified as destroyed by construction activities	N/A	N/A
Hydrologic [a] (Groundwater)	Immediate vicinity of site	Location and identification of existing private wells within 5 mi of the site	N/A	N/A
Hydrologic [a] (Groundwater)	Between the EGC ESP Facility, the CPS, and near Clinton Lake	Installation of additional shallow water table piezometers and deep piezometers to help define lateral continuity of sand layers and to be used during the pumping test	Water level probe	1/month

generation technologies and consulted various state energy plans to identify the alternative generation sources typically being considered by state authorities across the country. From this review, the USNRC had established a reasonable set of alternatives to be examined. These alternatives include wind energy, PV cells, solar thermal energy, hydroelectricity, geothermal energy, incineration of wood waste and MSW, energy crops, coal, natural gas, oil, and delayed retirement of existing non-nuclear plants. The USNRC has considered these alternatives pursuant to its statutory responsibility under NEPA. Although the GEIS is for license renewal, the alternatives analysis in the GEIS can be compared to the proposed action to determine if the alternative represents a reasonable alternative to the proposed action.

Each of the alternatives are assessed and discussed in the subsequent sections relative to the following criteria:

- The alternative energy conversion technology is developed, proven, and available in the relevant region within the life of the ESP permit.
- The alternative energy source provides baseload generating capacity equivalent to the capacity needed, and to the same level as the proposed EGC ESP Facility.
- The alternative energy source does not result in environmental impacts in excess of a nuclear plant, and the costs of an alternative energy source do not exceed the costs that make it economically impractical.

Each of the potential alternative technologies considered in this analysis are consistent with national policy goals for energy use, and are not prohibited by federal, state, or local regulations. These criteria were not factors in evaluating alternative technologies.

Based on one or more of these criteria, several of the alternative energy sources were considered technically or economically infeasible after a preliminary review and were not considered further. Alternatives that were considered to be technically and economically feasible were assessed in greater detail in Section 9.2.3.

9.2.2.1 Wind

Wind resource maps usually identify areas by wind power class (See Figure 9.2-3). Although some midwestern states like North and South Dakota, as well as parts of Iowa, have excellent potential (Class 6 and above) for development of wind generation, the potential for generation is more intermittent in Illinois (ELPC, 2001).

In general, areas identified as Class 4 and above are regarded as potentially economical for wind energy production with current technology. The Department of Energy's Wind Program and National Renewable Energy Laboratory (NREL) wind resource maps for Illinois show that there are scattered areas in central and northern Illinois with the classification of Class 4 with the total of these sites capable of 3000 MWe of potential installed capacity for wind generation. The most favorable of these sites are located southeast of Quincy, the greater Bloomington area, north of Peoria, the Mattoon area, and between Sterling and Aurora (USDOE/EERE, 2004b). EGC does not own or have rights to build a wind generating station on these sites.

At a Class 4 site, the average annual output of a wind power plant is typically about 25 percent of the installed capacity (USDOE/EERE, 2004b). For example, a wind farm on all of the land area identified as Class 4 by NREL within Illinois would generate an average annual output of 750 MWe. In fact, the National Electric Reliability Council (NERC) credits wind capacity at approximately 17 percent (USNRC, 2004). More optimistic assessments place the capacity factor for a Class 4 wind facility at about 29 percent, rising to 35 percent in 2020 based upon assumed improvements in technology (ELPC, 2001). However, even using such numbers would not affect the conclusions presented below (e.g., land usage per average MWe would decrease proportionately with increasing capacity factors, but would still be several times higher than the land usage for a nuclear plant).

As a result of advances in technology and the current level of financial incentive support within Illinois, a number of additional areas with a slightly lower wind resource (Class 3+) may also be suitable for wind development. These would, however, operate at an even lower annual capacity factor and output than that used by NREL for Class 4 sites.

In Illinois, the total amount of Class 4 and 3+ lands is about 1800 km2 (695 mi^2, or 444,800 acres) and the wind potential from these sites is about 9000 MWe of installed capacity (USDOE/EERE, 2004b).

In any wind facility, the land use could be significant. Wind turbines must be sufficiently spaced to maximize capture of the available wind energy. If the turbines are too close together, one turbine can impact the efficiency of another turbine. A 2 MWe turbine requires only about a quarter of an acre of dedicated land for the actual placement of the wind turbine, leaving landowners with the ability to utilize the remaining acreage for some other uses that do not impact the turbine, such as agricultural use.

For illustrative purposes, if all of the resource in Class 3+ and 4 sites were developed using 2 MWe turbines, with each turbine occupying one-quarter acre, 9000 MWe of installed capacity would utilize 1125 acres just for the placement of the wind turbines alone. Based upon the NERC capacity factor, this project would have an average output of 1530 MWe (approximately 0.73 acres / MWe). This is a conservative assumption since Class 3+ sites will have a lower percentage of average annual output, but it is being used here for illustrative purposes. In contrast, the EGC ESP Facility (operating at 90 percent capacity) would have an average annual output of 1962 MWe (2180 MWe * 0.9) and would only occupy approximately 461 acres (approximately 0.23 acres / MWe).

Although wind technology is considered mature, technological advances may make wind a more economic choice for developers than other renewables (CEC, 2003). Technological improvements in wind turbines have helped reduce capital and operating costs. In 2000, wind power was produced in a range of $0.03 - $0.06 / kWh (depending on wind speeds), but by 2020 wind power generating costs are projected to fall to $0.03 - $0.04 / kWh (ELPC, 2001).

The installed capital cost of a wind farm includes planning, equipment purchase and construction of the facilities. This cost, typically measured in $/kWe at peak capacity, has decreased from more than $2,500/kWe in the early 1980’s to less than $1,000/kWe for wind farms in the U.S. Illinois Rural Electric Cooperative recently installed a single 1.65 MWe turbine at a cost of $1.7 million (Halstead, 2004). This cost includes the purchase of the turbine itself, construction of access roads and foundations, and connection to the transmission system. This decrease in construction costs is due primarily to improvements in wind turbine technology, but also to the general increase in wind farm sizes. Larger wind farms in windy areas benefit from economies of scale in all phases of a wind project from planning to decommissioning, as fixed costs can be spread over a larger total generating capacity. These "economies of scale" may not be available in the region of interest, given the availability of the resource (CEC, 2003).

