

Alternatives to the Proposed Action

This chapter identifies alternatives to the proposed action in three ways. It identifies the impact of No Action; it reviews possible energy resources that could be used as alternatives to the proposed action; and it reviews alternative sites to determine if any are obviously superior to the EGC ESP Site. The review contained herein is in keeping with the effects from deregulation of the electric generation industry.

Efforts to deregulate the electric utility industry began with passage of the National Energy Policy Act of 1992. Provisions of this Act required electric utilities to allow open access to their transmission lines and encouraged development of a competitive wholesale market for electricity. The market place no longer follows traditional organizational, power production, transmission and sales patterns that were the norm when the nation's current nuclear fleet were constructed and licensed. The Act did not mandate competition in the retail market, leaving that decision to the states (NEI, 2000).

In December of 1997, the State of Illinois began the process of restructuring its retail electricity market (i.e., deregulation) by enacting the Illinois Electric Service Customer Choice and Rate Relief Act of 1997 (also known as the Illinois Electricity Choice Law). This Act eliminates regulated generation service areas and enables customers of electric distribution companies in the state to purchase electricity from their choice of electric generation suppliers by May 1, 2002. Electric generation supply is based on customers' needs and preferences (ICC, 1999). As discussed below, the regulatory imposition of competition among electric generators affects the need for power and the selection of alternatives for the EGC ESP Facility.

Before Illinois enacted its Electricity Choice Law, primarily two entities, electric utilities and the Illinois Commerce Commission, made decisions regarding reasonable alternatives for meeting electrical demands in Illinois. As a result of the Electricity Choice Law, the Illinois Commerce Commission no longer has a formal role in assessing Illinois's electricity needs or mandating additional capacity. Instead, market forces are expected to spur innovation, attract competition, drive the appropriate supply/demand balance, and attract new power suppliers to the State (IPCB, 2000). Therefore, generators of electric power in the State of Illinois are solely responsible for decisions regarding reasonable alternatives for meeting electrical demands.

Since the Illinois Electricity Choice Law was enacted, the IEPA has received more than 60 applications for construction of new generating facilities. Citizens, local governments, and legislators objected to several of the proposed plants. In response, the Illinois Pollution Control Board conducted hearings to evaluate whether additional siting or other regulations in connection with the construction of proposed plants should be recommended. The Illinois Pollution Control Board recommended that the IEPA adopt new rules that would

tighten restrictions on air emissions from new power plants and require public participation in the construction permit process, but stated that the IEPA does not have the authority to consider other issues related to the siting of a proposed facility (e.g., need for a proposed power plant, aesthetics, etc.) during permitting (IPCB, 2000).

It is not clear whether EGC or another supplier would ultimately construct new generating units. The decision to actually construct a new facility would be driven by market conditions. However, regardless of which entities construct and operate new generating facilities, certain environmental parameters would be constant among these alternative power sources.

Chapter 9 addresses reasonable alternatives to the EGC ESP Facility. The chapter evaluates what alternative actions might be undertaken, which alternatives are not reasonable and why and, for reasonable alternatives, what the associated environmental impacts might be. The impacts are then compared to those associated with the proposed action.

In determining the level of detail and analysis to be provided, the Applicant relied on the USNRC decision-making standard in that the discussion of alternatives:

"...shall be sufficiently complete to aid the Commission in developing and exploring, pursuant to section 102(2)(E) of NEPA, 'appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources.' To the extent practicable, the environmental impacts of the proposal and the alternatives should be presented in comparative form." (10 CFR 51.45(b)(3)).

Further, for consistency of alternate siting criteria, the process outlined in NUREG-1555 was employed.

This environmental report supports USNRC decision-making by providing sufficient information to clearly indicate whether an alternative would have a smaller, comparable, or greater environmental impact than the proposed action. Providing additional details or analysis would serve no function if it only brings to light the additional adverse impacts of alternatives to the EGC ESP Facility. This approach is consistent with regulations of the Council on Environmental Quality, which provide that the consideration of alternatives (including the proposed action) should enable reviewers to evaluate their comparative merits (40 CFR 1500-1508). This chapter includes sufficient details about alternatives and siting to establish the basis for necessary comparison to the discussions of impacts of the proposed action.

The chapter also identifies and evaluates a set of alternative sites for the proposed EGC ESP Facility. The objective of the evaluation is to verify that there is no 'obviously superior site' for the eventual construction and operation of a new nuclear facility.

9.1 No-Action Alternative

“No Action” means the USNRC denies the application for an ESP and no other generating station (either nuclear or non-nuclear) is constructed and operated.

The impacts of the No-Action Alternative are closely-related to a need for power, which has not been discussed in this ER; under Part 52, an analysis of the need for power is not required to issue an ESP (10 CFR 52.17).

As stated in NUREG-1555, *Standard Review Plans for Environmental Reviews of Nuclear Power Plants* (USNRC, 1999):

“The no-action alternative would result in the facility not being built, and no other facility would be built or other strategy implemented to take its place. This would mean that the electrical capacity to be provided by the project would not become available.”

Under the “No Action” alternative, the need for power would need to be met by other alternative means that involve no new generating capacity. These alternatives would include such approaches as demand-side management, energy conservation, and power purchased from other electricity providers. These alternatives are discussed in Section 9.2.1. Given the fact that the early site permit might not be used for twenty or more years, it is not feasible to evaluate other aspects of the need for power in a meaningful way at the ESP stage. Therefore, the need for power will not be evaluated as part of this ESP.

9.2 Energy Alternatives

The EGC ESP Facility will be constructed and operated as a merchant independent power producer (also referred to as a “merchant plant” or “merchant generator”). The power produced will be sold on the open wholesale market, without specific consideration to supplying a traditional service area or satisfying a reserve margin objective. Thus, discussion of the “relevant service area” for this facility is irrelevant and inconsistent with the facility’s sales objectives and thus does not provide a means to evaluate the site in the context of a service territory, as has been historically the practice. Therefore, for the purposes of this alternatives analysis, the “region of interest” has been defined as the State of Illinois rather than the more traditional “relevant service area.” The delineation of this region of interest is in keeping with current deregulation policies and the proposed location of the facility within the State of Illinois.

Alternatives that do not require new generating capacity were considered, and these include energy conservation and Demand-Side Management (DSM). Other alternatives that do require the construction of new generating capacity such as wind, geothermal, oil, natural gas, hydropower, Municipal Solid Wastes (MSW), coal, photovoltaic (PV) cells, solar power, wood waste/biomass, and energy crops were also analyzed. The technologies under consideration for the project were not regarded as alternatives.

While alternative energy technologies are reviewed here for the purposes of this ER, their availability was not important in selecting emerging nuclear technologies as the superior alternative. The decision to develop a nuclear power plant on land adjacent to the existing CPS was based on market factors such as the proximity to an already-licensed station, the ability to incorporate existing environmental permits in the operation and plant parameters, property ownership, and other location features conducive to the plant’s intended merchant generating objective.

Alternatives that do not require new generating capacity are discussed in Section 9.2.1, while alternatives that do are discussed in Section 9.2.2. In Section 9.2.2, some of the alternatives that require new generating capacity were eliminated from further consideration and discussion based on their availability in the region, overall feasibility, and environmental consequences. In Section 9.2.3, the alternatives that were not eliminated based on these factors addressed in Section 9.2.2 are investigated in further detail relative to specific criteria such as environmental impacts, reliability, and economic costs.

9.2.1 Alternatives That Do Not Require New Generating Capacity

In 1997, Illinois General Assembly enacted the Electric Service Customer Choice and Rate Relief Law. It noted that the citizens and businesses of the State of Illinois had been well served by a comprehensive electrical utility system that had provided safe, reliable, and affordable service. The electrical utility system in the State had historically been subject to State and federal regulation, aimed at assuring the citizens and businesses of the State of safe, reliable, and affordable service, while at the same time assuring the utility system of a safe return on investment.

The Assembly noted that competitive forces were affecting the market for electricity as a result of federal regulatory and statutory changes and the activities of other states.

Competition in the electric services market created opportunities for new products and services for customers and lower costs for users of electricity. Long-standing regulatory relationships needed to be altered to accommodate the competition that fundamentally altered the structure of the electric services market.

Lawmakers saw that, with the advent of increasing competition in the industry, the State had a continued interest in assuring that the safety, reliability, and affordability of electrical power was not sacrificed to competitive pressures, and to that end, intended to implement safeguards to assure that the industry continued to operate the electrical system in a manner that would serve the public's interest. Under the existing regulatory framework, the industry had been encouraged to undertake certain investments in its physical plant and personnel to enhance its efficient operation, the cost of which it had been permitted to pass on to consumers. It recognized that the State had an interest in providing the existing utilities a reasonable opportunity to obtain a return on investments on which they depended in undertaking those commitments in the first instance which, at the same time, not permitting new entrants into the industry to take unreasonable advantage of the investments made by the formerly regulated industry.

The Assembly dictated that a competitive wholesale and retail market must benefit all Illinois citizens. They told the Illinois Commerce Commission to act to promote the development of an effectively competitive electricity market that operates efficiently and is equitable to all consumers. Consumer protections were put in place to ensure that all customers continue to receive safe, reliable, affordable, and environmentally safe electric service.

They further determined that all consumers must benefit in an equitable and timely fashion from the lower costs for electricity that result from retail and wholesale competition and receive sufficient information to make informed choices among suppliers and services.

To that end, in Illinois, merchant generators do not have to request the permission from the Illinois Commerce Commission (ICC) for siting approval or demonstrate to the ICC that they are needed to meet energy demand. The ICC is also not involved in any formal energy planning for the State.

This section is intended to provide an assessment of the economic and technical feasibility of supplying the demand for energy without constructing new generating capacity. Specific elements may include:

- Initiating conservation measures (including implementing DSM actions),
- Reactivating or extending the service life of existing plants within the power system,
- Purchasing power from other utilities or power generators, and
- A combination of these elements that would be equivalent to the output of the project and therefore eliminate its need.

All of the above elements have been traditionally connected with an electric utility that supplies power within its service territory and not for a merchant generator whose revenue is derived from the sale of electricity generated from its own power plants. Therefore, alternatives that do not require additional generating capacity are not considered reasonable

alternatives to colocating a new merchant power plant with the CPS in Illinois. Nonetheless, an evaluation of these alternatives was performed within the context of emerging energy demands.

9.2.1.1 Initiating Conservation Measures

Historically, state regulatory bodies have required regulated utilities to institute programs designed to reduce demand for electricity. DSM programs included energy conservation and load modification measures. In the current deregulated Illinois market, EGC anticipates that it will not be able to offer competitively priced power if it has to retain an extensive conservation and load-modification-incentive program. However, EGC has evaluated the DSM alternative as a mitigative technique to the proposed action.

Traditionally, DSM programs either conserved energy or allowed the electric company to reduce customers' load requirements during periods of peak demand. DSM programs generally fall into the following categories:

9.2.1.1.1 Conservation Programs

- Educational programs that encourage the prudent use of energy
- Financial incentives to businesses and private customers
- Government - private partnerships to encourage conservation of energy resources.

9.2.1.1.2 Energy Efficiency Programs

- Discounted residential rates for homes that met specific energy efficiency standards
- Energy audit programs that provided residential energy audits and encouraged efficiency upgrades
- Incentive programs that encouraged customers to replace old, inefficient appliances or equipment with new high-efficiency appliances or equipment
- Government partnerships that assisted federal facilities in meeting mandated energy efficiency goals through design and installation of high-efficiency lighting systems and computerized energy management.

9.2.1.1.3 Load Management Programs

- Standby generator programs – encouraged customers to permit their electricity provider to switch loads to the customer's standby generators during periods of peak demand
- Interruptible service program – encouraged customers to allow blocks of their load to be interrupted during periods of peak demand
- Real time pricing – encouraged customers to discontinue electricity usage during specific times

Traditional utilities annually projected the summer and winter peak power, annual energy requirements, and impacts of DSM. Market and regulatory conditions, which provided the initial support for utility-sponsored conservation and DSM efforts during the late 1970s and early 1980s, can be broadly characterized by:

- Increasing long-term marginal prices for capacity and energy production resources

- Forecasts projecting increasing demand for electricity across the nation
- General agreement that conditions outlined above would continue for the foreseeable future
- Limited competition in the generation of electricity
- Economies of scale in the generation of electricity, which supported the construction of large central power plants, and
- The use of average embedded cost as the basis for setting electricity prices within a regulated context.

These market and regulatory conditions have undergone dramatic changes in a deregulated market, as previously described. Changes that have significantly impacted the cost effectiveness of utility-sponsored DSM, can be described as follows:

1. A decline in generation costs, due primarily to technological advances that have reduced the cost of constructing new generating units (e.g., the combined cycle gas generating facility), and
2. National energy legislation, which has encouraged wholesale competition through open access to the transmission grid, as well as state legislation designed to facilitate retail competition.

Consistent with (1) and (2) above, the typical electric utility planning environment has more recently been considering lower energy prices than during earlier periods, shorter planning horizons, lower reserve margins, and increased reliance on market prices to direct resource planning.

Other significant changes accompanying the newly deregulated marketplace include the following:

- The adoption of increasingly stringent national appliance standards for most major energy-using equipment and the adoption of energy efficiency requirements in state building codes. These mandates have further reduced the potential for cost-effective electric utility-sponsored measures.
- In states that are currently transitioning into deregulation, third parties are increasingly providing energy load management services and products in competitive markets at prices that reflect their value to the customer. Market conditions can be expected to continue this shift among providers of cost-effective load management.

For these reasons, EGC determined that DSM programs, which are primarily directed toward load management, are not a sufficient substitute for the generation contemplated by the EGC ESP Facility.

9.2.1.2 Reactivating or Extending Service Life of Existing Plants

Fossil plants slated for retirement tend to be ones that are old enough to have difficulty in economically meeting today's restrictions on air contaminant emissions. In the face of increasingly stringent environmental restrictions, delaying retirement, or reactivating plants

in order to compensate for the closure of a large base-loaded plant, would require major construction to upgrade or replace plant components. EGC concludes that the environmental impacts of such a scenario are bounded by its coal- and gas-fired alternatives discussed in Section 9.2.2.

9.2.1.3 Purchasing Power from Other Utilities or Power Generators

In a traditional alternatives analysis for examining the energy alternative to utility generation capacity, the purchased power alternative meant that the utility would meet a portion of its service territory demand using power that it purchased from another utility. Deregulation, however, has changed this traditional analysis. First, the end-user could purchase electricity from another entity (in this case, from a company other than EGC). Second, EGC expects retail competition to decrease generators' incentives to provide wholesale power to competing companies for resale, thus reducing the availability of power for EGC to purchase and resell competitively.

Because Illinois is a net exporter of power and would be fully deregulated, EGC assumes that in-state power could be purchased. For example, in 1999 Illinois exported 76 million kilowatt-hours of electricity (USDOE/EIA, 2001a). The GEIS, in Section 8.3, evaluated the environmental impacts of thirteen alternative energy sources (USNRC, 1996). EGC assumes that the generating technology producing purchased power would be one of the alternatives that were analyzed, and that the environmental impact from the alternative would occur to meet the market need.

Imported power from Canada or Mexico is unlikely to be available to supply the equivalent capacity of the EGC ESP Facility. In Canada, 62 percent of the country's electricity capacity is derived from renewable sources, principally hydropower (USDOE/EIA 2001). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (USDOE/EIA, 2001). Canada's nuclear generation is projected to decrease by 1.7 percent by 2020, but its share of power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (USDOE/EIA 2001). EIA projects that total gross U.S. imports of electricity from Canada and Mexico will gradually increase from 47.4 billion kilowatt-hours in 2000 to 66.1 billion kilowatt-hours in year 2005, and then gradually decrease to 47.4 billion kilowatt-hours in year 2020 (USDOE/EIA 2001). It is anticipated that the amount of electricity available for import from Canada and Mexico follows the amount of electricity that would be available for export from Canada and Mexico.

EGC has evaluated conventional and prospective purchase power supply options that could be reasonably implemented. In 1999, Unicom's subsidiary ComEd, completed a sale of its fossil-fuel-fired coal, gas, and oil units to Midwest Generation. As part of the sale, Unicom entered into long-term purchase contracts with Midwest Generation to provide firm capacity and energy (ComEd, 1999). Because these contracts are part of current and future capacity, however, EGC does not consider these power purchases to be a feasible source of power to satisfy the purchased power alternative.

If power were to be purchased from sources within the United States or a foreign country, the generating technology likely would be one of those described in this ER (probably coal, natural gas, or nuclear). The description of the environmental impacts of other technologies

described here is representative of the purchased electrical power alternative to the EGC ESP Facility. Thus, the environmental impacts of imported power would still occur, but would be located elsewhere within the region, nation, or another country.