As an example of cost, a wind generating facility that has an installed capacity of 75 MWe can produce power at a levelized rate of $0.049/kWh. With the Federal Production Tax Credit (PTC), the cost is reduced to $0.027 - $0.035/kWh. The PTC primarily reduced the tax burden and operating costs for wind generating facilities, which was vital to financing of facilities. The PTC expired in December 2003 and has not been renewed, even though it has support in the 2003 Energy Policy Act (U.S. Senate, 2003). As a result, a smaller number of completed wind projects in Illinois are anticipated. As the General Manager of the Illinois Rural Electric Cooperative explains "The energy bill stalled in Congress last fall, and still has not been passed, so right now there's not an authorization for production tax credits for new turbines. As a consequence, you're not going to have new turbines being installed by developers until that production tax credit returns. And the economics are such that you absolutely have to have a substantial body of grants and support as we do, and/or the production tax credits" (Halstead, 2004). As a tax credit, the PTC represented 1.8 cent per kWh of tax-free money to the project owner. If the owner did not receive the tax credit and wanted to recoup the 1.8 cents per kWh with taxable revenue from electricity sales, the owner would have to add at least 1.8 cents and possibly as much as 2.8 cents to the sales price of each kWh, assuming a 36-percent marginal tax rate.

The Energy Information Agency's (EIA) *Annual Energy Outlook 2004 with projections to 2025* assumes no extension of the PTC beyond 2003. Further, the EIA projects that the levelized cost of electricity generated by wind plants coming on line in 2006 (over a 20-year financial project life) would range from approximately 4.5 cents per kilowatthour at a site with excellent wind resources to 5.7 cents per kilowatthour at less favorable sites (USDOE/EIA, 2004a). In contrast, the levelized cost for electricity from new natural gas combined-cycle plants is 4.7 cents per kWh, and for new coal-fired plants, the projected cost in 2007 is 4.9 cents per kWh (USDOE/EIA, 2004a). Nuclear plants are anticipated to produce power in the range of 3.1 to 4.6 cents per kWh (USDOE, 2002) (USDOE, 2004).

In addition to the construction and operating and maintenance costs for wind farms, there are costs for connection to the transmission grid. Any wind project would have to be located where the project would produce economical generation and that location may be far removed from the nearest possible connection to the transmission system. A location far removed from the power transmission grid might not be economical, as new transmission lines will be required to connect the wind farm to the distribution system. Existing transmission infrastructure may need to be upgraded to handle the additional supply. Soil conditions and the terrain must be suitable for the construction of the towers' foundations. Finally, the choice of a location may be limited by land use regulations and the ability to obtain the required permits from local, regional and national authorities. The further a wind energy development project is from transmission lines, the higher the cost of connection to the transmission and distribution system. A recent report to Congress on wind resource locations and transmission requirements in the upper Midwest (Upper Midwest for this report was defined as the States of North and South Dakota, Minnesota, Illinois, Iowa, Nebraska, and Wisconsin) concluded, "Transmission in the upper Midwest is generally constrained. In addition, because power generation is often transmitted over long distances to metropolitan centers, the upper Midwest has voltage and stability issues that must be considered. Since it is more economic to transmit wind from remote areas, developing more wind energy in remote areas may aggravate these voltage and stability issues (USDOE/EERE, 2004a)." In contrast, the EGC ESP site is located in southern Illinois, and is located near interties with the adjoining transmission systems.

The distance from transmission lines at which a wind developer can profitably build depends on the cost of the specific project. Consider, for example, the cost of construction and interconnection for a 115-kV transmission line that would connect a 50 MWe wind farm with an existing transmission and distribution network. The EIA estimated, in 1995, the cost of building a 115-kV line to be $130,000 per mile, excluding right-of-way costs (USDOE/EIA, 2004b). This amount includes the cost of the transmission line itself and the supporting towers. It also assumes relatively ideal terrain conditions, including fairly level and flat land with no major obstacles or mountains (more difficult terrain would raise the cost of erecting the transmission line.). In 1993, the cost of constructing a new substation for a 115-kV transmission line was estimated at $1.08 million and the cost of connection for a 115-kV transmission line with a substation was estimated to be $360,000 (USDOE/EIA, 1995).

In 1999, the USDOE analyzed the total cost of installing a wind facility in various NERC regions. They first looked at the distribution of wind resources and excluded land from development based on the classification of land. For example, land that is considered wetlands and urban are totally excluded whereas land that is forested has 50 percent of its land excluded. They then characterized those resources that were sufficiently close to existing 115- to 230-kV transmission lines, classified them into three distinct zones, and applied an associated standard transmission fee for connecting the new plant with the existing network. They then used additional cost factors to account for the greater distances between wind sites and the existing transmission networks. Capital costs were added based on whether the wind resource was technically accessible now and whether it could be economically accessible by 2020. Based on this USDOE analysis, Illinois has no known economically useful wind resources (USDOE/EIA, 1999a).

Another consideration on the integration of the wind capacity into the electric utility system is the variability of wind energy generation. Wind-driven electricity generating facilities must be located at sites with specific characteristics to maximize the amount of wind energy captured and electricity generated (ELPC, 2001). In addition, for transmission purposes, wind generation is not considered "dispatchable," meaning that the generator can control output to match load and economic requirements. Since the resource is intermittent, wind, by itself, is not considered a firm source of baseload capacity. The inability of wind alone to be a dispatchable, baseload producer of electricity is inconsistent with the objectives for the EGC ESP Facility.

Finally, wind does have environmental impacts, in addition to the land requirements posed by large facilities. First, some consider large-scale commercial wind farms to be an aesthetic problem. In one case, residents opposing the Cordelia Hills wind project in Solano County,

9.2.2.4 Solar Power

Solar energy is dependent on the availability and strength of sunlight (strength is measured as kWh/m^2). Solar power is considered an intermittent source of energy. This section addresses solar power alone and only those solar technologies capable of being connected to a transmission grid. Combinations of solar power with other generating sources are discussed in Section 9.2.3.3.