9.2.2 Alternatives That Require New Generating Capacity

While many methods are available for generating electricity and many combinations or mixes can be assimilated to meet system needs, such expansive consideration would be too unwieldy to reasonably examine given the purposes of the alternatives analysis. In keeping with the USNRC's evaluation of alternatives to license renewal, a reasonable set of alternatives should be limited to analysis of single discrete electrical generation sources and those electric generation technologies that are technically reasonable and commercially viable (USNRC, 1996). Accordingly, EGC has not evaluated mixes of generating sources. The impacts from coal- and gas-fired generation presented in this chapter bounds the impacts from any generation mixture of the two technologies.

The current mix of power generation options in Illinois is one indicator of the feasible choices for electric generation technology within the state. EGC evaluated Illinois electric generation capacity and utilization characteristics. "Capacity" is the categorization of the various installed technology choices in terms of its potential output. "Utilization" is the degree to which each choice is actually used.

In 1999, Illinois's electric industry had a total generating capacity of 34,338 megawatts-electric. As Figure 9.2-1 indicates, this capacity includes units fueled by coal (46.7 percent); nuclear (31.2 percent); oil (3.2 percent); dual (e.g., oil/gas)-fired (0.9 percent); hydroelectric (0.1 percent); and other (2.3 percent) (USDOE/EIA, 2001).

Based on 1999 generation data, Illinois's electric industry provided approximately 164 terawatt hours of electricity. As Figure 9.2-2 depicts, Illinois's generation utilization was primarily from nuclear (50 percent), followed by coal (45.3 percent), gas (3.4 percent), oil (0.5 percent), other (0.7 percent), and hydroelectric (0.1 percent) (USDOE/EIA 2001).

The difference between capacity and utilization is the result of preferential usage by electricity suppliers. For example, in 1999, nuclear energy represented 31.2 percent of Illinois's installed capability, but produced 50 percent of the electricity generated (USDOE/EIA 2001, Tables 4 and 5). This reflects Illinois's preferential reliance on nuclear energy as a base-load generating source.

This section identifies alternatives that EGC has determined are not reasonable and the EGC basis for this determination. EGC's ESP application is premised on the installation of a facility that would primarily serve as a large base-load generator and that any feasible alternative would also need to be able to generate base-load power. In performing this evaluation, EGC relied heavily upon USNRC's Generic Environmental Impact Statement (GEIS) (USNRC, 1996).

The GEIS is useful for the analysis of alternative sources because the USNRC has determined that the technologies of these alternatives will enable the agency to consider the relative environmental consequences of an action given the environmental consequences of other activities that also meet the purpose of the proposed action. To generate the reasonable set of alternatives used in the GEIS, the USNRC included commonly known

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 mi², 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,

northeast of San Francisco, reportedly did not want to see turbines sited nearby, even though the hills chosen for the project already had numerous electronic relays and transmission lines. Aesthetic impacts were also a key factor behind opposition to wind development at Tejon Pass, one of the most scenic areas close to Los Angeles (NWCC, 1997). Second, high-speed wind turbine blades can be noisy, although technological advancements continue to lessen this problem. Finally, wind facilities sited in areas of high bird use can expect to have fatality rates higher than those expected if the wind facility were not there. Water within the vicinity of wind turbines, such as sites around the Great Lakes, may attract waterfowl and shorebirds, increasing the collision potential for water bird species, although other factors such as adjacent habitats and movement patterns would also greatly influence mortality near these water sources (NWCC, 2001). Land use and aesthetic impacts could be moderate to large, while other impacts to human health and the environment would be small. The environmental impacts of wind power are discussed in more detail in Table 9.2-7.

EGC has concluded that, due to the inability of wind power to generate baseload power, the projected land use impacts of development of Class 3+ and Class 4 sites in Illinois, the cost factors in construction and operation, along with the impacts associated with development, and cost of additional transmission facilities to connect all of these turbines to the transmission system, wind by itself is not a feasible alternative to the EGC ESP.

Wind power could be included in a combination of alternatives to the EGC ESP. The study of combinations is discussed in Section 9.2.3.3.

9.2.2.2 Geothermal

As illustrated by Figure 8.4 in the GEIS, geothermal plants might be located in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent. However, because there are no known high-temperature geothermal sites in the region of interest, EGC concludes that geothermal is not a reasonable alternative.

9.2.2.3 Hydropower

A small portion (about 80 MW) of Illinois utility generating capacity is hydroelectric. As the GEIS points out in Section 8.3.4, hydropower's percentage of United States generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern over flooding, destruction of natural habitat, and destruction of natural river courses. According to the U.S. Hydropower Resource Assessment for Illinois (INEL, 1997), there are no remaining sites in Illinois that would be environmentally suitable for a large hydroelectric facility.

The GEIS (Section 8.3.4) estimates land use of 1,600 mi² per 1,000 MWe generated by hydropower. Based on this estimate, a project the size of the EGC ESP Facility would require flooding more than 3,520 mi² resulting in a large impact on land use. Further, operation of a hydroelectric facility would alter aquatic habitats above and below the dam, which would impact existing aquatic species.

EGC has concluded that, due to the lack of suitable sites in Illinois and the amount of land needed (approximately 3,520 mi²), in addition to the adverse environmental impacts, hydropower is not a reasonable alternative.

9.2.2.4 Solar Power

Solar energy is dependent on the availability and strength of sunlight (strength is measured as kWh/m²). 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/m²/day in the summer to as low as 2-3 kWh/m²/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/m² at the brightest time of a summer day, but most of Illinois falls in the range of 5.5-6 kWh/m². This resource is relatively low, particularly when compared to the southwestern United States. For example, parts of southern California can generate 10-12 kWh/m² 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 plants 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/m² per day (USDOE/EERE, 2004b). If an average solar energy throughout the year of approximately 5 kWh/m² per day and a conversion efficiency of 15 percent were used, photovoltaic cells would yield an annual electricity production of approximately 274 kWh/m² 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 m² [(2180 MWe (See ER Sec. 3.7.2) * 0.9 * 8760 hr/yr * 1000 kW/MW / 274 kWh/m²/yr)] or approximately 63 km² (24 mi²) 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

discussed here ranges from 3 to 12 ac/MWe compared to 0.23 acres per MWe for nuclear. In addition, this land use is pre-emptive; land used for solar facilities would not be available for other uses such as agriculture.

Depending on the solar technology used, there may be thermal discharge impacts. These impacts are anticipated to be small. During operation, PV and solar thermal technologies produce no air pollution, little or no noise, and require no transportable fuels.

There are environmental impacts of PV related to manufacture and disposal. The process to manufacture PV cell is similar to the production of a semiconductor chip. Chemicals used in the manufacture of PV cells include cadmium and lead. Potential human health risks also arise from the manufacture and deployment of PV systems, since there is a risk of exposure to heavy metals such as selenium and cadmium during use and disposal (CEC, 2004). There is some concern that landfills could leach cadmium, mercury, and lead into the environment in the long term. Generally, PV cells are sealed and the risk of release is considered slight, however, the long-term impact of these chemicals in the environment is unknown. Another environmental consideration with solar technologies is the lead-acid batteries that are used with some systems. The impact of these lead batteries is lessening, however, as batteries become more recyclable, batteries of improved quality are produced and better quality solar systems that enhance battery lifetimes are created (Real, et. al., 2001).

9.2.2.4.4 Summary

Solar power alone cannot be used to generate baseload power, because of the intermittent nature of the resource. Therefore, solar power alone is not a reasonable alternative to the baseload generating facility being considered for the Clinton site. Solar power in combination with storage facilities (e.g., power troughs with molten salt storage) can be used to generate baseload power. However, such a facility is still in the developmental stage and such facilities (and solar facilities in general) are not economically competitive alternatives to the proposed EGC ESP Facility because the resource is intermittent and incoming solar radiation is low for most of the year throughout the region of interest. Additionally, there are potential environmental impacts associated with any large-scale solar generation facilities. Land use and aesthetic impacts would most likely be large compared to a nuclear plant.

The solar resource could contribute to a competitive combination of alternative energy sources. This combination of alternatives is discussed in Section 9.2.3.3.

9.2.2.5 Wood Waste (and Other Biomass)

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefiting from the use of waste materials that could otherwise represent a disposal problem. However, the largest wood waste power plants are 40 to 50 MW in size.

Nearly all of the wood-energy-using electricity generation facilities in the United States use steam turbine conversion technology. The technology is relatively simple to operate and it can accept a wide variety of biomass fuels. However, at the scale appropriate for biomass,

the technology is expensive and inefficient. Therefore, the technology is relegated to applications where there is a readily available supply of low-, zero-, or negative-cost delivered feedstocks.

Further, as discussed in Section 8.3.6 of the GEIS, construction of a wood-fired plant would have an environmental impact that would be similar to that for a coal-fired plant, although facilities using wood waste for fuel would be built on smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage, processing, and waste disposal (i.e., ash). Additionally, operation of wood-fired plants has environmental impacts, including impacts on the aquatic environment and air.

EGC has concluded that, due to the lack of significant wood resources in Illinois and the lack of an obvious environmental advantage, wood energy is not a reasonable alternative.

9.2.2.6 Municipal Solid Waste

As discussed in Section 8.3.7 of the GEIS, the initial capital costs for municipal solid waste plants are greater than for comparable steam turbine technology at wood-waste facilities. This is due to the need for specialized waste separation and handling equipment.

The decision to burn municipal solid waste to generate energy is usually driven by the need for an alternative to landfills, rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy due to the numerous obstacles and factors that may limit the growth in MSW power generation. Chief among them are environmental regulations and public opposition to siting MSW facilities.

Estimates in the GEIS suggest that the overall level of construction impacts from a waste-fired plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be moderate, but still larger than the proposed action.

EGC has concluded that, due to the high costs and lack of obvious environmental advantages, burning municipal solid waste to generate electricity is not a reasonable alternative.

9.2.2.7 Energy Crops

In addition to wood and municipal solid waste fuels, there are several other concepts for fueling electric generators, including burning energy crops, converting crops to a liquid fuel such as ethanol (ethanol is primarily used as a gasoline additive), and gasifying energy crops (including wood waste). As discussed in Section 8.3.8 of the GEIS, none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a base-load plant.

Further, estimates in the GEIS suggest that the overall level of construction impacts from a crop-fired plant should be approximately the same as that for a wood-fired plant. Additionally, crop-fired plants would have similar operational impacts (including impacts on the aquatic environment and air). In addition, these systems have large impacts on land use, due to the acreage needed to grow the energy crops.

EGC has concluded that, due to the high costs and lack of obvious environmental advantage, burning other biomass-derived fuels is not a reasonable alternative.

9.2.2.8 Petroleum Liquids (Oil)

Illinois has several oil-fired units; however, they produce less than one percent of the State's electricity. The cost of oil-fired operation is much more expensive than nuclear or coal-fired operation. The high cost of oil has prompted a steady decline in its use for electricity generation. From 1997 to 1998, production of electricity by oil-fired plants dropped by about 39.9 percent in Illinois (USDOE/EIA, 1998).

Also, construction and operation of an oil-fired plant would have environmental impacts. For example, Section 8.3.11 of the GEIS estimates that construction of a 1,000-MWe oil-fired plant would require about 120 ac. Additionally, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant (USNRC, 1996).

EGC has concluded that, due to the high fuel costs and lack of obvious environmental advantage, oil-fired generation is not a reasonable alternative.

9.2.2.9 Fuel Cells

Phosphoric acid fuel cells are the most mature fuel cell technology, but they are only in the initial stages of commercialization. Two hundred turnkey plants have been installed in the United States, Europe, and Japan. Recent estimates suggest that a company would have to produce about 100 MW of fuel cell stacks annually to achieve a price of \$1,000 to \$1,500 per kilowatt. However, the current combined production capacity of fuel cell manufacturers only totals about 60 MW per year (KE, 2002). EGC believes that this technology has not matured sufficiently to support production for a base load facility. EGC has concluded that, due to the cost and production limitations, fuel-cell technology is not a reasonable alternative.

9.2.2.10 Coal

Coal-fired steam electric plants provide the majority of electric generating capacity in the U.S., accounting for about 56 percent of the electric utility industry's net generation and 43 percent of its capacity in 1992 (USDOE/EIA, 1994). Conventional coal-fired plants generally include two or more generating units and have total capacities ranging from 100 MWe to more than 2,000 MWe. Coal is likely to continue to be a reliable energy source well into the future (USDOE/EIA, 1993), assuming environmental constraints do not cause the gradual substitution of other fuels.

The U.S. has abundant low-cost coal reserves, and the price of coal for electric generation is likely to increase at a relatively slow rate. Even with recent environmental legislation, new coal capacity is expected to be an affordable technology for reliable, near-term development and for potential use as a replacement technology for nuclear power plants (USNRC, 1996).

The environmental impacts of constructing a typical coal-fired steam plant are well known because coal is the most prevalent type of central generating technology in the U.S. The impacts of constructing a 1,000-MWe coal plant at a greenfield site can be substantial, particularly if it is sited in a rural area with considerable natural habitat. An estimated 1,700

ac would be needed, and this could amount to the loss of about 3 mi² of natural habitat and/or agricultural land for the plant site alone, excluding land required for mining and other fuel cycle impacts (USNRC, 1996).

EGC defined the coal-fired alternative as consisting of four 550-MWe units. EGC chose this configuration to be equivalent to the gas-fired alternative described below. This equivalency makes impact characteristics most comparable, facilitating impact analysis

Table 9.2-3 describes assumed basic operational characteristics of the coal-fired units. EGC based its emission control technology and percent-control assumptions on alternatives that the USEPA has identified as being available for minimizing emissions (USEPA, 1998). For the purposes of analysis, EGC has assumed that coal and lime (calcium oxide) would be delivered by rail after upgrading the existing rail spur into CPS.

Based on the well-known technology, fuel availability, and generally understood environmental impacts associated with constructing and operating a coal-fired power generation plant, it is considered a competitive alternative and is therefore examined further in Section 9.2.3.

9.2.2.11 Natural Gas

EGC has chosen to evaluate gas-fired generation, using combined-cycle turbines, because it has determined that the technology is mature, economical, and feasible. A scenario, for example, of four units with a net capacity of 2,200 MWe could be assumed to equal the EGC ESP Facility total net capacity. However, EGC's experience indicates that, although customized unit sizes can be built, using standardized sizes is more economical. Existing manufacturers' standard-sized units include a gas-fired combined-cycle plant of 550-MWe net capacity, consisting of two 184-MWe gas turbines (e.g., General Electric Frame 7FA) and 182 MWe of heat recovery capacity.

EGC assumed four 550-MWe units, having a total capacity of 2,200 MWe, as the gas-fired alternative at the EGC ESP Site. This provides the approximate EGC ESP capacity for estimating the environmental impacts of this alternative. Any shortfall in capacity could be replaced by other methods, such as purchasing power. However, for the reasons discussed above, EGC did not analyze a mixture of these alternatives and purchased power.

Table 9.2-5 describes assumed basic operational characteristics of the gas-fired units. As for the coal-fired alternative, EGC based its emission control technology and percent-control assumptions on alternatives that the EPA has identified as being available for minimizing emissions (USEPA, 1998). For the purposes of analysis, EGC has assumed that there would be sufficient gas availability.

Based on the well-known technology, fuel availability, and generally understood environmental impacts associated with constructing and operating a natural gas-fired power generation plant, it is considered a competitive alternative and is therefore examined further in Section 9.2.3.

9.2.3 Assessment of Reasonable Alternative Energy Sources and Systems

This chapter evaluates the environmental impacts from what EGC has determined to be reasonable alternatives to the EGC ESP Facility: coal-fired generation, and gas-fired generation.

EGC has identified the significance of the impacts associated with each issue as Small, Moderate, or Large. This characterization is consistent with the criteria that USNRC established in 10 CFR 51, Appendix B, Table B-1, Footnote 3 as follows:

- **SMALL** - Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.
- **MODERATE** - Environmental effects are sufficient to alter noticeably, but not to destabilize, any important attribute of the resource.
- **LARGE** - Environmental effects are clearly noticeable and are sufficient to destabilize any important attributes of the resource.

In accordance with National Environmental Policy Act (NEPA) practice, EGC considered ongoing and potential additional mitigation in proportion to the significance of the impact to be addressed (i.e., impacts that are small receive less mitigative consideration than impacts that are large).

9.2.3.1 Coal-Fired Generation

The USNRC evaluated environmental impacts from coal-fired generation alternatives in the GEIS (USNRC, 1996) and concluded that construction impacts could be substantial, due in part to the large land area required (which can result in natural habitat loss) and the large workforce needed. USNRC pointed out that siting a new coal-fired plant where an existing nuclear plant is located would reduce many construction impacts. USNRC identified major adverse impacts from operations as human health concerns associated with air emissions, waste generation, and losses of aquatic biota due to cooling water withdrawals and discharges.