Solar power is not generally considered a baseload source. Storage technologies have not advanced to a point where solar power can be considered as feasible alternatives to large baseload capacity (USDOE/EERE, 2004e). However, all solar technologies provide a fuel-saving companion to a baseload source. These technologies can be divided into two groups. The first group concentrates the sun's energy to drive a heat engine (concentrating solar power systems). The other group of solar power technologies directly converts solar radiation into electricity through the photoelectric effect by using photovoltaics (also known as PV).

In Illinois, solar energy varies from 4-5 $kWh/m^2/day$ in the summer to as low as 2-3 $kWh/m^2/day$ in the winter (see figure 9.2-4). The areas with the highest amount of solar radiation are in the southwestern part of the state, with radiation rates of 6-7 kWh/m^2 at the brightest time of a summer day, but most of Illinois falls in the range of 5.5-6 kWh/m^2. This resource is relatively low, particularly when compared to the southwestern United States. For example, parts of southern California can generate 10-12 kWh/m^2 of solar radiation during the brightest part of summer days. From a national resource availability perspective, then, it can be seen that the region of interest is not an attractive location for development of solar power. In addition to the relatively low amount of solar resource available, solar radiation varies by month (USDOE/NREL, 2004c). Solar energy also has a definite diurnal characteristic – the sun does not shine at night. Recognizing the comparative "abundance" of solar energy in the region of interest and the intermittent nature of solar-based electricity generation, various solar technologies are discussed below.

9.2.2.4.1 Concentrating Solar Power Systems

Concentrating solar power plants only perform efficiently in very sunny locations, specifically the arid and semi-arid regions of the world (USDOE/EERE, 1999). This does not include Illinois.

Concentrating solar plants produce electric power by converting the sun's energy into high-temperature heat using various mirror configurations. The heat is then channeled through a conventional generator, via an intermediate medium (i.e., water or salt). Concentrating solar plants consist of two parts: one that collects the solar energy and converts it to heat, and another that converts heat energy to electricity.

Concentrating solar power systems can be sized for "village" power (10 kW) or grid-connected applications (up to 100 MW). Some systems use thermal energy storage (TES), setting aside heat transfer fluid in its hot phase during cloudy periods or at night. These attributes, along with solar-to-electric conversion efficiencies, make concentrating solar power an attractive renewable energy option in the Southwest of the United States and other Sunbelt regions worldwide (USDOE/EERE, 2004d). Others can be combined with natural gas. This type of combination is discussed in Section 9.2.3.3.

There are three kinds of concentrating solar power systems—troughs, dish/engines, and power towers—classified by how they collect solar energy (USDOE/EERE, 2004d). Each is briefly discussed below.

Trough systems: The sun's energy is concentrated by parabolically curved, trough- shaped reflectors onto a receiver pipe running along the inside of the curved surface. This energy heats oil flowing through the pipe and the heat energy is then used to generate electricity in a conventional steam turbine generator.

A collector field comprises many troughs in parallel rows aligned on a north-south axis. This configuration enables the single-axis troughs to track the sun from east to west during the day to ensure that the sun is continuously focused on the receiver pipes. Individual trough systems currently can generate about 80 MWe. Experimental trough systems in California can currently generate approximately 300 MWe.

Current storage capacity at trough plants is minimal – most plant only have a storage capacity of 25 percent. Trough designs can incorporate TES allowing for electricity generation several hours into the evening. Currently, all parabolic trough plants are "hybrids," meaning they use fossil-fueled generation to supplement the solar output during periods of low solar radiation. This type of combination is discussed in Section 9.2.3.3.

Dish/engine systems: A dish/engine system is a stand-alone unit composed primarily of a collector, a receiver, and an engine. The sun's energy is collected and concentrated by a dish-shaped surface onto a receiver that absorbs the energy and transfers it to the engine's working fluid. The engine converts the heat to mechanical power in a manner similar to conventional engines—that is, by compressing the working fluid when it is cold, heating the compressed working fluid, and then expanding it through a turbine or with a piston to produce work. The mechanical power is converted to electrical power by an electric generator or alternator.

Dish/engine systems use dual-axis collectors to track the sun. The ideal concentrator shape is parabolic, created either by a single reflective surface, multiple reflectors, or facets. Many options exist for receiver and engine type, including Stirling engine and Brayton receivers.

Dish/engine systems are not commercially available yet, although ongoing demonstrations indicate the potential for commercial viability. Individual dish/engine systems currently can generate about 25 kW of electricity. More capacity is possible by connecting dishes together. These systems can be combined with natural gas generation and the resulting hybrid provides continuous power generation. This type of combination is discussed in Section 9.2.3.3.

Power tower systems: The sun's energy is concentrated by a field of hundreds or even thousands of mirrors (called "heliostats") onto a receiver located on top of a tower. This energy heats molten salt flowing through the receiver, and the salt's heat energy is then used to generate electricity in a conventional steam turbine generator. The molten salt retains heat efficiently, so it can be stored for hours or even days before it loses its capacity to generate electricity. Solar Two, a demonstration power tower located in the Mojave Desert in California, generated about 10 MW of electricity before the project was discontinued in 1999.

In these systems, the molten salt at 550°F is pumped from a "cold" storage tank through the receiver, where it is heated to 1,050°F and then on to a "hot" tank for storage. When power is needed from the plant, hot salt is pumped to a steam generating system that produces steam to power a turbine generator. From the steam generator, the salt is returned to the cold tank, where it is stored and eventually reheated in the receiver.

With TES, power towers can operate at an annual capacity factor of 65 percent which means they can potentially operate for 65 percent of the year without the need for a back-up fuel source. Without energy storage, solar technologies like this are limited to annual capacity factors near 25 percent. The power tower's ability to operate for extended periods of time on stored solar energy separates it from other solar energy technologies.

Concentrating solar energy systems have a close resemblance to most power plants operated by the nation's power industry and their ability to provide central generation. Concentrating solar power technologies utilize many of the same technologies and equipment used by conventional power plants, simply substituting the concentrated power of the sun for the combustion of fossil fuels to provide the energy for conversion into electricity. This "evolutionary" aspect—as distinguished from "revolutionary" or "disruptive"—allows for easy integration into the transmission grid. It also makes concentrating solar power technologies the most cost-effective solar option for the production of large-scale electricity generation (10 MWe and above).

While concentrating solar power technologies currently offer the lowest-cost solar electricity for large-scale electricity generation, these technologies are still in the demonstration phase of development and cannot be considered competitive with fossil- or nuclear-based technologies (CEC, 2003). Current technologies cost 9 to 12 cents per kilowatt-hour (kWh). New innovative hybrid systems that combine large concentrating solar power plants with conventional natural gas combined cycle or coal plants can reduce costs to $1.5 per watt and drive the cost of producing electricity from solar power to below 8 cents per kWh (USDOE/EERE, 2004b). This type of combination is discussed in Section 9.2.3.3. Future advances are expected to allow electricity from solar power to be generated for 4 to 5 cents per kWh in the next few decades (USDOE/EERE, 2004d). In contrast, nuclear plants are anticipated to produce power in the range of 3.1 to 4.6 cents per kWh (USDOE, 2002) (USDOE, 2004).

9.2.2.4.2 Photovoltaic Cells

The second main method for capturing the sun's energy is through the use of photovoltaics. A typical PV or solar cell might be a square that measures about 4 inches (10 cm) on a side. A cell can produce about 1 watt of power—more than enough to power a watch, but not enough to run a radio.

When more power is needed, some 40 PV cells can be connected together to form a "module." A typical module is powerful enough to light a small light bulb. For larger power needs, about 10 such modules are mounted in PV "arrays," which can measure up to several meters on a side. The amount of electricity generated by an array increases as more modules are added.

"Flat-plate" PV arrays can be mounted at a fixed-angle facing south, or they can be mounted on a tracking device that follows the sun, allowing them to capture more sunlight over the course of a day. Ten to 20 PV arrays can provide enough power for a household; for large electric utility or industrial applications, hundreds of arrays can be interconnected to form a single, large PV system (USDOE/EERE, 2004b). According to USDOE estimates, land use for this technology is approximately 2.5 ac to 12 ac/MWe (USDOE/NREL, 2004b).

Some PV cells are designed to operate with concentrated sunlight, and a lens is used to focus the sunlight onto the cells. This approach has both advantages and disadvantages compared with flat-plate PV arrays. Economics of this design turns on the use of as little of the expensive semiconducting PV material as possible, while collecting as much sunlight as possible. The lenses cannot use diffuse sunlight, but must be pointed directly at the sun and move to provide optimum efficiency. Therefore, the use of concentrating collectors is limited to the west and southwest areas of the country. According to the USDOE estimates, land use for this method is approximately 5 ac to 12 ac/MWe (USDOE/NREL, 2004a).

Available photovoltaic cell conversion efficiencies are in the range of approximately 15 percent (15 percent) (Siemens, 2004). The average solar energy falling on a horizontal surface in the Illinois region in June, a peak month for sunlight, is approximately 4 to 5 kWh/m^2 per day (USDOE/EERE, 2004b). If an average solar energy throughout the year of approximately 5 kWh/m^2 per day and a conversion efficiency of 15 percent were used, photovoltaic cells would yield an annual electricity production of approximately 274 kWh/m^2 per year in Illinois. At this rate of generation, generating base-loaded electricity equivalent to the EGC ESP Facility would require approximately 62,726,715 m^2 [(2180 MWe (See ER Sec. 3.7.2) *0.9 * 8760 hr/yr * 1000 kW/MW / 274 kWh/m^2/yr)] or approximately 63 km^2 (24 mi^2) of PV arrays.

The same values that drive the PV system market also set the wide range of PV costs. The high range of capital costs of $5 to $12 per watt is offset by low operating costs, measured in kWh. The 20-year life-cycle cost ranged from 20 to 50 cents per kWh (USDOE/EERE, 2004f).

Currently, photovoltaic solar power is not competitive with other methods of producing electricity for the open wholesale electricity market. When determining the cost of solar systems, the totality of the system must be examined. There is the price per watt of the solar cell, price per watt of the module (whole panel), and the price per watt of the entire system. It is important to remember that all systems are unique in their quality and size, making it difficult to make broad generalizations about price. The average PV cell price was $2.40 per peak watt in 2000 and the average per peak watt cost of a module was $3.46 in the same year (USDOE/EIA, 1999). The module price however does not include the design costs, land, support structure, batteries, an inverter, wiring, and lights/appliances. With all of these included, a full system can cost anywhere from $7 to $20 per watt (Fitzgerald, 2004). Costs of PV cells in the future may be expected to decrease with improvements in technology and increased production. Optimistic estimates are that costs of grid-connected PV systems could drop to $2,275 per kW and to $0.15 to $0.20 per kWh by 2020 (ELPC, 2001). These costs would still be substantially in excess of the costs of power from a new nuclear plant.

9.2.2.4.3 Environmental Impacts

Land use and aesthetics are the primary environmental impacts of solar power. Land requirements for each of the individual solar energy technologies is large, compared to the land used for the EGC ESP Facility. The land required for the solar generating technologies combination alternative to have the capacity to generate baseload power equivalent to the EGC ESP Facility.

When examining a combination of alternatives that would meet the business objectives similar to that of the EGC ESP Facility, any combination that includes a renewable power source (either all or part of the capacity of the EGC ESP Facility) must be combined with a fossil-fueled facility equivalent to the generating capacity of the EGC ESP Facility. This combination would allow the fossil-fueled portion of the combination alternative to produce the needed power if the renewable resource is unavailable and to be displaced when the renewable resource is available. For example, if the renewable portion is some amount of potential wind generation and that resource became available, then the output of the fossil-fueled generation portion of the combination alternative could be lowered to offset the increased generation from the renewable portion. This facility, or facilities, would satisfy business objectives similar to those of the EGC ESP Facility in that it would be capable of supporting fossil-fueled baseload power.