The coal-fired alternative defined by EGC in Section 9.2.2.10 would be located at the EGC ESP Site.

9.2.3.1.1 Air Quality

Air quality impacts of coal-fired generation are considerably different from those of nuclear power. A coal-fired plant would emit sulfur dioxide (SO₂, as SO_x surrogate), oxides of nitrogen (NO_x), particulate matter (PM), and carbon monoxide (CO), all of which are regulated pollutants. As Section 9.2.2.10 indicates, EGC has assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. EGC estimates the coal-fired alternative emissions to be as follows:

SO_x = 8,127 tons per year

NO_x = 2,054 tons per year

CO = 2,118 tons per year

PM:

PM = 292 tons per year

PM₁₀ (particulates having a diameter of less than 10 microns) = 67 tons per year

Table 9.2-1 presents the methodology and basis for the above emission figures.

Coal combustion results in emissions of heavy metals such as mercury, hazardous air pollutants such as benzene, polychlorinated dibenzo-p-dioxins, and polychlorinated dibenzo-fuiana.

In 1999, emissions of SO₂ and NO_x from Illinois's generators ranked 7th and 4th highest nationally, respectively (USDOE/EIA, 2002). In fact, seventeen Illinois generators were cited in the Clean Air Act Amendments of 1990 as requiring that by 1995 they be in compliance with stricter emission controls for SO₂ and NO_x. The acid rain requirements of the Clean Air Act Amendments capped the nation's SO₂ emissions from power plants. Each company having fossil-fuel-fired units was allocated SO₂ allowances. To be in compliance with the Act, the companies must hold enough allowances to cover their annual SO₂ emissions. EGC, having no fossil units, would have to purchase allowances from the open market to operate a fossil-fuel-burning plant at the EGC ESP Site. A company that has fossil units might also have the option of shutting down existing capacity and applying credits from that plant to the new one, thus mitigating the air quality impacts of these generating sources.

Both SO₂ and NO_x will increase with operation of a new coal-fired plant at the EGC ESP Site. In order to operate a fossil-fuel-fired plant at the site, EGC would have to obtain sufficient pollution credits to cover annual emissions either from the set-aside pool or by purchasing pollution credits from other sources.

While this option is available, it is unlikely that it will be feasible for a new generating facility. In October 1998, EPA promulgated the NO_x State Implementation Plan Call regulation that requires 22 states, including Illinois, to reduce their NO_x emissions by over 30 percent to address national ozone transport (USEPA, 2001). The regulation imposes a NO_x "budget" to limit the NO_x emissions from each state. The IEPA allocated NO_x credits among the existing electrical generating units in the State (IAC, 2000). Beginning May 31, 2004, each electrical generating unit must hold enough NO_x credits to cover its annual NO_x emissions. A small percentage of NO_x credits was set aside for new sources.

The likelihood, however, of buying setoffs for a new facility is extremely remote, if at all possible. This being the case, the coal-fired alternative, while possible, will not be economically feasible since there are no mitigating efforts (like emissions trading) to make the alternative worthwhile. In addition, emission credits' trading generally applies to non-attainment areas. The site that EGC has chosen as the preferred site is located in an attainment area, making emission credit trading not effective as a mitigation technique.

The USNRC did not quantify coal-fired emissions, but implied that air impacts from fossil fuel generation would be substantial. The USNRC noted that adverse human health effects from coal combustion have led to important federal legislation in recent years and that

public health risks, such as cancer and emphysema, have been associated with coal combustion. USNRC also mentioned global warming and acid rain as potential impacts. EGC concludes that federal legislation and large-scale concerns, such as global warming and acid rain, are indications of concerns about destabilizing important attributes of air resources. However, SO₂ emission allowances, NO_x emission offsets, low NO_x burners, overfire air, fabric filters or electrostatic precipitators, and scrubbers are regulatorily imposed mitigation measures. As such, EGC concludes that the coal-fired alternative may have moderate to large impacts on air quality; the impacts may be clearly noticeable and may destabilize air quality in the area.

9.2.3.1.2 Waste Management

EGC concurs with the GEIS assessment that the coal-fired alternative would generate substantial solid waste. The coal-fired plant, using coal having an ash content of 6.9 percent, would annually consume approximately 8,500,000 tons of coal (Table 9.2-1). Particulate control equipment would collect most (99.9 percent) of this ash, approximately 584,000 tons per year. Illinois regulations encourage recycling of coal-combustion by-products. ComEd, as the former owner of certain fossil fuel electric generating facilities now currently owned by Mid-West Generation historically recycled 87 percent of its coal ash (ComEd, 2000). Assuming continuation of this waste mitigation measure, the coal-fired alternative would generate approximately 76,000 tons of ash per year for disposal.

SO_x-control equipment, annually using nearly 150,000 tons of calcium oxide, would generate another 443,000 tons per year of waste in the form of scrubber sludge. EGC estimates that ash and scrubber waste disposal over a 40-yr plant life would require approximately 234 ac (a square area with sides of approximately 3,200 ft). Table 9.2-4 shows how EGC calculated ash and scrubber waste volumes.

With proper placement of the facility, coupled with current waste management and monitoring practices, waste disposal would not destabilize any resources. There would be space within the EGC ESP Site footprint for this disposal. After closure of the waste site and revegetation, the land would be available for other uses. For these reasons, EGC believes that waste disposal for the coal-fired alternative would have moderate impacts; the impacts of increased waste disposal would be clearly noticeable, but would not destabilize any important resource and further mitigation of the impact would be unwarranted.

9.2.3.1.3 Other Impacts

Construction of the power block and coal storage area would impact approximately 300 ac of land and associated terrestrial habitat. Because most of this construction would be in previously disturbed areas, impacts would be minimal. Visual impacts would be consistent with the industrial nature of the site. As with any large construction project, some erosion, collection of lake sedimentation, and fugitive dust emissions could be anticipated, but would be minimized by using best management practices. It is assumed that construction debris from clearing and grubbing could be disposed of on site and municipal waste disposal capacity would be available. Socioeconomic impacts would result from the approximately 250 people needed to operate the coal-fired facility. EGC believes that these impacts would be small due to the mitigating influence of the site's proximity to the surrounding population area. Cultural resource impacts would be unlikely, due to the previously disturbed nature of the site, and could be, if needed, minimized by survey and recovery techniques.

Impacts to aquatic resources and water quality would be minimized but could be construed as moderate due to the plant's use of a new cooling water system. The new stacks, boilers, and rail deliveries would be an incremental addition to the visual impact from existing CPS structures and operations. Coal delivery would add noise and transportation impacts associated with unit-train traffic.

EGC believes that other construction and operation impacts would be small. In most cases, the impacts would be detectable, but they would not destabilize any important attribute of the resource involved. Due to the minor nature of these impacts, mitigation would not be warranted beyond that mentioned.

9.2.3.1.4 Design Alternatives

The CPS Site location lends itself to coal delivery by rail.

Use of cooling towers as the cooling mechanism for coal-fired generation would reduce cooling water intake and discharge water usage by 90 percent when compared to once thru cooling as is used currently by the CPS. Use of cooling towers would reduce impingement, entrainment, and thermal impacts, increase consumptive water use through evaporation, and introduce a visual impact (100-foot-high mechanical towers or 600-foot-high natural draft towers). Wet/dry cooling towers may be used to reduce makeup water consumption to match water demand with available water supply.

9.2.3.2 Natural Gas Generation

The USNRC evaluated environmental impacts from gas-fired generation alternatives in the GEIS, focusing on combined-cycle plants. Section 9.2.2.11 presents EGC's reasons for defining the gas-fired generation alternative as a combined-cycle plant on the EGC ESP Site. Land-use impacts from gas-fired units on the site would be less than those of the coal-fired alternative. Reduced land requirements, due to construction on the existing site and a smaller facility footprint would reduce impacts to ecological, aesthetic, and cultural resources as well. As discussed under "Other Impacts," an incremental increase in the workforce could have socioeconomic impacts. Human health effects associated with air emissions would be of concern, but the effect would likely be less than those presented by coal-fired generation. Aquatic biota losses due to cooling water withdrawals would be exacerbated by the concurrent operation of CPS.

The gas-fired alternative defined by EGC in Section 9.2.2.11 would be located at the EGC ESP Site.

9.2.3.2.1 Air Quality

Natural gas is a relatively clean-burning fossil fuel. Also, because the heat recovery steam generator does not receive supplemental fuel, the combined-cycle operation is highly efficient (56 percent vs. 33 percent for the coal-fired alternative). Therefore, the gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative. Control technology for gas-fired turbines focuses on the reduction of NO_x emissions. EGC estimates the gas-fired alternative emissions to be as follows:

- SO_x = 177 tons per year
- NO_x = 568 tons per year

- CO = 120 tons per year
- PM = 99 tons per year (all particulates are PM₁₀)

Table 9.2-2 presents the methodology and basis for the above emission figures.

The Section 9.2.3.1 discussion of regional air quality, Clean Air Act requirements, and the NO_x State Implementation Plan Call is also applicable to the gas-fired generation alternative. NO_x effects on ozone levels, SO_x allowances, and NO_x emission offsets could be issues of concern for gas-fired combustion. The emissions from a gas-fired plant are substantial. EGC concludes that emissions from a gas-fired alternative located at the EGC ESP Site may noticeably alter local air quality, but may not destabilize regional resources. Air quality impacts would therefore be moderate, but substantially larger than those of nuclear generation.

9.2.3.2.2 Waste Management

Gas-fired generation would result in almost no waste generation, producing minor (if any) impacts. EGC concludes that gas-fired generation waste management impacts would be small.

9.2.3.2.3 Other Impacts

Similar to the coal-fired alternative, the ability to construct the gas-fired alternative on the EGC ESP Site would reduce construction-related impacts relative to construction on a greenfield site.

To the extent practicable, EGC would route the gas supply pipeline along previously disturbed rights-of-way to minimize impacts. However, this would still be a costly (i.e., approximately \$1 million/mi) and potentially controversial action with ecological impacts from installation of a minimum of 2.5 mi of buried 24-in. gas pipeline to the EGC ESP Site. An easement encompassing 30 to 40 ac would need to be graded to permit the installation of the pipeline. Construction impact would be minimized through the application of best management practices that minimize soil loss and restore vegetation immediately after the excavation is backfilled. Construction would result in the loss of some less mobile animals (e.g., frogs and turtles). Because these animals are common throughout the area, EGC expects negligible reduction in their population as a result of construction. EGC does not expect that installation of a gas pipeline would create a long-term reduction in the local or regional diversity of plants and animals. In theory, these impacts from construction of a pipeline could be reduced or eliminated by locating the gas-fired plant at a different site adjacent to an existing pipeline.

The USNRC estimated in the GEIS that 110 ac would be needed for a plant site; this much previously disturbed acreage is available at the EGC ESP Site, reducing loss of terrestrial habitat. Aesthetic impacts, erosion and sedimentation buildup, fugitive dust, and construction debris impacts would be similar to the coal-fired alternative, but smaller because of the reduced site size. Socioeconomic impacts would result from the approximately 150 people needed to operate the gas-fired facility as estimated in the GEIS. EGC expects this number to be closer to 40 to 80 workers for a plant this size. EGC believes that these impacts would be small due to the mitigating influence of the site's proximity to the surrounding population area.

Use of cooling towers as the cooling mechanism for gas-fired generation would reduce cooling water intake and discharge by 90 percent when compared to once thru cooling as is used currently by the CPS. Use of cooling towers would also reduce impingement, entrainment, and thermal impacts, increase consumptive water use through evaporation, and introduce a visual impact (100-foot-high mechanical towers or 600-ft-high natural draft towers). Wet / dry cooling towers may be used to reduce makeup water consumption to match water demand with available water supply.

9.2.3.3 Combination of Alternatives

This section examines combinations of alternatives that could generate baseload power in an amount equivalent to the proposed EGC ESP Facility.

As discussed in Section 9.2.2.1, the capacity of the EGC ESP facility is 2180 MWe, with an annual energy output of about 17,200,000 MWh. There are a number of combinations of alternatives that have the potential of producing this baseload capacity and output.

Because of the intermittent nature of the resource and the lack of cost-effective technology, wind and solar are not sufficient on their own to generate the equivalent baseload capacity or output of the EGC ESP Facility, as discussed in Section 9.2.2.1 and 9.2.2.4. As shown in Sections 9.2.3.1 and 9.2.3.2, fossil-fired generation generates baseload capacity, but environmental impacts are greater than the EGC ESP Facility. It is conceivable, however, that a combination of alternatives (renewables in combination with fossil-fired generation) might be cost-effective and have less environmental impact than the EGC ESP Facility.

There is a multitude of possible combinations when considering the power sources and the output of each source. For the renewal of licenses pursuant to 10 CFR, Part 54, the NRC has already determined that expansive consideration of combinations would be too unwieldy given the purposes of the alternative analysis (USNRC, 1996). However, the combination alternative analysis should be sufficiently complete to aid the Commission in its analysis of alternative sources of energy pursuant to the National Environmental Policy Act (NEPA). The following analysis provides the basis for an evaluation of a reasonable combination of alternative energy sources to the EGC ESP Facility that is required by NEPA.

9.2.3.3.1 Determination of Alternatives

Many possible combinations of alternatives could satisfy the baseload capacity requirements of the EGC ESP Facility. Some combinations can include renewable sources, such as wind and solar. As discussed earlier in Section 9.2.2.1 and 9.2.2.4, wind and solar do not, by themselves, provide a reasonable alternative energy source to the baseload power to be produced by the EGC ESP Facility. However, wind and solar, in combination with fossil fuel-fired plant(s), may be a reasonable alternative to nuclear energy produced by the EGC ESP Facility.

The EGC ESP Facility is to operate as a baseload merchant independent power producer. The power produced will be sold on the wholesale market, without specific consideration to supplying a traditional service area or satisfying a reserve margin objective. The ability to generate baseload power in a consistent, predictable manner meets the business objective of the EGC ESP Facility. Therefore, when examining combinations of alternatives to the EGC ESP Facility, the ability to generate baseload power must be the determining feature when analyzing the reasonableness of the combination. This section reviews the ability of the

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

costs of the gas facility would be spread across fewer kWh from the gas facility, thereby increasing its cost per kWh. The projected cost associated with the operation a new nuclear facility similar to the EGC ESP Facility is in the range of 3.1 to 4.6 cents per kWh (USDOE, 2002) (USDOE, 2004). The projected costs associated with all other forms of generation other than the EGC ESP Facility are greater than the EGC ESP Facility. Therefore, the cost associated with the operation of the combination alternative would not be competitive with the EGC ESP Facility.

9.2.3.3.4 Summary

Wind and solar facilities in combination with fossil facilities could be used to generate baseload power and would serve the purpose of the EGC ESP Facility. However, wind and solar facilities in combination with fossil facilities would have equivalent or greater environmental impacts relative to a new nuclear facility at the EGC ESP Site. Similarly, wind and solar facilities in combination with fossil facilities would have higher costs than a new nuclear facility at the EGC ESP Site. Therefore, wind and solar facilities in combination with fossil facilities are not preferable to the EGC ESP Facility.

9.2.4 Conclusion

As shown in detail in Tables 9.2-6 and 9.2-7, based on environmental impacts, EGC has determined that neither a coal-fired, nor a gas-fired, nor a combination of alternatives, including wind and solar facilities, would provide an appreciable reduction in overall environmental impact relative to a nuclear plant. Furthermore, each of these types of alternatives, with the possible exception of the combination alternative, would entail a significantly greater environmental impact on air quality than would a nuclear plant. To achieve the small air impact in the combination alternative, however, a moderate to large impact on land use would be needed. Therefore, EGC concludes that neither a coal-fired, nor a gas-fired, nor a combination of alternatives would be environmentally preferable to a nuclear plant. Furthermore, these alternatives would have higher economic costs, and therefore are not economically preferable to a nuclear plant.

9.3 Alternative Sites

This section identifies and evaluates a set of alternatives for the proposed EGC ESP Site. The objective of this evaluation is to verify there is no “obviously superior site” for the eventual construction and operation of a new nuclear unit.

The EGC ESP Facility will be constructed and operated by an unregulated merchant generator as a “merchant plant.” This means that there is no regulatory structure in place to guarantee a return on investments, and many of the decisions affecting the location of the plant are based on factors such as cost, ease of construction, and the ability to transmit the power to customers. The facility will operate in the competitive marketplace created by the National Energy Policy Act of 1992 and subsequent actions by the FERC to impose open transmission requirements. These changes have fundamentally altered both the marketplace for electricity and the makeup of electricity generating companies.