Coal - and gas – fired generation have been examined in Sections 9.2.3.1 and 9.2.3.2, respectively, as having environmental impacts that are equivalent to or greater than the impacts of the EGC ESP Facility. Based on the comparative impacts of these two technologies, as shown in Table 9.2-6, it can be concluded that a gas-fired facility would have less of an environmental impact than a comparably sized coal-fired facility. In addition, the operating characteristics of gas-fired generation are more amenable to the kind of load changes that may result from inclusion of renewable generation such that the baseload generation output of 2180 MWe is maintained. "Clean Coal" power plant technology could decrease the air pollution impacts associated with burning coal for power. Demonstration projects show that clean coal programs reduce NO_x, SO_x, and particulate emissions. However, the environmental impacts from burning coal using these technologies, if proven, are still greater than the impacts from natural gas (USDOE/NETL, 2001). Therefore, for the purpose of examining the impacts from a combination of alternatives to the EGC ESP Facility, a facility equivalent to that described in Section 9.2.3.2 (gas-fired generation) will be used in the environmental analysis of combination alternatives. The analysis accounts for the reduction in environmental impacts from a gas-fired facility when generation from the facility is displaced by the renewable resource. The impact associated with the combined-cycle natural gas-fired unit is based on the gas-fired generation impact assumptions discussed in Section 9.2.3.2. Additionally, the renewable portion of the combination alternative would be any combination of renewable technologies that could produce power equal to or less than the EGC ESP Facility at a point when the resource was available. The environmental impacts associated with wind and solar generation schemes are outlined in Sections 9.2.2.1 and 9.2.2.4, respectively. This combination of renewable energy and natural gas fired generation represents a viable mix of non-nuclear alternative energy sources.

For the purpose of the economic comparison of a combination of alternatives, a coal plant in combination with the renewable resource was analyzed. Coal is used for the purposes of the economic comparison because coal plants generate power at a lower cost than gas plants.

9.2.3.3.2 Environmental Impacts

The environmental impacts associated with a gas-fired facility sized to produce power equivalent to the EGC ESP Facility have already been analyzed in Section 9.2.3.2. Depending on the level of potential renewable output included in the combination alternative, the level of impact of the gas-fired portion will be comparably lower. If the renewable portion of the combination alternative were not enough to displace the power produced by the fossil fueled facility, then there would be some level of impact associated with the fossil fueled facility. Consequently, if the renewable portion of the combination alternative were enough to fully displace the output of the gas-fired facility, then, when the renewable resource is available, the output of fossil fueled facility could be eliminated, thereby eliminating its operational impacts. The lower the output of the renewable portion of the combination alternative, the closer the impacts approach the level of impact described in Section 9.2.3.2 for gas-fired generating facilities.

Determination of the types of environmental impacts of these types of 'hybrid' plants or combination of facilities can be surmised from analysis of past projects.

For instance, in 1984, Luz International, Ltd. built the Solar Electric Generating System (SEGS) plant in the California Mojave Desert. The SEGS technology consists of modular parabolic-trough solar collector systems, which use oil as a heat transfer medium. One unique aspect of the Luz technology is the use of a natural-gas-fired boiler as an oil heater to supplement the thermal energy from the solar field or to operate the plant independently during evening hours. SEGS I was installed at a total cost of $62 million (~$4,500/kW) and generates power at 24 cents/kWh (in 1988 real levelized dollars). The improvements incorporated into the SEGS III-VI plants (~$3,400/kW) reduced generation costs to about 12 cents/kWh, and the third-generation technology, embodied in the 80-MW design at an installed cost of $2,875/kW, reduced power costs still further, to 8 to 10 cents/kWh. Because solar energy is not a concentrated source, the dedicated land requirement for the Luz plants is large compared to conventional plants--on the order of 5 ac/MW (2 ha/MW) (USDOE/NREL, 2004b), compared to 0.23 acres per MWe for a nuclear plant.

In Illinois, the solar thermal source is approximately 4.5 kWh/m²; the SEGS units were built in an area of where the solar source is 5.5 kWh/m². Using the above metrics for land use and the solar source of 4.5 kWh/m² per day in Illinois, a similar SEGS unit within the region of interest would require dedicated land of approximately 6 acres/MWe (USDOE/EERE, 2004b), compared to 0.23 acres per MWe for a nuclear plant. Land use for generating baseload equivalent to the EGC ESP Facility would require approximately 13,000 acres (20 mi²)(2180 MWe *6 acres/MW). Additionally, given the lower thermal source in Illinois, the capital costs for the solar portion of the hybrid plant would be proportionally greater than for the SEGS.

In the case of parabolic trough plants, all plants of this type of solar technology are configured in combination with a fossil fueled generation component. A typical configuration is a natural gas-fired heat or a gas steam boiler/reheater coupled to the trough system. Troughs also can be integrated with existing coal-fired plants. With the current trough technology, annual production nationwide is about 100 kWh/m² (USDOE/EERE, 2004d). Parabolic trough plants require a significant amount of land; typically the use is preemptive because parabolic troughs require the land to be graded level. A report, developed by the California Energy Commission (CEC), notes that 5 to 10 acres per MWe is necessary for concentrating solar power technologies such as trough systems (CEC, 2004).

The environmental impacts associated with a solar and a wind facility equivalent to the EGC ESP Facility have already been analyzed in Sections 9.2.2.1 and 9.2.2.4, respectively. It is reasonable to expect that the impacts associated with an individual unit of a smaller size would be similarly scaled. None of the impacts would be greater than those discussed in Sections 9.2.2.1 and 9.2.2.4. If the renewable portion of the combination alternative is unable to generate an equivalent amount of power as the EGC ESP Facility, then the combination alternative would have to rely on the gas-fired portion to meet the equivalent capacity of the EGC ESP Facility. Consequently, if the renewable portion of the combination alternative has a potential output that is equal to that of the EGC ESP Facility, then the impacts associated with the gas-fired portion of the combination alternative would be lower but the impacts associated with the renewable portion would be greater. The greater the potential output of the renewable portion of the combination alternative, the closer the impacts would approach the level of impact described in Sections 9.2.2.1 and 9.2.2.4.