Additionally, existing nuclear sites have also changed the way alternatives are reviewed and selected, since a new plant could be located at these sites. Existing sites offer decades of environmental and operational information about the impact of a nuclear plant on the environment. These sites are licensed nuclear facilities, thus, the USNRC has found them to be acceptable relative to other undeveloped sites in the region of interest. The USNRC recognizes (in NUREG-1555, ESRP, Section 9.3(III)(8)) that proposed sites may not be selected as a result of a systematic review (USNRC, 1999):

“Recognize that there will be special cases in which the proposed site was not selected on the basis of a systematic site-selection process. Examples include plants proposed to be constructed on the site of an existing nuclear power plant previously found acceptable on the basis of a NEPA review and/or demonstrated to be environmentally satisfactory on the basis of operating experience, and sites assigned or allocated to an applicant by a State government from a list of State-approved power-plant sites. For such cases, the reviewer should analyze the applicant’s site-selection process only as it applies to candidate sites other than the proposed site, and the site-comparison process may be restricted to a site-by-site comparison of these candidates with the proposed site. As a corollary, all nuclear power plant sites within the identified region of interest having an operating nuclear power plant or a construction permit issued by the NRC should be compared with the applicant’s proposed site.”

In addition to looking at other nuclear power plant sites in Illinois, EGC’s site selection was also based on an evaluation of undeveloped sites (commonly known as “greenfields”), and previously developed sites (commonly known as “brownfields”). These sites are not obviously superior to existing nuclear sites in the region of interest. Ultimately, the proposed location was chosen based on the applicant’s ability to colocate an additional power facility at an existing nuclear power facility near Clinton, Illinois, and transmit power to the wholesale marketplace. The existing facility currently operates under a USNRC license, and the proposed location has already been found acceptable under the requirements for that license. Further, operational experience at the existing facility has shown that the environmental impacts are small, and operation of a new facility at the site should have essentially the same environmental impacts.

The traditional “relevant service area” does not necessarily provide a meaningful way to evaluate the alternative sites because once the facility is built it will generate power for sale

to consumers in a deregulated marketplace. For the purposes of this review, the “region of interest” (ROI) is defined as the State of Illinois rather than the “relevant service area.” This is due to current deregulation policies, the proposed location in the State of Illinois, the availability of transmission capabilities in the state, and market flexibility. The ROI is explained below in Section 9.3.1.

The decision to collocate the new nuclear power facility at the EGC ESP Site near Clinton, Illinois was based on market factors and a comparison of the seven existing nuclear sites within the state and an evaluation of postulated brownfield and greenfield sites. The review process outlined in this section was consistent with the special case noted in NUREG-1555, ESRP, Section 9.3(III)(8), and took into account the advantages already present at existing nuclear facilities within the ROI (USNRC, 1999). The evaluation of alternative sites, and a comparison with greenfield and brownfield sites focused on whether there are any sites that are obviously superior to the EGC ESP Site.

9.3.1 Site Preferences and the Region of Interest

9.3.1.1 Site Preferences

The review procedure described in this chapter compares and evaluates existing nuclear sites within the ROI. The candidate site criteria described in NUREG-1555 are incorporated into the site review in Section 9.3.3. This section explains the Applicant’s preference for an existing nuclear site. The following preference factors influenced the decision to review existing nuclear sites within the ROI.

- There are benefits offered by existing nuclear sites. For example, collocated sites offer existing infrastructure and other advantages.
- The environmental impacts of an existing unit are known and the impacts of a new unit should be comparable to those of the operating nuclear plant.
- Site physical criteria, primarily geologic/seismic suitability, have been characterized at existing sites; these criteria are important in determining site suitability.
- Transmission is available and the existing sites have nearby markets.
- Existing nuclear plants have local support and the availability of experienced personnel.

Initially, candidate sites within the ROI were identified and screened. Given the factors listed above, collocating a facility at the EGC ESP Site became the preferable alternative. The EGC has made agreements with AmerGen for access to and control of the proposed site at Clinton. The CPS has been a licensed facility there since 1987, and the site has a proven record of environmental, health, socioeconomic, and market performance

As discussed in Sections 9.3.3.1 and 9.3.3.2, the economically and environmentally preferable alternative for the EGC ESP Facility is collocation; therefore, the consideration of alternative sites within the region of interest focused primarily on sites with an existing nuclear power facility. It considered additional issues such as environmental impacts, land use, transmission congestion, proximity to population centers, and economical viability. The assessment was focused on existing nuclear sites controlled by EGC within the identified ROI, and evaluations were also performed of hypothetical greenfield and

brownfield sites. A site-by-site comparison of candidate sites with existing power plants did not result in identification of a site obviously superior to the EGC ESP Site as the preferred site.

9.3.1.2 Region of Interest

NUREG-1555 provides that the ROI includes the state where the candidate site is located, so that alternatives sites may be considered for review (USNRC, 1999). The basis for the ROI is the candidate site's location within the State of Illinois. There are sufficient existing nuclear sites that meet the threshold criteria discussed below. The ROI also was the geographic area considered in searching for a comparative evaluation of greenfield and brownfield sites. While power generated at the proposed facility will be sold in a deregulated marketplace, the potential for line loss, flexibility of transmission, and the proximity of EGC's customer base limits the ROI to the State of Illinois. The topography, ecology, and socioeconomic conditions throughout the region are roughly the same. Generally, the region is rural/agricultural with pockets of heavy population near important waterways such as the Mississippi River and Lake Michigan, or in traditionally populated areas such as the State Capital and university sites.

9.3.1.3 The Candidate Site

The candidate site is reviewed at length in this ER. This section reviews the EGC ESP Site in relation to the selection criteria suggested in NUREG 1555, ESRP 9.3 in order to consider whether the site is "obviously superior" to other candidate sites. The criteria are more fully discussed in Section 9.3.3.

9.3.1.3.1 Consumptive Use of Water

Clinton Lake is specifically available for cooling. The lake/impoundment of Salt Creek was constructed for the CPS, and includes the UHS. The UHS is a submerged impoundment located within Clinton Lake that provides emergency cooling water. There are other small lakes and ponds, both man-made and natural, scattered throughout the region. Most of these other water bodies are used for farming and recreation. Salt Creek is a tributary of the Sangamon River.

There is no groundwater used at the CPS, and it is not anticipated that groundwater will be used at the EGC ESP Facility (see Chapter 5).

9.3.1.3.2 No Further Species Endangerment

As noted in Chapters 4 and 5, there are no endangered species in the vicinity of the site. Important species and habitats are presented in Table 2.4-3.

9.3.1.3.3 Effects on Spawning Grounds

The Clinton Lake State Recreation Area, along with adjacent recreation areas, is designated as an important habitat for some species. Table 2.4-1 identifies those species and their habitats. There are no identified spawning grounds at the EGC ESP Site.

9.3.1.3.4 Effluent Discharge and Water Quality

The CPS discharges blowdown water through a discharge canal into Clinton Lake. As noted in Chapter 5, the proposed plant will also discharge any blowdown water through the canal and into Clinton Lake. One target established for the EGC ESP Facility is to maintain the cumulative discharge rate within CPS NPDES permit conditions. It is not anticipated

that construction and operation of the EGC ESP Facility at the EGC ESP Site will adversely affect water quality.

9.3.1.3.5 Preemption and Other Land Use Issues

Land in the region is designated primarily for agricultural use (92.5 percent). However, the land inside the CPS Site boundary (including the candidate site) is zoned industrial; approximately 0.6 percent is designated industrial within the region. Approximately 6 percent of the land in the region is classified for recreational use, and 1.5 percent has been designated for residential use. There are 10 areas within the region specifically reserved for state recreation areas, historical sites, or wildlife areas. Figure 2.2-5 shows the land use designations within the region.

9.3.1.3.6 Potential Effect on Aquatic and Terrestrial Environment

As noted in Chapters 4 and 5, wetland and floodplain forest areas are present along Salt Creek and North Fork of Salt Creek. Additionally, some floodplain forest areas can be found along Clinton Lake, north of the EGC ESP Facility (USFWS, 2002). Clinton Lake, and other waterbodies located within the site vicinity, provide a suitable habitat for a variety of waterfowl species. Waterfowl observed, or documented to occur within the site vicinity include the blue-winged teal, mallard, American widgeon, wood duck, lesser scaup, and Canada goose. In addition, migratory shorebirds were also observed during surveys. Common species identified include a variety of sandpipers and heron (CPS, 1972). Reptiles and amphibians that commonly occur within the site vicinity include various species of frogs, salamanders, snakes, and turtles (CPS, 1972).

The EGC ESP Facility is located on Clinton Lake, a 4,895-ac waterbody created as a cooling source for the CPS. Since its creation, Clinton Lake has become a resource for a variety of stocked and naturally occurring populations of fish species. Fisheries in watercourses of the site vicinity are consistent with fisheries commonly found in the central Illinois region. During extensive surveys performed in Salt Creek and the North Fork of Salt Creek, species collected include several species of shiner (common, bigmouth, red, sand, and redbelly), bluntnose minnow, creek chub, white sucker, black bullhead, channel catfish, bluegill, largemouth bass, and crappie (CPS, 1972).

9.3.1.3.7 Population Characteristics

Major population centers (as defined by 10 CFR 100) include Decatur, the closest population center (22-mi south-southwest) with a population of 81,860 as of the year 2000. Other population centers within an 80-km (50-mi) radius include Champaign and Urbana with populations of 67,518 and 36,395, respectively. Otherwise, the vicinity's population is relatively low; Clinton, the nearest incorporated town, has a current population over 7,000. In addition, the population density for the vicinity is approximately 97 people per mi². The population within 10 mi of the site is expected to decrease through the year 2060 (see ER Table 2.5-2). Figure 2.5-2 shows the regional population centers.

9.3.2 Superiority of Existing Sites Within the Region of Interest

During initial review, EGC determined that the advantages of collocating the new facility with an existing nuclear power facility outweighed the advantages of any other probable siting alternative. The preferred siting alternative was, therefore, to colocate the EGC ESP Facility with the CPS Facility, an existing nuclear facility in Illinois. In addition to the

factors assessed and described previously in this section, there are several advantages to colocating nuclear facilities as a general rule. Some of the potential environmental and market advantages include:

- The total number of required generating sites is reduced.
- Construction of new transmission corridors may not be required due to potential use of existing corridors.
- No additional land acquisitions will be necessary, and the applicant can readily obtain control of the property.
- The site has already gone through the alternatives review process mandated by the National Environmental Policy Act (NEPA), and was the subject of extensive environmental screening during the original selection process.
- The site development costs and environmental impact of any preconstruction activities are reduced.
- Construction, installation, and operation and maintenance costs are reduced because of existing site infrastructure.

Existing facilities where EGC could obtain access and control were preferred over the other sites within the region of interest. Sites that were originally designed for more generation than actually constructed also received preference.

The applicant considered colocating with the following existing nuclear power facilities within the region of interest:

- Braidwood Generating Station;
- Byron Generating Station;
- Clinton Power Station;
- Dresden Generating Station;
- LaSalle County Generating Station;
- Quad Cities Generating Station; and
- Zion Generating Station.

The CPS near Clinton, Illinois, was the preferred site. The proposed site is preferable to the sites of the other existing nuclear facilities within Illinois, primarily based upon the alternative site reviews described below.

9.3.3 Alternative Site Review

Regulatory Guide 4.2 notes: “The applicant is not expected to conduct detailed environmental studies at alternative sites; only preliminary reconnaissance-type investigations need be conducted” (USNRC, 1976). The alternatives described here are compared based on recently updated safety analysis report (USAR) information about the existing plants and the surrounding area, and existing environmental studies and Final

Environmental Impact Statements issued by the Atomic Energy Commission or USNRC. An undeveloped site (greenfield) and former industrial site (brownfield) were also considered for comparison in order to determine if they were obviously superior to an existing nuclear site.

9.3.3.1 Greenfield Site

An undeveloped (greenfield) site is useful as a bounding comparison for identifying impacts at the site, and this concept has been used by the USNRC in other licensing activities (USNRC, 1996), where the USNRC has developed generic characteristics of a greenfield site for comparison during license renewal. Some of the issues identified for greenfields in the USNRC's *Generic Environmental Impact Statement (GEIS) for License Renewal* can correlate with the issues the applicant faces in determining the superiority of the proposed site.

In order to maximize the advantages and minimize the disadvantages of the greenfield site, the applicant assumed the greenfield site would be in Illinois, have characteristics where cooling water would be available and where access to transmission lines would be available. Otherwise, the site would be undeveloped for generating capacity and no existing infrastructure would be available.

EGC has made some conservative assumptions using the characteristics of two potential greenfield sites in Illinois. One potential site, on the shores of Clinton Lake, has similar characteristics to the undeveloped areas around the lake. As noted in Chapter 2, the undeveloped greenfield site along Clinton Lake is close to transmission lines and transportation corridors, and a railway spur could likely be developed from the current CPS. The population near this greenfield site is also reported in Chapter 2. Another site is on the banks of the Illinois River near the Dresden Station and Collins Station, a large gas-fired generating plant. The land itself is cleared farm land and forest terrain. There is potential access to cooling water from the Illinois River and Mizan Creek. Additionally, there is a ComEd Transmission right-of-way adjacent to the property, and asphalt road frontage leads to IL Rt. 47 and IL Rt. 155. Land use is predominantly agricultural. The population around the site is characteristically rural, with low population similar to the Dresden site. There is a lessee living in a small farm house on the site.

A greenfield site is not considered environmentally preferable for a number of reasons including:

- The applicant does not own a suitable area with the required characteristics for a nuclear plant. The land (and/or access to it), including any easements, would have to be obtained from third parties.
- An undeveloped site would require an area of considerable size (USNRC, 1996), with a potentially adverse economic impact. The USNRC has determined that a new nuclear generating facility (e.g. an advanced light water reactor) would require 500 to 1,000 ac including an exclusion area. The exclusion area requirement would be mitigated by building at a greenfield inside the existing CPS exclusion area (the total area of the existing CPS Site is 13,700 ac, including the 5,000 ac Clinton Lake). According to Chapter 4, a total of 461 ac are included in the site boundary, and approximately 96 ac will be disturbed. (This area will likely be greater at either greenfield site, because much

of the area for the proposed ESP site has been cleared.) The greenfield area near Collins Station is approximately 500 ac, and could likely meet the land requirements. Although both greenfield sites have sufficient acreage for construction of the EGC ESP Facility, construction of the facility at these greenfields may disturb important habitats and resources that are not present at the EGC ESP Site.

- The USNRC notes that the impact of a new reactor at a greenfield would be severe but could be moderated somewhat by locating the plant at a current nuclear site (USNRC 1996). While the impact of this new plant at the CPS greenfield site would still be moderate, impact at the Collins Station site would be severe, since it is a relatively pristine site. Transmission and other issues could be moderated by the proximity of existing infrastructure.
- New transmission lines and corridors would be required to intertie with the existing system. Existing transmission lines near a potential CPS greenfield and at a potential Collins Station greenfield could be modified; however, new interties would be required. With the use of existing corridors, some disturbance would still occur at either greenfield site, since new transmission lines from the new plant to existing lines would require some clearing, grubbing and other construction (see Chapter 3.7).
- Terrestrial and aquatic resource impacts are expected to be greater than those experienced at an existing site (USNRC, 1996). These impacts are similar to the construction of any large energy generating facility (see Chapter 9.2.3). Destruction of wildlife and aquatic habitat would occur with construction of the plant, corridors, and intake and discharge structures. As noted in Chapters 4 and 5, most aquatic displacement from construction and operation may be temporary; loss of terrestrial habitat at the greenfield will be permanent. However, the site near Collins Station is part of the Prairie Parklands Resource Rich Area (RRA), and is proximate to marshes, wetlands, and forests (INHS, 2003). The Heideke State Fish and Wildlife Area is also near the Collins Station greenfield (IDNR, 2003). Unlike the CPS greenfield, which has no critical habitat or endangered species, the second site is near critical habitat for the endangered upland sandpiper (INHS, 2003).
- Aesthetic and socioeconomic impacts from construction and operation of a new nuclear facility at the greenfield sites would be similar to those forecast for the EGC ESP Site in Chapters 4 and 5. Erosion, sedimentation, and fugitive dust are likely aesthetic impacts from construction, and operational impacts would include an increased workforce, increased transportation requirements, and public services would be affected.

In summary, the environmental impacts from construction and operation of a nuclear power plant at a greenfield site would be similar to or greater than those at the proposed CPS Site. Therefore, a greenfield site is not obviously superior to the EGC ESP Site.

9.3.3.2 Brownfield Site

A “brownfield” site is one that is released for redevelopment after cleanup under Resource Conservation and Recovery Act or Superfund programs (USEPA, 2002). Such sites have been recommended for redevelopment by the EPA, and general characteristics can be identified based on EPA reports describing such sites (USEPA, 2003). The sites reviewed here are former industrial facilities where existing buildings and other infrastructure have

been removed to facilitate cleanup. The environmental consequences of building on a brownfield site will not be as severe as those noted for greenfield development.