The environmental impacts associated with a gas-fired facility and equivalent renewable facilities are shown in Table 9.2-7 and summarized in Table 9.2-6. The gas-fired facility alone has impacts that are larger than the EGC ESP Facility; some environmental impacts of renewables are also greater than or equal to the EGC ESP Facility.

The combination of a gas-fired plant and wind or solar facilities would have environmental impacts that are equal to or greater than those of a nuclear facility.

- All of the environmental impacts of a new nuclear plant at the EGC ESP Site and all of the impacts from a gas-fired plant are small, except for air quality impacts from a gas-fired facility (which are moderate). Use of wind and/or solar facilities in combination with a gas-fire facility would be small, and therefore would be equivalent to the air quality impacts from a nuclear facility.
- All of the environmental impacts of a new nuclear plant at the EGC ESP Site and all of the impacts from wind and solar facilities are small, except for land use and aesthetic impacts from wind and solar facilities (which range from moderate to large). Use of a gas-fired facility in combination with wind and solar facilities would reduce the land usage and aesthetic impacts from the wind and solar facilities. However, at best, those impacts would be small, and therefore would be equivalent to the land use and aesthetic impacts from a nuclear facility.

Therefore the combination of wind and solar facilities and gas-fired facilities is not environmentally preferable to the EGC ESP Facility.

9.2.3.3.3 Economic Comparison

As noted earlier, the combination alternative must generate power equivalent to the capacity of the EGC ESP Facility. The USDOE has estimated the cost of generating electricity from a gas-fired facility (4.7 cents per kWh), a coal facility (4.9 cents per kWh), as well as wind (5.7 cents per kWh for sites similar to those in the region of interest), and solar (4 to 5 cents per kWh). The cost for gas-fired facility in combination with a renewable facility would increase, because the facility would not be operating at full availability when it is displaced by the renewable resource. As a result, the capital costs and fixed operating nuclear facility at the area would have roughly the same general environmental impact as the existing facility.

9.3.3.3.3.1 Consumptive Use of Water

Dresden's primary source of makeup water is the Kankakee River, with discharge flowing into the Illinois River. Earlier environmental reports on the Dresden Station note little discernable effect caused by consumptive use of surface water or groundwater. The top of the Cambrian-Ordovician aquifer is 500 to 800 ft below the surface and use of surface water for cooling and other activities at a new plant would not affect aquifer levels. However, shallow aquifers were affected by initial construction of the units in the late 1960s and EGC assumes that the same effect would occur if a new facility were built at the site. Some change in the pattern of surface water runoff was noted, although the impacts were considered indiscernible (USNRC, 1972).

The station only draws water from the deep aquifer in small amounts, compared to other consumptive uses in the area. It is expected that the continued use of groundwater will not have any significant impact on shallow aquifers or water use in the area. The two operating units use indirect closed cycle systems, and the effect on surface water use is minimal (EGC, 2003). The bounding case for this report also plans cooling towers, as described in Chapter 3, that will mitigate consumptive water use. Consumptive use of water predicted for the EGC ESP Facility cooling systems is described in Table 5.2-2. Consumptive use is expected to be minimal.

9.3.3.3.3.2 No Further Species Endangerment

At the time early environmental assessments were made of the Dresden facilities, all large-scale construction activities had been completed and operation was in full force. Recent environmental reviews show that three Illinois-listed threatened and endangered species have been collected in the vicinity of the site (EGC, 2003a). It is not expected that construction or operation of a new nuclear plant would have any detrimental effects on the area around the facility.

9.3.3.3.3.3 Effects on Spawning Grounds

The Dresden site has been operated as a nuclear plant since the early 1960s. No spawning grounds or otherwise sensitive ecosystems have been noted. It is expected that no adverse effect on spawning grounds will occur with the construction and operation of new units at the facility (EGC, 2003a).

9.3.3.3.3.4 Effluent Discharge and Water Quality

Dresden operates under a NPDES permit issued by the State of Illinois. The early environmental reports note that water quality of the Illinois River may be affected by chemical discharge (USNRC, 1972).

It is not anticipated that discharges from a new facility will exceed current limits. As noted in Section 5.2, one target established for the EGC ESP Facility is to maintain the cumulative discharge rate within CPS permit conditions. For the purposes of this review, it is anticipated that the bounding case for the proposed facility would be the existing permits at Dresden.

available in the site boundaries. There are no records of endangered aquatic species on this stretch of the Illinois River (USNRC, 1972).

9.3.3.3.4.3 Effects on Spawning Grounds
No spawning grounds or otherwise sensitive ecosystems have been noted. It is expected that no adverse effect on spawning grounds will occur with the construction and operation of new units at the facility.

9.3.3.3.4.4 Effluent Discharge and Water Quality
LaSalle County Station operates under a NPDES permit issued by the State of Illinois. The early environmental reports note that water quality may be affected by chemical discharge; there is no record that NPDES limits have been exceeded during operation of the existing plants. As noted in Section 5.2, one target established for the EGC ESP Facility is to maintain the cumulative discharge rate within CPS permit conditions. For the purposes of this review, it is anticipated that the bounding case for the proposed facility would be the existing permits at the Station.

9.3.3.3.4.5 Preemption and Other Land Use Issues
Land use remains predominantly agricultural. No new land will be preempted if new units are placed on the site.

9.3.3.3.4.6 Potential Effect on Aquatic and Terrestrial Environment
No long term negative effects are anticipated if new units were placed at the LaSalle County Station site. Three groups of terrestrial bird life (waterfowl, upland game, and raptors) use the area, but no difference in the populations has been attributed to the operation of the LaSalle Station. Mammalian species have likewise adjusted to the station's operations, and no change in range or viability of these populations has been noted. The applicant expects that the population will remain stable if new units are placed at the site. However, some temporary displacement is expected as a result of construction of new units (see Chapter 4).

Adverse impacts to aquatic environments are not expected to result from operation of new units at the site. The Illinois River is best characterized as a recovering river system, and abundance and diversity of aquatic species and habitats is restricted by upstream pollutants, commercial and recreational boat traffic, and continuing habitat alteration. These factors arise from offsite use of the river corridor; operation of the current LaSalle County Station is not a significant factor in the overall quality of aquatic habitats in the vicinity of the plant.

9.3.3.3.4.7 Population Characteristics
The LaSalle County Station site currently meets the population requirements of 10 CFR 100, and overall population is consistent with a rural, agrarian community. The population within 5 mi is expected to grow to 1,273 by the year 2020, which maintains the low population density of 16.20. The density reflects the continuing rural character of the site. The population within 50 mi is expected to reach 1.6 million by the year 2020. Population growth is expected to occur in the 35- to 50-mi range, as population centers like Joliet continue to grow, and Chicago suburbs expand. It is expected that population density in the 50-mi radius will grow to approximately 211.1 people per mi^2. However, it is predicted that the density between 40 and 50 mi will increase to 292.7 people per mi^2. Low density expected to continue inside the 10-mi radius (EGC, 2002a).

of 25 mi are approximately 449,082 and 229 people per mi^2, respectively. Davenport, Iowa, is the largest population center within 50 mi, with a population of over 100,000. Population growth near the plant has been slow and generally consistent with the rural population growth rate in the Quad Cities area of about 1 percent per year maximum. There are no known factors that would change the 1 percent maximum rural growth rate in the foreseeable future (EGC 2003c).

9.3.3.3.6 Zion Generating Station

Zion Generating Station is located on the west shore of Lake Michigan about 40-mi north of Chicago, Illinois, and about 42-mi south of Milwaukee, Wisconsin. The site is in the extreme eastern portion of the city of Zion, Illinois (Lake County). It is on the west shore of Lake Michigan, approximately 6-mi north-northeast of the center of the city of Waukegan, Illinois, and 8-mi south of the center of the city of Kenosha, Wisconsin. The site comprises approximately 250 ac, which are owned by the EGC. The site is traversed from west to east by Shiloh Boulevard near the northern property boundary.

The facility is a former nuclear facility that has been converted into a voltage-stabilizing facility. The two reactors were shut down in early 1998. The unit's generators were converted to synchronous condensers (EGC, 1998).

The most current information is from the Zion decommissioning SAR prepared in 1998. However, some of the existing environmental information from the 1972 final environmental statement has been used to postulate impacts from siting a new nuclear facility at Zion. The Zion station is currently in SAFSTOR. The Zion facilities still exist; however, they are currently used for synchronous condenser operations. It is assumed that a new nuclear facility at the area would have roughly the same general environmental impact as the existing facility.

9.3.3.3.6.1 Consumptive Use of Water

The plant's cooling water is drawn from Lake Michigan. The Lake County Public Water District operates a water intake about 1-mi north of the site and about 3,000 ft out in the Lake. Operation of a new plant will not result in releases greater than 10 CFR 20 limits at the point of discharge, and consequently, normal operation should not result in significant radioactivity concentrations in drinking water. The topography of the site and its immediate environs is relatively flat with elevations varying from the lake shoreline to approximately 20 ft above the level of the lake. Approximately 2-mi west of Lake Michigan is a topographical divide causing surface water drainage west of the divide to flow away from the lake while the east drainage flows toward the lake (EGC, 1998).

At the time of operation, the Zion facility used more than 1.5 million gpm water in its cooling system, along with minor consumption. The domestic water was obtained from the City of Zion's system. It is assumed that for a new plant, consumptive water use would also come from the City of Zion (USNRC, 1972b). However, consumptive use of water for the EGC ESP Facility depends on the cooling system and plant design selected. Bounding requirements for consumptive use of water from the EGC ESP Facility are described in Table 5.2-2. Consumptive use is expected to be minimal.

9.3.3.3.6.2 No Further Species Endangerment

The Final Environmental Statement contained no reviews of endangered species to determine whether operation of the station would lead to further species endangerment. The current information shows that no endangered species have been identified at the site. However, Lake Michigan provides an important habitat and spawning grounds for several species.

9.3.3.3.6.3 Effects on Spawning Grounds

There is no indication from available data that there are any spawning grounds in the vicinity of the site. Generally, inshore regions with sand-gravel bottoms are considered valuable spawning grounds in the Great Lakes ecosystem, and it is anticipated that additional impacts from construction and operation of a new facility at the site will affect these areas.

9.3.3.3.6.4 Effluent Discharge and Water Quality

Aside from cooling water discharge, some industrial effluent and stormwater will be discharged. As noted in Section 5.2, one target established for the EGC ESP Facility is to maintain the cumulative discharge rate within CPS permit conditions. For the purposes of this review, it is anticipated that the bounding case for the proposed facility would be the permits historically issued at the Station.

9.3.3.3.6.5 Preemption and Other Land Use Issues

The Zion Station site was acquired in the 1950s, and has been used as a generating facility and synchronous condenser site. Land use at the site and surrounding vicinity is expected to remain industrial. It is not anticipated that any additional land will be preempted if the site were used for a new nuclear facility.

9.3.3.3.6.6 Potential Effect on Aquatic and Terrestrial Environment

The terrestrial ecology around the site is characterized by dunes, prairie, forest, and beach environments. There is a unique dune environment in the vicinity of the site, but there was no history of adverse impacts from operation of the Zion nuclear facility. There may be some temporary adverse impacts from construction of the EGC ESP Facility at Zion, as noted in the construction impacts discussion of this ER (see Chapter 4). There is no evidence of permanent adverse environmental impacts on terrestrial ecology if a new facility were to be built on this site.

The primary aquatic ecology is Lake Michigan. The lake is characterized by low nutrient concentrations and biological productivity. Near the Zion site, inshore waters are characterized as mesotrophic or intermediate, with respect to nutrients. Substantial declines in fish populations have occurred in Lake Michigan due to pollution and other uses. Nothing in the USNRC's environmental statement or the decommissioning SAR indicate that operation of a facility at the site would adversely affect aquatic environments (USNRC, 1972b; EGC, 1998).