There are no brownfield sites near Clinton. EGC has made some conservative assumptions based on available EPA information about two brownfield sites in Illinois to compare the brownfield site with an existing nuclear site. The EPA has recently identified example sites in Antioch and DePue, Illinois (USEPA, 2002). The site in Antioch, IL, is a former landfill where the remedy included a clay cap and an updated methane and leachate collection system. The site in DePue, IL, is a former zinc plant located along the Illinois River. Part of the site may be re-used as an industrial site, while remaining portions of the site may be set aside for a recreational or ecological resort. These sites serve as a baseline to identify characteristics of the hypothetical brownfield site.

The hypothetical brownfield site would be the site of a former industrial complex in Illinois. Generally, these sites are in areas where heavy industry has been the predominant land use. The hypothetical brownfield will be near an existing water source such as the Mississippi or Illinois River. This alternative site will not have all of the infrastructure currently available at the existing nuclear sites. Most potential brownfield sites in Illinois do not have the all of the required infrastructure, although some interties with existing transmission corridors may be close to the site.

The brownfield site is not considered environmentally preferable for the following reasons:

- New infrastructure requirements such as pipeline construction, transmission corridor development or expansion, supply line development (e.g., a rail spur or other transportation), and cooling systems, will incur economic costs and environmental impacts not associated with location of a plant at an existing nuclear site. These impacts would be greater than construction at an existing nuclear facility.
- Terrestrial habitat loss will be minimal, but aquatic habitat will be moderately affected. Some ecological impacts would occur as intake, heat sink, and discharge capabilities were constructed. For example, if the EGC ESP Facility were built at the DePue brownfield, there may be entrainment and impingement to the sports fisheries in the neighboring lake as a result of construction of intake structures.
- Aesthetic impacts would include impaired views from cooling towers, fugitive dust, erosion, and sedimentation. These impacts would likely be similar to those impacts forecast for the EGC ESP Site in Chapters 4 and 5.
- Socioeconomic and environmental justice impacts are assumed to occur at brownfield sites, since sites such as those considered in this evaluation are located in or near urban areas (Deason, 2001). Larger urban areas could accommodate changes in population brought about by the construction of a new nuclear generating facility. However, urban and industrial communities such as those near the Antioch and DePue sites may be disproportionately affected by development of a new nuclear plant in those areas, compared to the relatively homogeneous socioeconomic structure at Clinton. Other socioeconomic issues would be roughly similar to those forecast for the EGC ESP Site.

- Impacts associated with new transportation corridors, housing and other public services may be affected by an influx of an experienced workforce, however, necessary infrastructure will likely be available.
- Most brownfield example sites do not meet the size requirements for a new nuclear plant. These requirements would be more difficult to meet than the greenfield example site. Enough area for the proposed plant, site boundaries and exclusion area boundaries would likely be unavailable. For example, the Antioch site is 160 ac adjacent to a wetland and recreational lakes. The DePue site sits on 250 ac adjacent to a lake and other commercial and industrial development. According to Chapter 4, a total of 461 ac are included in the site boundary, and approximately 96 ac will be disturbed. The existing exclusion area boundary for the CPS exceeds 10,000 ac.

In summary, the environmental impacts from construction and operation of a nuclear power plant at a brownfield site would be greater than or equal to those at the proposed EGC ESP Site. Therefore, a brownfield site is not obviously superior to the EGC ESP Site.

9.3.3.3 Existing Nuclear Facilities in the ROI

Since development of greenfield or brownfield sites was not considered obviously superior, EGC preferred siting a proposed nuclear power facility adjacent to an existing facility. There are six existing nuclear power facility sites in Illinois that were considered as potential siting alternatives. The discussion below reviews information about the sites that assist the applicant in a site-by-site comparison. This review is based on siting and safety criteria outlined in 10 CFR 100, and as identified in the updated safety analysis reports (USARs) and environmental reports for each site. These reports provide the most recent information about the sites. Each site was reviewed using the site characteristic criteria noted in NUREG 1555, ESRP 9.3. They are:

- Consumptive use of water should not cause significant adverse effects on other users.
- There should not be any further endangerment of federal, state, regional, local, and affected Native American tribal listed threatened, endangered, or candidates species.
- There should not be any potential significant impacts to spawning grounds or nursery areas of populations of important aquatic species on federal, state, regional, local, and affected Native American tribal lists.
- Discharges of effluents into waterways should be in accordance with federal, state, regional, local, and affected Native American tribal regulations and would not adversely impact efforts to meet water quality objectives.
- There would be no preemption of or adverse impacts on land specially designated for environmental, recreational, or other special purposes.
- There would not be any potential significant impact on terrestrial and aquatic ecosystems including wetlands, which are unique to the resource area.
- Population density and numbers conform to 10 CFR 100.

Using the available information, EGC then determined whether there were any environmentally preferred sites among the candidate sites, and then identified whether

economic, technological or institutional factors outweighed the proposed EGC ESP Site. This approach is similar to the two part “obvious superiority” test outlined in NUREG 1555. This review performs “only preliminary reconnaissance-type investigations” based on environmental information available (USNRC, 1976). For purposes of review, EGC assumed that the EGC ESP Facility would be the bounding case for each candidate site. The applicant performed sufficient review to determine whether the sites met the candidate criteria and if there were obviously superior sites. The proposed EGC ESP Site is not summarized here since it is the subject of this ER. Rather, the alternative sites are summarized below, and compared with the proposed EGC ESP Site in Table 9.3-1.

9.3.3.3.1 Braidwood Generating Station

Braidwood Generating Station is located in northeastern Illinois about 50-mi southwest of Chicago and about 20-mi south-southwest of Joliet. The site is located primarily on flat agricultural land that has been scarred by strip coal mining. The site itself is located primarily on a former strip mining area. The roughly rectangular site occupies about 4,457 ac, and the main cooling pond occupies about 2,537 ac. The cooling pond is located on a former strip mine area. Water for the pond is withdrawn from, and eventually returned to, the Kankakee River. The Kankakee River is a popular recreational area and supports numerous sports such as fishing and hunting. Despite its proximity to Joliet and Chicago, the area is not heavily industrialized, and remains an agricultural area. Braidwood was originally developed for four units; two are operational (EGC, 2000). It is assumed that a new nuclear facility at the area would have roughly the same general environmental impact as the existing facility.

9.3.3.3.1.1 Consumptive Use of Water

Cooling water for the plant is obtained from the Kankakee River, and is held in the cooling pond. There is little public consumptive use of the water, although downstream uses include fishing and other recreational activities (EGC, 2000). Makeup water for the pond is pumped from the river screen house on the Kankakee River via pipeline to the northeast corner of the cooling pond. Blowdown water is discharged from the plant by pipeline to the blowdown outfall structure and discharge flume to the Kankakee River. The existing Braidwood units withdraw greater than 50 million gallons of water per day, with corresponding discharge. The 1973 ER predicts withdrawals up to 150 million gpd by the year 2020, anticipating the operation of 4 units (ComEd, 1973). However, the EGC ESP Facility may use a number of cooling systems options that do not require this kind of consumption. 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 for the EGC facility.

Groundwater has not been used at the Braidwood Station during plant operation. All plant water requirements are currently met from the Kankakee River. For a detailed review of site and regional conditions, please see the Braidwood USAR (EGC, 2000). There are approximately 31 wells within the vicinity used for public supply of groundwater. There is large-scale industrial and municipal use of groundwater around Joliet, and studies show that a resulting cone of depression could affect groundwater use around the Braidwood facility (EGC, 2000).

9.3.3.3.1.2 No Further Species Endangerment

The Goose Lake Prairie Nature Preserve is located 9-mi northwest of the plant, along the borders of the Dresden Facility. Some sensitive habitats and species exist there, including the upland sandpiper. The Kankakee Nature Preserve is also approximately 13 mi from the facility, and hosts some sensitive species and plants. There have been no reported observations of sensitive species and plants within the facility boundaries (EGC, 2000).

9.3.3.3.1.3 Effects on Spawning Grounds

There is no evidence of spawning grounds on the facility or in the vicinity.

9.3.3.3.1.4 Effluent Discharge and Water Quality

Blowdown water is discharged into the Kankakee River. Stormwater discharge and other effluents are occasionally discharged into the river, but they do not exceed the limits set forth in the station's National Pollution Discharge Elimination System (NPDES) permit. However, with new units, additional permitting would be required. 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 Braidwood.

9.3.3.3.1.5 Preemption and Other Land Use Issues

No land would be preempted for additional facilities built at the station.

9.3.3.3.1.6 Potential Effect on Aquatic and Terrestrial Environment

Terrestrial habitats in the area are characterized as reclaimed strip mining sites. The strip mine spoil habitat is different from the surrounding agricultural habitat. Most species have adjusted to both habitat types. The site boundaries are characterized by overgrown drainage, fallow fields, and woodlands. There is marshy habitat created by water-filled strip mine spoil. Mammals and bird species are adapted to the various habitats. Important small game species have also been observed at the site, including ring-necked pheasants, bobwhite, rabbits, mourning dove, and big game is likewise observed. The cooling pond serves as some habitat for migrating water fowl, but there have been no adverse affects noted from operation of the existing facilities (ComEd, 1973).

The Kankakee River is the aquatic habitat most affected by site operations. The river supports sport fishing opportunities, but there is no commercial fishing (EGC, 2000). Aquatic life within the Braidwood cooling pond is similar to that in Dresden Lake, about 10-mi downstream from the Braidwood site. As with Dresden, the major impact of to the aquatic environment is entrainment and impingement as a result of the intake and discharge structures (ComEd 1973, EGC, 2000).

9.3.3.3.1.7 Population Characteristics

Projected population of the area suggests that the population (including transient population) within 10 mi of the Braidwood Station will reach nearly 86,000 by the year 2020. The population between 10 and 50 mi includes the Chicago metroplex, and the total population is predicted to reach more than 5 million by the year 2020. The low population zone (LPZ) is predicted to include 1,465 people by the year 2020 (EGC, 2000).

The closest population centers over 25,000 include Joliet, with a predicted 2020 population of 85,000, and Kankakee, with a projected population of 31,065. There are approximately 22 urban centers within a 30-mi radius of the site (EGC, 2000).

The population density within 10 mi of the site is estimated to be approximately 187 people per mi² by the year 2020. The predicted density for the 50-mi radius from the site is 653 people per mi² by the year 2020 (EGC, 2000).

9.3.3.3.2 Byron Generation Station

A construction permit was issued for the Byron Station in 1975; Unit 1 and has been operating since approximately 1984, and Unit 2 has been operating since approximately 1985. The Byron Station is located in northern Illinois, 3.7-mi south-southwest of the city of Byron, and 2.2-mi east of the Rock River, in Ogle County. The site is situated in the approximate center of the county in a predominately agricultural area. The Byron Station occupies approximately 1,782 ac of land. This area consists of the main site area and the transmission and pipeline corridor to the Rock River. The main site area occupies approximately 1,398 ac, while the corridor occupies the remaining 384 ac. Byron is a two-unit operational nuclear generating facility with 495-ft-high twin cooling towers that help cool the pressurized water reactors. EGC owns and operates the facility. There are no industrial, institutional, commercial, recreational, or residential structures on the site, other than those used by EGC in the normal conduct of its utility business. The development of the site for uses other than power generation and agriculture is not planned (EGC, 2002). It is assumed that a new nuclear facility at the area would have roughly the same general environmental impact as the existing facility.

9.3.3.3.2.1 Consumptive Use of Water

The major source of plant makeup water is the Rock River. Rock River is nonnavigable for commercial purposes, but remains a popular recreation area. Boating, fishing, and water-skiing are popular pastimes on the river. The only other uses for Rock River are industrial water and some irrigation (EGC, 2002). Plant blowdown water is discharged to the Rock River.

While some surface water is used at the site, makeup can be supplied to the cooling towers by two deep wells. Generally, most of the water for domestic, municipal, and industrial use in the region is obtained from groundwater sources. The major unit is the St. Peter Sandstone within the Cambrian-Ordovician Aquifer, although minor supplies commonly are obtained from the shallower glacial drift and dolomite aquifers. There are seven public water supply systems within 10 mi of the plant site. All use groundwater wells for water supply. Due to the relatively low level of urbanization around the site area and the small amount of on-site use, it is unlikely that future increases in groundwater withdrawal in the area would have much effect on the groundwater supply at the site (EGC, 2002).

A site groundwater monitoring program was begun in December of 1975. This monitoring program was performed (1) to define existing conditions as a base for future comparisons; (2) to monitor the effects of construction; (3) to check for either plant operation or groundwater use by others; and (4) to protect off-site groundwater users in case of detrimental changes in groundwater quality. The site groundwater monitoring program was not part of any radiological monitoring program. Six domestic and agricultural water wells were monitored for monthly changes in piezometric levels. Three of the water wells are now owned by EGC and are located on the inside perimeter of the Byron site boundaries. The other three wells are on the outside perimeter of the site boundary. Data from this monitoring program indicated no changes in groundwater chemistry or

piezometric levels attributable to excavation, grouting, groundwater pumping, or other activities at the Byron site (EGC, 2002).

In addition to this site groundwater monitoring program, the detailed site geotechnical investigation identified an area of groundwater contaminated by toxic materials prior to the purchase of the land by Commonwealth Edison and EGC. The operation of the Byron Station is not expected to effect groundwater at the site (EGC, 2002). 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.

9.3.3.3.2.2 No Further Species Endangerment

At the time early environmental assessments were made of the Byron facilities, all large-scale construction activities had been completed and operation was in full force. No evidence has been found to indicate that construction or operation of a new nuclear plant would have any detrimental effects on the area around the facility (USNRC, 1982).

9.3.3.3.2.3 Effects on Spawning Grounds

The Byron Station received its construction permit in 1975, and operating licenses were issued for both units in the mid-1980s. No spawning grounds or otherwise sensitive ecosystems were noted. It is expected that no adverse effect on spawning grounds will occur with the construction and operation of new units at the facility (USNRC, 1982).

9.3.3.3.2.4 Effluent Discharge and Water Quality

Byron 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 (USNRC, 1982). 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 Byron.

9.3.3.3.2.5 Preemption and Other Land Use Issues

Land use within the 5-mi radius of the Byron Station is agricultural. There is little industry in the vicinity, and that is primarily developed for supporting the agrarian economy. Wheat, corn, and soybeans are the primary products (EGC, 2002).

Illinois State Route 2, which is the closest major highway to the site, is located 2.5-mi west of the plant and has an annual average traffic flow per 24-hr period that ranges from 4,000 cars between Byron and Oregon to 8,800 cars in Oregon. State Routes 72 and 64 are also well traveled, having 24-hr annual averages that exceed 2,000 cars (EGC, 2002).

The Rock River is the major waterway for the area surrounding the Byron site, although it is considered nonnavigable to commercial traffic in this vicinity. It is a popular recreation spot (EGC, 2002). Construction and operation of new nuclear units are not expected to preempt these uses.

9.3.3.3.2.6 Potential Effect on Aquatic and Terrestrial Environment

Currently, the Byron Station uses the Rock River for makeup water and blow down is likewise discharged into the river (EGC 2002). Water from Rock River will likely serve these functions for any new units placed on the site.

Sport fisheries and other aquatic and terrestrial habitats could be temporarily affected by a construction of the EGC ESP Facility at this site. The Rock River is a popular recreational river. It is not expected that construction and operation of a new nuclear plant will significantly affect the water quality of the river.

Terrestrial effects are also expected to be limited to short-term displacement during construction. Earlier reports and current reviews indicate that wildlife inhabit undisturbed areas at the Byron site; this trend is expected to continue.

9.3.3.3.2.7 Population Characteristics

The site currently meets population criteria for 10 CFR 100. The population for the 10-mi radius around the Byron Station is projected to be approximately 31,616 by the year 2020, or 101 people per mi². That population generally lives between 5 and 10 mi from the site. The regional population in the 10- to 50-mi radius is expected to reach 1,514,138 people by the year 2020, with 269 people per mi² (EGC, 2002).

The primary population center is Rockford, 17 mi to the northeast of the plant. The projected 2020 population is 246,700. DeKalb, about 28-mi east-southeast of the plant, has a projected 2020 population of more than 73,000. The population density is generally at its greatest between 10 to 20 mi from the Byron Station (EGC, 2002).

There are 28 industries within 10 mi of the site. There are 16 schools within the 10-mi radius, and it is anticipated that most of the students live in the same radial area (EGC, 2002).

Transient populations are expected to be composed primarily of recreational users. The transient population is estimated at 43,617 due to the influx of recreational users to the vicinity (EGC, 2002).

There are several recreational facilities in the LPZ, which is defined for Byron as a 3-mi radius from the plant. Peak daily usage of these areas occurs on the weekends (EGC, 2002).

9.3.3.3.3 Dresden Generating Station

The Dresden Nuclear Power Station site consists of approximately 953 ac. It is a three-unit station. The site boundaries generally follow the Illinois River to the north, the Kankakee River to the east, a county road from Divine extended eastward to the Kankakee River on the south, and the Elgin, Joliet and Eastern Railway right-of-way on the west (EGC, 2003).

Unit 1 is located in the northeast quadrant of the site with an intake canal extending west from the Kankakee River and a discharge canal extending north to the Illinois River. Unit 1 was officially retired on August 31, 1984, but its major structures are still present and intact. It is now designated a nuclear Historic Landmark by the American Nuclear Society. Unit 2 is located on the site directly west of and adjacent to Unit 1. The location of Unit 3 is directly west of and adjacent to Unit 2 (EGC, 2003). Units 2 and 3 are operational.

Portions of the area outside the station footprint have been leased to a neighboring farmer for grazing cattle and raising crops. Hunting is also permitted outside security areas. A microwave relay tower belonging to International Bell Telephone system is located approximately 1,000 ft from the reactor building. A meteorological tower is located approximately 3,000 ft from the reactor building (EGC, 2003). It is assumed that a new

nuclear facility at the area would have roughly the same general environmental impact as the existing facility.

9.3.3.3.3.1 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.

9.3.3.3.5 Preemption and Other Land Use Issues

Current land use is industrial. Given the fact that the entire Dresden site has been a large power generating facility since 1965, the current land use is not expected to change. However, the Dresden site does not have additional available land within the boundaries. In order to build a new facility, an operating unit or Unit 1 would require decommissioning. The area around Dresden has become increasingly urbanized, and it is expected that the trend will continue. The construction and operation of a new nuclear facility at the site would not be expected to affect the land use patterns of the area.

9.3.3.3.6 Potential Effect on Aquatic and Terrestrial Environment

The major rivers within 5 mi of the plant are the Illinois, Des Plaines, and Kankakee rivers. The Kankakee River joins the Des Plaines River, east of the plant, to form the Illinois River, which extends along the north boundary of the site. The closest navigational channel is on the Illinois River, located approximately 0.5-mi north of the plant. The closest river lock is the Dresden Island Lock, approximately 1-mi northwest of the plant (EGC, 2003).

Sport fisheries and other aquatic and terrestrial habitats could be affected by a proposed new facility at this site, as well as decommissioning activities. The Illinois River is an industrial river. Although water quality has improved somewhat through environmental regulation and cleanup efforts, large commercial and sports fisheries are virtually nonexistent. Increased turbidity, commercial traffic (e.g. barges), and effluent discharges unrelated to the operation of the Dresden facility have contributed to a decrease in vegetation and other aquatic life in the river. It is not expected that construction and operation of a new nuclear plant will significantly affect the water quality of the river.

The Kankakee River serves as the existing station's source of cooling water, and would likely provide cooling water for any new facility. The Kankakee is a small river. It is several degrees cooler than the Illinois River, and supports a sports fishery. Entrainment and impingement are both noted at the intake of the existing units, and are expected to continue during the operations of a new facility (USNRC, 1972).

Terrestrial effects are also expected to be limited to short-term displacement during construction. Earlier reports and current reviews indicate that wildlife inhabit undisturbed areas at the Dresden site; this trend is expected to continue (USNRC, 1972; EGC, 2003a).

9.3.3.3.7 Population Characteristics

The Dresden site currently meets the population requirements of 10 CFR 100. The LPZ for the station is an area within a 5-mi radius. The population within the 5-mi radius area is 8,948. The nearest resident population within the LPZ is contained in a cluster of cottages along the west shore of the Kankakee River; the nearest line of cottages is just outside the exclusion area boundary (EAB). The estimated population of this cluster of homes is approximately 280. The other closest residences are widely separated in several directions from the station. A single residence is located approximately 0.6-mi southeast of the station on the east shore of the Kankakee River (EGC, 2003).

The closest significant residential concentration of over 1,000 residents is 3- to 4-mi northeast of the station along the Illinois River (EGC, 2003).

The Chicago metropolitan area lies within 50 mi of the site.

9.3.3.3.4 LaSalle County Station

The LaSalle County Station is a 2-unit, 3060 ac site located in Brookfield Township of LaSalle County in northeastern Illinois. The Illinois River is 5-mi north of the site. The major transportation routes near the site include the Illinois River, approximately 3-mi north of the northern boundary; IL State Highway 170, 0.5-mi east of the eastern boundary of the site; and Interstate Highway 80, 8-mi north of the northern site boundary. The Chicago, Rock Island, & Pacific RR, approximately 3.25-mi north of the northern site boundary, is the closest operable RR line (EGC, 2002a).

It is assumed that a new nuclear facility at the area would have roughly the same general environmental impact as the existing facility.

9.3.3.3.4.1 Consumptive Use of Water

The Illinois River is the primary surface water source for the facility. The river is an important source of commercial and recreational navigation. Surface consumption is primarily by neighboring industrial and agricultural use. The LaSalle County Station does not significantly affect surface water use from the Illinois River, because a 2058 ac cooling lake was created to provide water for cooling and discharge.

Groundwater is used at LaSalle County Station to supply the water requirements for the plant systems, makeup demineralizer and potable supply (EGC, 2002a).

Groundwater is obtained from two deep wells in the Cambrian-Ordovician Aquifer, which underlies the site. Each well is equipped with a deep well submersible pump with a rated capacity of 300 gpm. The water is stored in a 350,000-gallon, ground level tank prior to distribution to the demineralizer and domestic systems. Maximum groundwater use is presently estimated to be approximately 521,600 gpd. The maximum water requirements for each system and the percentage of the total used are as follows: makeup demineralizer, 479,600 gpd (92 percent); potable supply, 15,000 gpd (3 percent); sand filter backwash, 11,500 gpd (2 percent); and recreational supply, 15,500 gpd (3 percent) (EGC, 2002a). The use of water for the EGC ESP Facility depends on the cooling system and plant design selected. Consumptive use of water predicted for the EGC ESP Facility cooling systems is described in Table 5.2-2. It is expected to be minimal.

Groundwater for public use within 10 mi of the site is obtained predominantly from wells in the Cambrian-Ordovician Aquifer. A large cone of depression has developed in the potentiometric surface of the Cambrian-Ordovician Aquifer in response to continuous and increasing withdrawals of groundwater at the major municipal and industrial pumping centers along the Illinois River (EGC, 2002a). However LaSalle County Station groundwater use does not create a significant impact on the groundwater at the site.

9.3.3.3.4.2 No Further Species Endangerment

Bald eagle and peregrine falcon are known to occur in LaSalle County. Other listed threatened or endangered species (Indiana bat and timber rattlesnake) are known to occur in LaSalle County. However, sightings are rare and occur along the bluffs of the Illinois River, offsite from the LaSalle County Station. Most sightings have been determined to be incidental during migration, and not an indication of an established population. None of these threatened or endangered species occur on the site, since there is no suitable habitat

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 mi². However, it is predicted that the density between 40 and 50 mi will increase to 292.7 people per mi². Low density expected to continue inside the 10-mi radius (EGC, 2002a).

Transient populations will include recreational users. Some parks outside the 5-mi radius generally expect over one-half million visitors each year. However, no projections are available for the area within the 5-mi radius (EGC, 2002a).

The LPZ has no schools, industry or other facilities. It is anticipated that the population within the LPZ will be approximately 502 in the year 2020 (EGC, 2002a).

The nearest population center is Ottawa, with a projected population of 25,904 by the year 2020. The population density in the year 1980 within 50 mi of the LaSalle County Station is projected to be approximately 141 people per mi². By the year 2020, the density is projected to reach 211 people per mi² (EGC, 2002a).

9.3.3.3.5 Quad Cities Generating Station

The Quad Cities Generating Station is a two-unit facility on the east bank of the Mississippi River opposite the mouth of the Wapsipinicon River, and about 3-mi north of Cordova, Illinois. The facility was licensed and began operations in 1973. It is roughly the same design as the Dresden Units 2 and 3, described above. The site is about 20-mi northeast of the Quad Cities (Davenport, Iowa; Rock Island, Moline, and East Moline, Illinois).

Topographic relief at the site is low and relatively flat. The station elevation represented by the ground floor level of the reactor building, is 595 ft above msl datum. The ground surface drops off abruptly at the bank of the river, forming a bluff about 30-ft high. The station is located on a 784-ac tract of land and has a 310-ft cooling tower.

It is assumed that a new nuclear facility at the area would have roughly the same general environmental impact as the existing facility.

9.3.3.3.5.1 Consumptive Use of Water

Cooling water is obtained from the Mississippi river. Water for other industrial and home use comes from the river and wells in the area. Groundwater sources in the area come from three aquifer systems composed of unconsolidated alluvial and outwash sand and gravel deposits, shallow Silurian dolomite formations, and the Cambrian-Ordovician aquifer. Neither groundwater use nor surface water use has been adversely affected by the continuing operation of the facility.

The facility obtains water for circulation cooling and other plant uses from the Mississippi River. The facility operates open cycle per an agreement with the states of Illinois and Iowa. No groundwater is used to operate the plant (EGC, 2003c). 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.

9.3.3.3.5.2 No Further Species Endangerment

There has been no indication that endangered or threatened species will be affected by the operation of a new nuclear facility at the site. No evidence has been found to indicate that construction or operation of a new nuclear plant at the Quad Cities site would have any detrimental effects on the area around the facility (EGC, 2003b).

9.3.3.3.5.3 Effects on Spawning Grounds

The Quad Cities site has been operated as a nuclear plant since the early 1970s. EGC is not aware of any federally-listed endangered or threatened terrestrial species at the Quad Cities site. However, relatively few threatened and endangered terrestrial species have been

recorded in the counties crossed by the transmission corridors associated with Quad Cities, including bald eagle, the Indiana bat, two orchid species, snails and reptiles (EGC, 2003b).

Pool 14 of the Upper Mississippi River harbors a diverse freshwater mussel community, including one federally-listed species, the Higgins' eye pearly mussel (*Lampsilis higginsii*) (EGC, 2003b). *Lampsilis higginsii* has historically been found in Pool 14 up- and downstream of Quad Cities, with highest densities and spawning areas in the vicinity of Cordova, Illinois, some 1.5- to 3.5-mi downstream of the Station (EGC, 2003b).

9.3.3.3.5.4 Effluent Discharge and Water Quality

Quad Cities currently operates under a NPDES permit issued by the State of Illinois. 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.

9.3.3.3.5.5 Preemption and Other Land Use Issues

Land use around the station is a combination of agriculture and industrial uses (EGC, 2003c). Some land in the region has been set aside for recreational and environmental use; the Mississippi River supports a large sport fishery as well as commercial and recreational boating. It is not expected that current land use at Quad Cities will change or expand, and there will be no preemption or adverse effects on land that has been set aside for environmental or recreational uses.

9.3.3.3.5.6 Potential Effect on Aquatic and Terrestrial Environment

The woody islands and sloughs near the site are popular habitats for waterfowl as well as small game animals such as squirrel, rabbit, muskrat, beaver, and mink. The upper Mississippi Wildlife and Fish Refuge is located opposite the site. Ducks and geese rely on the refuge for nesting and other habitat. There are marshy wetlands along the banks of the river across from and above the site, but none are apparent within the site boundaries (EGC, 2003b).

Industrial waste discharges unrelated to the operation of the Quad Cities site have occasionally affected aquatic habitat in the river. The river pool at Quad Cities encompasses a variety of aquatic habitats and communities. These habitats are diverse and represent important variety for aquatic and terrestrial ecosystems. The river provides important habitat for sport and commercial fisheries as well as the biota that support those fisheries. Major Mississippi River habitats around the station include channel habitats, border habitats, side channel habitats, river lake and pond habitat, slough habitat, and island lake habitat (EGC, 2003b).

9.3.3.3.5.7 Population Characteristics

The site currently meets the population requirements of 10 CFR 100. The population distribution around the site is quite low with typical rural characteristics. Within a 5-mi radius of the site, the 1980 population density is approximately 72 people per mi² and is less than 10 people per mi² in some areas. The nearest population center is Clinton, Iowa (population approximately 32,828) located 8.5 mi to the northeast. Southwest of the site, at distances of 15 to 20 mi, are the Quad-Cities of Rock Island, Moline, and East Moline, Illinois, and Davenport, Iowa. Total population and density from the site out to a distance

of 25 mi are approximately 449,082 and 229 people per mi², 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 mi². 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 mi² 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:

- The postulated consumptive use of water at the EGC ESP Site is less than or equal to water use at other sites.
- The EGC ESP Site does not contain any critical habitat or occurrence of listed threatened or endangered species. Therefore, the impact to any endangered species is less than or equal to the impact postulated for the other candidate sites.
- The EGC ESP Site does not contain spawning grounds for any threatened or endangered species. Most other sites record no endangered species or spawning areas in the site vicinity. Quad Cities, as a bounding case, is near an important spawning area. Thus, the impact to any spawning areas are less than or equal to other candidate sites.
- The EGC ESP Site impact review (see Chapters 4 and 5) does not postulate effluent discharge beyond the limits of existing NPDES permits or regulations. Based on the information available for the candidate sites, the impacts from effluent discharge are less than or equal to other candidate sites.
- The EGC ESP Site review postulates no preemption or land use changes for construction and operation of the proposed facility. Likewise, it is not anticipated that preemption or other land use changes would be required to co-locate a facility at any of the candidate sites. Therefore impact would equal at all sites.
- Terrestrial and aquatic impacts at the EGC ESP Site are noted in Chapters 4 and 5. The potential impact of a new nuclear facility on terrestrial and aquatic environments at the other sites varies, depending on the location of the site. However, with the exception of the Quad Cities site, it is anticipated that the impacts will be generally equal to those postulated for the EGC ESP Site.
- Each site generally meets the population criteria of 10 CFR 100. However, candidate sites like Zion and Braidwood are located in largely urban areas with high population density, and construction or operation may result in disproportionate impacts in those areas. Therefore, the impact on population density would be greater than the EGC ESP Site. The impact at other candidate sites would be similar to those postulated for the EGC ESP Site.
- The EGC ESP Site does not require decommissioning or dismantlement of an existing facility as required for Byron, Quad Cities or Dresden.

Therefore, none of the other existing nuclear sites is obviously superior to the EGC ESP Site on the basis of environmental considerations. Table 9.3-1 reviews the criteria in relation to all seven sites.

Although the preferred candidate sites are not obviously superior to the proposed EGC ESP Site, the applicant also considered the second test for superiority by reviewing economic, technological, and institutional factors. Three additional criteria were used to further evaluate these factors: 1) Ability to transmit to demand centers; 2) Not proximate to population centers; and 3) Ease of construction. The candidate sites are evaluated using these additional review criteria in the following sections.

9.3.3.3.8 Ability to Transmit to Demand Centers

Since the site will eventually support a merchant generating plant, EGC must consider opportunities the site offers for transmitting generated power to customers who buy it. Each candidate site, including Clinton, has existing transmission corridors that may, according to discussions with the transmission operator and ComEd, be expanded to accommodate new power lines. However, early discussions with ComEd and Illinois Power noted that the southern end of Illinois has relatively sparse transmission and light loads as opposed to the heavily loaded lines serving Chicago. All sites except the EGC ESP Facility are in northern Illinois, and are affected by transmission congestion around the major metropolitan areas around Chicago and the Quad Cities (USDOE, 2001). Section 3.7 also describes the transmission systems and load requirements in southern Illinois.

Transactions between the Midwest, Southeastern, and Eastern transmission grids are limited because they are interconnected at only a few points through interties (USDOE, 2001). For example, electricity and pricing spikes in the Midwest in the summer of 1998 were caused in part by transmission constraints limiting the availability of the region to import electricity from other regions of the country that had available electricity (USDOE, 2001). Additionally, high levels of congestion are found from Minnesota to Wisconsin, the Midwest through the Mid-Atlantic, and often power must be routed through the Chicago hub (USDOE, 2002). Transmission capacity limits are predicted to affect reliability throughout the Great Lakes Region (USDOE, 2001). On the other hand, the existing site at Clinton offers more flexible transmission opportunities, since power can be transmitted to the Chicago hub, and south through other interconnections.

A high or medium score indicates that additional nuclear power generated at the site could be transmitted to different markets. Six of the seven sites were rated with medium ability, and the EGC ESP Site was rated with high ability, primarily because the site has direct interties in multiple directions, and flexible access opportunities to other markets. Therefore, the EGC ESP Site is preferable with respect to transmission.