9.3.3.3.6.7 Population Characteristics

The Zion station is less than 50 mi from Chicago, with a current population of more than 5 million. Additionally, The Waukegan-North Chicago area is predominantly an industrial region with 144 manufacturing establishments. The product of the largest of these manufacturing firms is pharmaceuticals and chemicals. The most predominant product of the remainder is in the metallurgical and fabricated metal products field. The Zion-Winthrop Harbor area is a small industrial region. A portion of this industry is located between the western boundary of the site and the Chicago and Northwestern RR tracks, approximately 0.8-mi west of the plant location, and is light in nature. There are no schools or hospitals within 1 mi of the station. The site is bordered on the north and the south by the Illinois Beach State Park (EGC, 1998). The centers of the communities of Zion and Winthrop Harbor are located 1.6 mi and 2.5 mi, respectively, from the plant location.

The estimated population within 5 mi of the site for the year 2000 was 88,700 persons (USNRC, 1972b). The 2002 population for Lake County is over 600,000. The Chicago/Cook County population is estimated at 5.3 million (US Census Bureau, 2003).

9.3.3.3.7 Site Comparison Summary

All sites generally meet the criteria outlined in NUREG-1555. However, three of the six candidate sites (e.g., Byron, Quad Cities, and Dresden) do not have enough remaining land at the site to construct and operate a new nuclear facility while remaining operational. The applicant has already determined that early retirement of existing plants is not preferable (see Section 9.2.4). Therefore, construction of new units on these sites would entail a loss of existing generating capacity, which would largely offsite the benefits of operation of the new units. The three remaining candidate sites (e.g., Braidwood, LaSalle, and Zion) have available land, but the impacts of construction and operation there would be greater than or equal to those postulated for the EGC ESP Site.

Braidwood and LaSalle may provide alternative sites, but neither is obviously superior, based on the site review. Braidwood is closer to larger population centers; as noted in the Braidwood USAR, the projected population within the vicinity is 187 per mi^2. The LPZ is expected to reach nearly 2,000 people by 2020. Thus, impacts from severe accidents at Braidwood will be greater than or equal to the proposed EGC ESP Site. At the LaSalle County Station, the population within 5 mi is expected to grow to 1,273 by the year 2020, which maintains the low population density of 16.20. It is predicted that the density between 40 and 50 mi will increase to 292.7 people per mi^2 by 2020. The site comparison showed that impacts of the EGC ESP Facility at Braidwood or LaSalle would be equal to those postulated for the EGC ESP Site.

Zion provides another alternative, and other than the proposed EGC ESP Facility, presents a viable alternative from a market view. The site is linked to existing transmission facilities and the transmission flow pattern around Chicago lends itself to additional generation north of the city. Unlike any of the other candidate sites, Zion is no longer operational. However, the Waukegan-North Chicago area near Zion is predominantly an industrial region with 144 manufacturing establishments and an urban population similar to other Chicago suburbs. The greater Chicago area is home to more than 5 million people. Zion is on the shores of Lake Michigan, and, as noted in Section 9.3.3.3.6, environmental impacts from construction and operation of the EGC ESP Facility at Zion would be equal to or greater than the impacts postulated for the EGC ESP Site. Because Zion is also in a highly populated and industrialized area, impacts from severe accidents and socioeconomic factors would be disproportionately greater than or equal to those predicted for the EGC ESP Site.

The EGC ESP Site is the environmentally preferred site among the candidate sites:

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Section 9.4

None

TABLE 9.2-7
Impacts Comparison Detail

Proposed Action (EGC ESP)	Coal-Fired Generation	Gas-Fired Generation	Combination	
			Gas-fired	Renewable

[a] All total suspended particulates (TSP) for gas-fired alternative is PM10.

Notes: SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not destabilize, any important attribute of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

10 CFR 51, Subpart A, Appendix B, Table B-1, Footnote 3.

Btu = British thermal unit

MW = Megawatt

MWe = Megawatt electric

Ft^3 = cubic foot

NO_x = oxides of nitrogen

gal = gallon

PM_{10} = particulate matter having diameter less than 10 microns

GEIS = Generic Environmental Impact Statement (USNRC, 1996)

SHPO = State Historic Preservation Office

kWh = kilowatt-hour

SO_x = sulfur oxides

lb = pound

TSP = total suspended particulates

MM = million

yr = year

PV = photovoltaic

ROI = Region of Interest

TABLE 9.3-2
Illinois Nuclear Station Comparison Alternatives

Site	Ability to Transmit to Demand Centers	Not Proximate to Population Centers	Ease of Construction	Comments
Braidwood	Medium	Medium	Medium/High	Braidwood is affected by the transmission bottleneck around the Chicago hub, and is also near population centers in Northeastern Illinois. Two licensed units are currently operational – Land is available for additional units.
Byron	Medium	High	Low	Byron is affected by the transmission bottleneck around the Chicago hub, despite its rural location. Both licensed units are currently operational – no additional land is available for new units.
Clinton	High	High	High	Clinton's rural location and low population in southern Illinois allows flexibility in transmission. The site was approved for two units. One unit was built, and the area reserved for the second unit is available for construction.
Dresden	Medium	High	Low	Dresden is affected by the transmission bottleneck around the Chicago hub, despite its rural location. The site meets 10 CFR 100. Two units are operational, and a third unit is a Nuclear Historic Landmark. There is no available land within site boundaries to colocate a new nuclear facility, and therefore the site scores low for ease of construction.
LaSalle	Medium	High	Medium/High	LaSalle's location meets 10 CFR 100 population requirements, but it is affected by the transmission bottleneck around the Chicago hub. Both units are currently operational. Land is available for construction of a new unit.
Quad Cities	Medium	Medium	Low	Quad Cities is affected by the transmission bottleneck around major metropolitan areas such as the Quad Cities, and is also near population centers in Northwestern Illinois. Both units are currently operational – there is no available land at the site for additional units.
Zion	Medium/High	Low	Medium/High	Zion is also affected by the transmission bottleneck around the Chicago hub, and is the most affected by Chicago's population. The units are not operational, and the facility is decommissioned. The two units were converted into a voltage stabilization facility to relieve pressure on Illinois Power lines during peak demand periods – the units would require dismantling for siting a new plant, and the stabilization function would probably be lost. Construction may require demolition of existing structures; otherwise ability to build is high.