9.3.3.3.9 Not Proximate to Population Centers

Sites with low populations within their vicinity were scored high. For example, the proposed EGC ESP Site is located about 6 mi from the Town of Clinton, and the smaller Town of Dewitt is also in the vicinity. Both towns (and other smaller towns in the vicinity) have low populations, and thus, the EGC ESP Site scores high. Sites that scored medium are in rural areas, but are nearer to large populations. For example, the other sites are located closer to the Chicago area, such as Zion and Braidwood, or are relatively close to other metropolitan areas, such as Quad Cities. These sites were not rated high because of their proximity to the larger population bases. Therefore, the EGC ESP Site is preferable with respect to its lack of proximity to population centers.

9.3.3.3.10 Ease of Construction

The ability to achieve cost savings and potential ease of construction at an existing nuclear site is an important additional factor in selecting a site. For example, the EGC ESP Site scored high because only one unit is currently constructed, when most existing infrastructure at the facility was intended for two units. Thus, the EGC ESP Site presents opportunities in land availability and infrastructure that are not present at some of the other two-unit candidate sites, such as Quad Cities, Dresden, and Byron. The sites undergoing decommissioning (i.e., Zion) actually scored higher than the alternative sites with existing

units because the decommissioning process has already begun and the dismantling process can shortly follow. One site (i.e., Dresden) with three units (two operating and one decommissioned) also scored medium. Sites with two existing and operating units scored low (e.g., Byron, Dresden, and Quad Cities), based on available land within the site boundaries for new construction, and the fact that one or both units would need to be removed from operation to acquire space for construction.

9.3.3.3.11 Summary

Table 9.3-2 summarizes how each existing site was rated based on the factors described in this section. This table shows that the EGC ESP Site scored high in each secondary category.

9.3.4 Conclusions

The EGC ESP Site was chosen as the preferred site for reasons described below.

- Alternative greenfield, brownfield, and nuclear sites offer no environmental advantages. In fact, construction and operation of a new nuclear plant at each of the alternative sites would entail environmental impacts that are equal to or greater than those at the EGC ESP Site.
- The EGC ESP Site is the best location from which to transmit generated power to demand centers. As noted above, congestion and reliability issues through the Chicago hub and surrounding areas have been documented in national grid studies. These reliability issues, as well as congestion problems north of Chicago into Wisconsin and the upper Midwest, make the EGC ESP Site a more reliable site. These studies also indicate that transmission constraints hinder a generator's ability to sell cheap Midwest power to the south during periods of peak demand (USDOE, 2001). The EGC ESP Site is positioned to produce and transmit power through the Chicago hub if necessary, but the sparse transmission and light loads on the existing system will also allow reliable power transmission through interties to the Southeastern and Eastern grids. This is an important advantage over the other sites. The capability of these systems to support future market demand weighed heavily in favor of the EGC ESP Site.
- Other sites are located in more suburban areas and lack the flexibility in site characteristics and areal extent that the EGC ESP Site possesses, and present potentially disproportionate socioeconomic and environmental impacts.
- The facility at the EGC ESP Site was originally designed for two units, and much of the existing infrastructure can be utilized in the construction and operation of a new unit.

In summary, there are no alternative sites that are obviously superior to the EGC ESP Site in the region of interest.

9.4 Alternative Facility Systems

The design for the EGC ESP Facility has not yet been selected. The detail in this section depends on the selection of a vendor design, and the design of individual components of the system. As noted elsewhere in this ER (see Chapter 3, Chapter 4, and Chapter 5), the bounding parameters of a number of facility designs were used to develop the composite parameters for the site. Based on the evaluations provided in this ER, the site will accommodate the operational and environmental requirements for any one of them. Therefore, alternative facility systems will be discussed at the COL stage, when the full spectrum of design alternatives will be available.

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None

CHAPTER 9

Tables

TABLE 9.2-1

Air Emissions from Coal-Fired Alternative

| Parameter | Calculation | Result |
|--------------------------------|---|-------------------------------------|
| Annual coal consumption | $4 \text{ units} \times \frac{583 \text{ MW}}{\text{unit}} \times \frac{10,200 \text{ Btu}}{\text{kW} \times \text{hr}} \times \frac{1,000 \text{ kW}}{\text{MW}} \times \frac{\text{lb}}{9,648 \text{ Btu}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times 0.85 \times \frac{24 \text{ hr}}{\text{day}} \times \frac{365 \text{ day}}{\text{yr}}$ | 8,470,288 tons of coal per year |
| SO _x ^{a,c} | $\frac{38 \times 1.01 \text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times (1 - 95/100) \times \frac{8,470,288 \text{ tons}}{\text{yr}}$ | 8,127 tons SO _x per year |
| NO _x ^{b,c} | $\frac{9.7 \text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times (1 - 95/100) \times \frac{8,470,288 \text{ tons}}{\text{yr}}$ | 2,054 tons NO _x per year |
| CO ^c | $\frac{0.5 \text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times \frac{8,470,288 \text{ tons}}{\text{yr}}$ | 2,118 tons CO per year |
| PM ^d | $\frac{10 \times 6.9 \text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times (1 - 99.9/100) \times \frac{8,470,288 \text{ tons}}{\text{yr}}$ | 292 tons PM per year |
| PM ₁₀ ^d | $\frac{2.3 \times 6.9 \text{ lb}}{\text{ton}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times (1 - 99.9/100) \times \frac{8,470,288 \text{ tons}}{\text{yr}}$ | 67 tons PM ₁₀ per year |

^a USEPA, 1998, Table 1.1-1.

^b USEPA, 1998, Table 1.1-2.

^c USEPA, 1998, Table 1.1-3.

^d USEPA, 1998, Table 1.1-4.

Notes: CO = carbon monoxide

NO_x = oxides of nitrogen

PM = particulate matter

PM₁₀ = particulate matter having diameter nominally less than 10 microns

SO₂ = sulfur dioxide

TABLE 9.2-2
Air Emissions from Gas-Fired Alternative

| Parameter | Calculation | Result |
|-------------------------------|--|--|
| Annual gas consumption | $4 \text{ unit} \times \frac{572 \text{ MW}}{\text{unit}} \times \frac{6,120 \text{ Btu}}{\text{kW} \times \text{hr}} \times \frac{1,000 \text{ kW}}{\text{MW}} \times 0.85 \times \frac{\text{ft}^3}{1,021 \text{ Btu}} \times \frac{24 \text{ hr}}{\text{day}} \times \frac{365 \text{ day}}{\text{yr}}$ | 102,118,571,753 ft ³ per year |
| Annual Btu input | $\frac{102,118,571,753 \text{ ft}^3}{\text{yr}} \times \frac{1,021 \text{ Btu}}{\text{ft}^3} \times \frac{\text{MM Btu}}{10^6 \text{ Btu}}$ | 104,263,061 MMBtu per year |
| SO _x ^a | $\frac{0.0034 \text{ lb}}{\text{MM Btu}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times \frac{104,263,061 \text{ MMBtu}}{\text{yr}}$ | 177 tons SO _x per year |
| NO _x ^b | $\frac{0.0109 \text{ lb}}{\text{MM Btu}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times \frac{104,263,061 \text{ MMBtu}}{\text{yr}}$ | 568 tons NO _x per year |
| CO ^b | $\frac{0.0023 \text{ lb}}{\text{MM Btu}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times \frac{104,263,061 \text{ MMBtu}}{\text{yr}}$ | 120 tons CO per year |
| PM ^a | $\frac{0.0019 \text{ lb}}{\text{MM Btu}} \times \frac{\text{ton}}{2,000 \text{ lb}} \times \frac{104,263,061 \text{ MMBtu}}{\text{yr}}$ | 99 tons filterable PM per year |
| PM ₁₀ ^a | $\frac{99 \text{ tons TSP}}{\text{yr}}$ | 99 tons filterable PM ₁₀ per year |

^a USEPA, 2000, Table 3.1-2.

^b USEPA, 2000, Table 3.1 database.

Notes: Btu = British thermal units
CO = carbon monoxide
MM = million
NO_x = oxides of nitrogen
PM = particulate matter
PM₁₀ = particulate matter having diameter less than 10 microns
SO₂ = sulfur dioxide
TSP = total suspended particulates

TABLE 9.2-3
Coal-Fired Alternative

| Characteristic | Basis |
|--|---|
| Unit size = 550 MW ISO rating net ^a | Set to match capacity of gas-fired alternative |
| Unit size = 583 MW ISO rating gross ^a | Calculated based on 6 percent onsite power |
| Number of units = 4 | Calculated to be approximate to EGC ESP facility net capacity of 2,200 MW |
| Boiler type = tangentially fired, dry-bottom | Minimizes nitrogen oxides emissions (USEPA, 1998). |
| Fuel type = bituminous, pulverized coal | Typical for coal used in Illinois |
| Fuel heating value = 9,648 Btu/lb | 1999 value for coal used in Illinois (USDOE/EIA, 2000) |
| Fuel ash content by weight = 6.9 percent | 1999 value for coal used in Illinois (USDOE/EIA, 2000) |
| Fuel sulfur content by weight = 1.01 percent | 1999 value for coal used in Illinois (USDOE/EIA, 2000) |
| Uncontrolled NO _x emission = 9.7 lb/ton Uncontrolled CO emission = 0.5 lb/ton Uncontrolled SO _x emission = 38.4 lb/ton | Typical for pulverized coal, tangentially fired, dry-bottom, with low- NO _x burner (USEPA, 1998) |
| Uncontrolled PM = 10 lb/ton Uncontrolled PM ₁₀ = 2.3 lb/ton | Typical for pulverized coal, tangentially fired, dry-bottom (USEPA, 1998) |
| Heat rate = 10,200 Btu/kWh | Typical for coal-fired single-cycle steam turbines (USDOE/EIA, 2000) |
| Capacity factor = 0.85 | Typical for large coal-fired units (Exelon Corporation experience) |
| NO _x control = low NO _x burners, overfire air and selective catalytic reduction (95 percent reduction) | Best available and widely demonstrated for minimizing NO _x emissions (USEPA 1998). |
| Particulate control = fabric filters (baghouse- 99.9 percent removal efficiency) | Best available for minimizing particulate emissions (USEPA, 1998) |
| SO _x control = Wet scrubber –lime (95 percent removal efficiency) | Best available for minimizing SO _x emissions (USEPA, 1998) |

^a The difference between “net” and “gross” is electricity consumed onsite.

Notes: Btu = British thermal unit

CO = carbon monoxide

ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch

kWh = kilowatt hour

lb = pound

MW = megawatt

NO_x = nitrogen oxides

PM = particulate matter

PM₁₀ = particulate matter nominally less than 10 microns diameter

SO_x = sulfur oxides

TABLE 9.2-4
Solid Waste from Coal-Fired Alternative

| Parameter | Calculation | Result |
|---|---|--|
| Annual SO _x generated ^a | $\frac{8,470,288 \text{ ton coal}}{\text{yr}} \times \frac{1.01 \text{ ton S}}{100 \text{ ton coal}} \times \frac{64.1 \text{ ton SO}_2}{32.1 \text{ ton S}}$ | 170,833 tons of SO _x per year |
| Annual SO _x removed | $\frac{170,833 \text{ ton SO}_2}{\text{yr}} \times (95/100)$ | 162,291 tons of SO _x per year |
| Annual ash generated | $\frac{8,470,288 \text{ ton coal}}{\text{yr}} \times \frac{6.9 \text{ ton ash}}{100 \text{ ton coal}} \times (99.9/100)$ | 583,865 tons of ash per year |
| Annual lime consumption ^b | $\frac{170,833 \text{ ton SO}_2}{\text{yr}} \times \frac{56.1 \text{ ton CaO}}{64.1 \text{ ton SO}_2}$ | 149,512 tons of CaO per year |
| Calcium sulfate ^c | $\frac{162,291 \text{ ton SO}_2}{\text{yr}} \times \frac{172 \text{ ton CaSO}_4 \cdot 2\text{H}_2\text{O}}{64.1 \text{ ton SO}_2}$ | 435,477 tons of CaSO ₄ · 2H ₂ O per year |
| Annual scrubber waste ^d | $\frac{149,512 \text{ ton CaO}}{\text{yr}} \times \frac{(100 - 95)}{100} + 354,653 \text{ ton CaSO}_4 \cdot 2\text{H}_2\text{O}$ | 442,952 tons of scrubber waste per year |
| Total volume of scrubber waste ^e | $\frac{442,952 \text{ ton}}{\text{yr}} \times 40 \text{ yr} \times \frac{2,000 \text{ lb}}{\text{ton}} \times \frac{\text{ft}^3}{144.8 \text{ lb}}$ | 244,724,862 ft ³ of scrubber waste |
| Total volume of ash dispensed onsite ^{f,g} | $\frac{583,865 \text{ ton}}{\text{yr}} \times \frac{100 - 87}{100} \times 40 \text{ yr} \times \frac{2,000 \text{ lb}}{\text{ton}} \times \frac{\text{ft}^3}{100 \text{ lb}}$ | 60,721,960 ft ³ of ash |
| Total volume of solid waste disposed onsite | 244,724,862 ft ³ + 60,721,960 ft ³ | 305,446,822 ft ³ of solid waste |
| Waste pile area (acres) | $\frac{305,446,822 \text{ ft}^3}{30 \text{ ft}} \times \frac{\text{acre}}{43,560 \text{ ft}^2}$ | 234 acres of solid waste |
| Waste pile area (ft × ft square) | $\sqrt{(305,446,822 \text{ ft}^3 / 30 \text{ ft})}$ | 3,191 feet by 3,191 feet of solid waste |

^a Calculations assume 100 percent combustion of coal.

^b Lime consumption is based on total SO₂ generated.

^c Calcium sulfate generation is based on total SO₂ removed.

^d Total scrubber waste includes scrubbing media carryover.

^e Density of CaSO₄ · 2H₂O is 144.8 lb/ft³.

^f Density of coal bottom ash is 100 lb/ft³ (FHA, 2000).

^g Assumed 87 percent of ash is recycled.

Notes: S = sulfur

SO₂ = sulfur dioxide

CaO = calcium oxide (lime)

CaSO₄ · 2H₂O = calcium sulfate dihydrate

TABLE 9.2-5
Gas-Fired Alternative

| Characteristic | Basis |
|--|---|
| Unit size = 550 MW ISO rating net: ^a Two 184-MW combustion turbines and a 182-MW heat recovery boiler | Manufacturer's standard size gas-fired combined cycle plant |
| Unit size = 572-MW ISO rating gross: ^a Two 191.4-MW combustion turbines 189.3-MW heat recovery boiler | Calculated based on 4 percent onsite power |
| Number of units = 4 | Calculated to be approximate to EGC ESP Facility net capacity of 2,200 MW |
| Fuel type = natural gas | Assumed |
| Heat rate = 6,120 Btu/kWh | Manufacturer's listed heat rate for General Electric Frame 7FA unit. |
| Fuel heating value = 1,021 Btu/ft ³ | 1999 value for natural gas used in Illinois (USDOE/EIA, 2000) |
| NO _x emission = 0.0109 lb/MMBtu | Typical for large SCR-controlled gas fired units with water-steam injection (USEPA, 2000) |
| CO emission = 0.00226 lb/MMBtu | Typical for large SCR-controlled gas fired units with water-steam injection (USEPA, 2000) |
| Uncontrolled SO _x emission = 0.0034 lb/ton | Typical for gas-fired units (USEPA, 2000) |
| Uncontrolled PM emission = 0.0066 lb/MMBtu | Typical for gas-fired units (USEPA, 2000) |
| Uncontrolled PM ₁₀ emission = 0.0066 lb/MMBtu | Typical for gas-fired units (USEPA, 2000) |
| Capacity factor = 0.85 | Typical for large gas-fired base load units |
| NO _x control = selective catalytic reduction (SCR) with steam/water injection (90 reduction) | Best available for minimizing NO _x emissions (USEPA, 2000) |

^a The difference between "net" and "gross" is electricity consumed on site.

Notes: Btu = British thermal unit

CO = carbon monoxide

ft³ = cubic foot

ISO rating = International Standards Organization rating at standard atmospheric conditions of 59°F, 60 percent relative humidity, and 14.696 pounds of atmospheric pressure per square inch

kWh = kilowatt hour

MM = million

MW = megawatt

NO_x = nitrogen oxides

PM = particulate matter

PM₁₀ = particulate matter nominally less than 10 microns diameter

TABLE 9.2-6
Impacts Comparison Summary

| Impact Category | Proposed Action (EGC ESP) | Coal-Fired Generation | Gas-Fired Generation | Combinations |
|-----------------------------------|----------------------------------|------------------------------|-----------------------------|---------------------|
| Land Use | Small | Small | Small | Small to Large |
| Water Quality | Small | Small | Small | Small |
| Air Quality | Small | Moderate to Large | Moderate | Small to Moderate |
| Ecological Resources | Small | Small | Small | Small |
| Threatened and Endangered Species | Small | Small | Small | Small |
| Human Health | Small | Moderate | Small | Small |
| Socioeconomics | Small | Small | Small | Small |
| Waste Management | Small | Moderate | Small | Small |
| Aesthetics | Small | Small | Small | Small to Large |
| Cultural Resources | Small | Small | Small | Small |
| Accidents | Small | Small | Small | Small |

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.

TABLE 9.2-7**Impacts Comparison Detail**

| Proposed Action (EGC ESP) | Coal-Fired Generation | Gas-Fired Generation | Combination |
|---|---|---|--|
| EGC ESP for 20 years, followed by construction, operation, and decommissioning. | New construction at the CPS site. | New construction at the CPS site. | New construction at the CPS site and construction for solar/wind installations throughout region of interest. |
| Upgrade existing switchyard and transmission lines. | Upgrade existing switchyard and transmission lines. | Upgrade existing switchyard and transmission lines. | Upgrade existing switchyard and transmission lines. Construction of transmission and rights-of-way for renewable generation. |
| | Upgrade existing rail spur. | Construct 2.5 miles of gas pipeline along existing rights-of-way. | Construct 2.5 miles of gas pipeline along existing rights-of-way. |
| | Four 550-MW tangentially-fired, dry bottom units; capacity factor 0.85. | Four 550-MW units, each consisting of two 184-MW combustion turbines and a 182-MW heat recovery boiler; capacity factor 0.85. | Four 550-MW units, each consisting of two 184-MW combustion turbines and a 182-MW heat recovery boiler; capacity factor 0.85 maximum and probably less depending upon the amount of generation by renewable sources. |
| | | | Renewable energy sources: combination of solar and wind turbine technologies to produce up to 2180 MWe when resource is available. |
| New cooling water system with potential construction of new cooling towers. | New cooling water system with potential construction of new cooling towers. | New cooling water system with potential construction of new cooling towers. | New cooling water system with potential construction of new cooling towers. Depending on solar technology utilized, cooling water may also be needed. |

TABLE 9.2-7

Impacts Comparison Detail

| Proposed Action (EGC ESP) | Coal-Fired Generation | Gas-Fired Generation | Combination |
|------------------------------|---|---|--|
| | Pulverized bituminous coal, 9,648 Btu/pound; 10,200 Btu/kWh; 6.9% ash; 1.01% sulfur; 9.7 pound/ton nitrogen oxides; 8,470,288 tons coal/yr. | Natural gas, 1,021 Btu/ft ³ ; 6,120 Btu/kWh; 0.0034 lb sulfur/MMBtu; 0.0109 lb NO _x /MMBtu; 102,118,571,753 ft ³ gas/yr. | Natural gas, 1,021 Btu/ft ³ ; 6,120 Btu/kWh; 0.0034 lb sulfur/MMBtu; 0.0109 lb NO _x /MMBtu; 102,118,571,753 ft ³ gas/yr when operating at capacity mentioned above. Effluents would be scaled based on level of renewable generation. |
| | Low NO _x burners, overfire air, and selective catalytic reduction (95% NO _x reduction efficiency). | Selective catalytic reduction with steam/water injection. | Selective catalytic reduction with steam/water injection. |
| | Wet scrubber – lime desulfurization system (95% SO _x removal efficiency); 149,512 tons limestone/yr. | | |
| | Fabric filters (99.9% particulate removal efficiency). | | |
| 580 workers | 250 workers | 25-40 workers | 40-50 workers |

TABLE 9.2-7**Impacts Comparison Detail**

| Proposed Action (EGC ESP) | Coal-Fired Generation | Gas-Fired Generation | Combination | |
|---|--|---|---|--|
| | | | Gas-fired | Renewable |
| Land Use Impacts | | | | |
| SMALL – Construction at CPS would be in previously disturbed areas. Facility would consist of approximately 150 acres. | SMALL – Construction at CPS would be in previously disturbed areas. The plant would upgrade existing rail spur and use transportation corridors. Forty years of ash and scrubber waste disposal would require 234 acres and construction of the power block and coal storage areas would impact approximately 200 acres. | SMALL – Construction at CPS would be in previously disturbed areas. 110 acres for facility; pipeline could be routed along existing rights-of-way and would require an additional 40 acres for easement. | SMALL – Construction at CPS would be in previously disturbed areas. 110 acres for facility; pipeline could be routed along existing rights-of-way and would require an additional 40 acres for easement. | SMALL to LARGE – Impacts are dependent on the level of renewables included in the combination alternative. Wind/solar siting and building of transmission access infrastructure could remove substantial amounts of land throughout the ROI and would remove substantially more land per MWe produced when compared to any other form of generation. Land use impacts for wind are discussed in 9.2.2.1; for solar technologies see 9.2.2.4. |
| Water Quality Impacts | | | | |
| SMALL – Construction impacts minimized by use of best management practices. Operational impacts minimized by use of best management practices by use of new cooling water system. | SMALL – Construction impacts minimized by use of best management practices. Operational impacts minimized by use of best management practices by use of new cooling water system. | SMALL – Smaller cooling water demands (then coal), inherent in combined-cycle design. Construction of pipeline could cause temporary erosion and sedimentation in streams crossed by right-of-way. | SMALL – Smaller cooling water demands (then coal), inherent in combined-cycle design. Construction of pipeline could cause temporary erosion and sedimentation in streams crossed by right-of-way. | SMALL - Some water use and quality issues will occur depending on solar technology used. |

TABLE 9.2-7

Impacts Comparison Detail

| Proposed Action (EGC ESP) | Coal-Fired Generation | Gas-Fired Generation | Combination | |
|---|--|---|---|--|
| | | | Gas-fired | Renewable |
| Air Quality Impacts | | | | |
| SMALL – Construction impacts minimized by use of best management practices. Operational impacts are negligible. | MODERATE to LARGE – 8,127 tons SO _x /yr 2,054 tons NO _x /yr 2,118 tons CO/yr 292 tons PM/yr 67 tons PM ₁₀ /yr | MODERATE – 117 tons SO _x /yr 568 tons NO _x /yr 120 tons CO/yr 99 tons PM ₁₀ /yr ^a | SMALL to MODERATE – 117 tons SO _x /yr 568 tons NO _x /yr 120 tons CO/yr 99 tons PM ₁₀ /yr ^a These would be reduced based on the level of renewable generation. | SMALL - Small risk of fugitive emissions from manufacture of PV cells, or accidental leaks. |
| Ecological Resource Impacts | | | | |
| SMALL – Construction of power block would impact up to 150 acres of terrestrial habitat, potentially displacing various species. Potential new cooling towers would reduce impingement, entrainment, and thermal impacts to aquatic species. | SMALL – Construction of the power block and coal storage areas and 40 years of ash/sludge disposal would impact approximately 300 acres of terrestrial habitat, displacing various species. Potential new cooling towers would reduce impingement, entrainment, and thermal impacts to aquatic species. | SMALL – Construction of power block would impact up to 150 acres of terrestrial habitat, potentially displacing various species. Potential new cooling towers would reduce impingement, entrainment, and thermal impacts to aquatic species. | SMALL – Construction of power block would impact up to approximately 150 acres of terrestrial habitat, potentially displacing various species. Potential new cooling towers would reduce impingement, entrainment, and thermal impacts to aquatic species. | SMALL - Avian mortality remains an issue at wind farms; heavy metals (e.g., cadmium) in PV cells can lead to a variety of impacts, depending on organism and exposure. |
| Threatened and Endangered Species | | | | |
| SMALL – No resident threatened and endangered species are known to occur at the site or along transmission corridors. | SMALL – No resident threatened and endangered species are known to occur at the site or along transmission corridors. | SMALL – No resident threatened and endangered species are known to occur at the site or along transmission corridors. | SMALL – No resident threatened and endangered species are known to occur at the site. | SMALL – Siting and routing of additional transmission corridors for wind/solar installations can be altered to minimize impacts, however, altered siting may remove resources from availability. |

TABLE 9.2-7**Impacts Comparison Detail**

| Proposed Action (EGC ESP) | Coal-Fired Generation | Gas-Fired Generation | Combination | |
|--|---|---|---|---|
| | | | Gas-fired | Renewable |
| Human Health Impacts | | | | |
| SMALL – Impacts associated with noise are not anticipated. Radiological exposure is not considered significant. Risk from microbiological organisms minimal due to thermal characteristics at the discharge and lack of innoculant. Risk due to transmission-line induced currents minimal due to conformance with consensus code. | MODERATE – Adopting by reference GEIS conclusion that risks such as cancer and emphysema from emissions are likely (USNRC, 1996). | SMALL – Adopting by reference GEIS conclusion that some risk of cancer and emphysema exists from emissions (USNRC, 1996). | SMALL – Adopting by reference GEIS conclusion that some risk of cancer and emphysema exists from emissions (USNRC, 1996). | SMALL - Small carcinogen exposure risk noted from leaching materials during PV cell manufacture and at installations. |
| Socioeconomic Impacts | | | | |
| SMALL – The socioeconomic impacts for this option are discussed in Section 3.8 and Section 4.8. Public service impacts are not anticipated. Location in low population area without growth controls minimizes potential for housing impacts. Plant contribution to county tax base may be significant, and continued plant operation would benefit county. Capacity of public water supply and transportation infrastructure minimizes potential or related impacts. | SMALL – Increase in permanent work force at CPS by 250 workers could affect surrounding counties, but would be mitigated by site's proximity to metropolitan areas within the region. | SMALL – Increase in permanent work force at CPS by 25-40 workers could affect surrounding counties, but would be mitigated by the site's proximity to metropolitan areas within the region. | SMALL – Increase in permanent work force at CPS by 40-50 workers could affect surrounding counties, but would be mitigated by the site's proximity to metropolitan areas within the region. | SMALL – Potential minor impacts from reliability and transmission congestion. These transmission issues are more likely with wind. Land values may increase due to lease revenue to landowners from wind installations. |
| Waste Management Impacts | | | | |
| SMALL – Non-radiological impacts will be negligible. Radiological impacts will be small. | MODERATE – 583,865 tons of coal ash per year and 442,952 tons of scrubber sludge per year would require 234 acres over the 40-year term. | SMALL – Almost no waste generation. | SMALL – Almost no waste generation. | SMALL - Used PV cells contain potential hazardous wastes, but chemicals are sealed within the cell. Waste minimization practices also limits waste issues for used cells. Potential for leaching at landfills unknown. |

TABLE 9.2-7

Impacts Comparison Detail

| Proposed Action (EGC ESP) | Coal-Fired Generation | Gas-Fired Generation | Combination | |
|---|--|--|--|--|
| | | | Gas-fired | Renewable |
| Aesthetic Impacts | | | | |
| SMALL – Visual impacts would be consistent with the industrial nature of the site. | SMALL – Visual impacts would be consistent with the industrial nature of the site. | SMALL – Visual impacts would be consistent with the industrial nature of the site. | SMALL – Visual impacts would be consistent with the industrial nature of the site. | SMALL to LARGE - Visual/auditory impacts of wind/solar installations could be substantial but could be mitigated through placement. Placement to mitigate this impact may remove resources from availability. The amount of the impact will depend on the amount of resource used. |
| Cultural Resource Impacts | | | | |
| SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site. | SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site. | SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site. | SMALL – Impacts to cultural resources would be unlikely due to developed nature of the site. | SMALL - Impacts to cultural resource of renewable portion and additional transmission infrastructure can be mitigated through placement. Placement to mitigate this impact may remove resources from availability. |
| Impacts of Accidents | | | | |
| SMALL – Although the consequences of accidents could potentially be high, the overall risk of accidents is low given the low probability of an accident involving a significant release of radioactivity. | SMALL – Impacts of accidents in coal-fired plants are not applicable. | SMALL – Impacts of accidents in gas-fired plants are not applicable. | SMALL – Impacts of accidents in gas-fired plants and wind/solar are not applicable. | |

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

Ft³ = cubic foot

NO_x = oxides of nitrogen

gal = gallon

PM₁₀ = 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 9.3-1
Illinois Nuclear Station Comparison – General Criteria for All Sites

| Site | Consumptive Use of Water | No Further Species Endangerment | Effects on Spawning Grounds | Effluent Discharge/ Water Quality | No Preemption or Adverse Impacts to Land Use | Potential Effects on Aquatic and Terrestrial Ecology | Population Characteristics |
|-------------|---|---|--|---|---|---|---|
| Braid-wood | Minor consumptive use | No record of endangered species on the site | No potential significant impacts noted | Discharges anticipated to be within current regulatory limits | No preemption or change to land use – site licensed for 4 units | Effects expected to be similar to current impacts | Meets 10 CFR 100 Site is within 50 mi of Chicago and in industrialized suburbs with potentially disproportionate environmental impacts |
| Byron | Consumptive groundwater use (for cooling and potable water) | No record of listed threatened or endangered species | No record of spawning grounds at the site | Discharges anticipated to be within current regulatory limits | Site licensed for 2 units; currently operating at license capacity – new construction would require additional area | Effects expected to be similar to current impacts | Meets 10 CFR 100 |
| Clinton | Minor consumptive use | No record of listed threatened or endangered species | No record of spawning grounds at the site | Discharges anticipated to be within current regulatory limits | Site licensed for 2 units – 1 unit operating No preemption or additional land use | Effects expected to be similar to current impacts | Meets 10 CFR 100 |
| Dresden | Minor consumptive use | No record of listed threatened or endanger species | No record of spawning grounds at site | Discharges anticipated to be within current regulatory limits | 3 units, 2 units operating 1 unit not operational. No additional land available at the site | Effects expected to be similar to current impacts | Meets 10 CFR 100 |
| LaSalle | Groundwater used for makeup, systems, and potable supply. | Occur in vicinity, but not at site | No record of spawning grounds at site | Discharges anticipated to be within current regulatory limits | 2 units operating – licensed for 4 units. No additional land required. | Effects expected to be similar to current impacts | Meets 10 CFR 100 |
| Quad Cities | Minor consumptive use | None at site-listed aquatic species present about 1.5 mi from site. | None at site – Essential Habitat and spawning area about 1.5 mi. from site | Discharges anticipated to be within current regulatory limits | Site licensed for 2 units; currently operating at license capacity – new construction would require additional area | Effects expected to similar to current operation; essential habitat may be affected | Meets 10 CFR 100 |

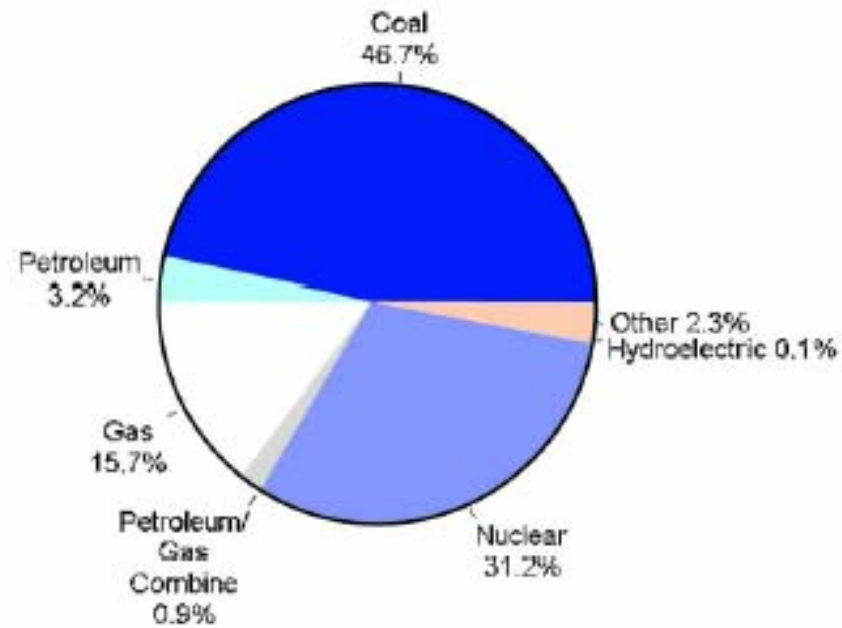
TABLE 9.3-1
Illinois Nuclear Station Comparison – General Criteria for All Sites

| Site | Consumptive Use of Water | No Further Species Endangerment | Effects on Spawning Grounds | Effluent Discharge/ Water Quality | No Preemption or Adverse Impacts to Land Use | Potential Effects on Aquatic and Terrestrial Ecology | Population Characteristics |
|-------------|---------------------------------|---|---|---|--|---|--|
| Zion | Minor consumptive use | No listed threatened or endangered species reported | No spawning grounds reported, but site presents characteristics common to inshore spawning grounds on Lake Michigan | Discharges anticipated to be within current regulatory limits | Current plant not operational. No expected preemption or adverse impacts to land use | Effects similar to operation of proposed EGC ESP Facility at the EGC ESP Site | Meets 10 CFR 100 Site is in an urbanized, industrial area with potentially disproportionate environmental impacts. |

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. |

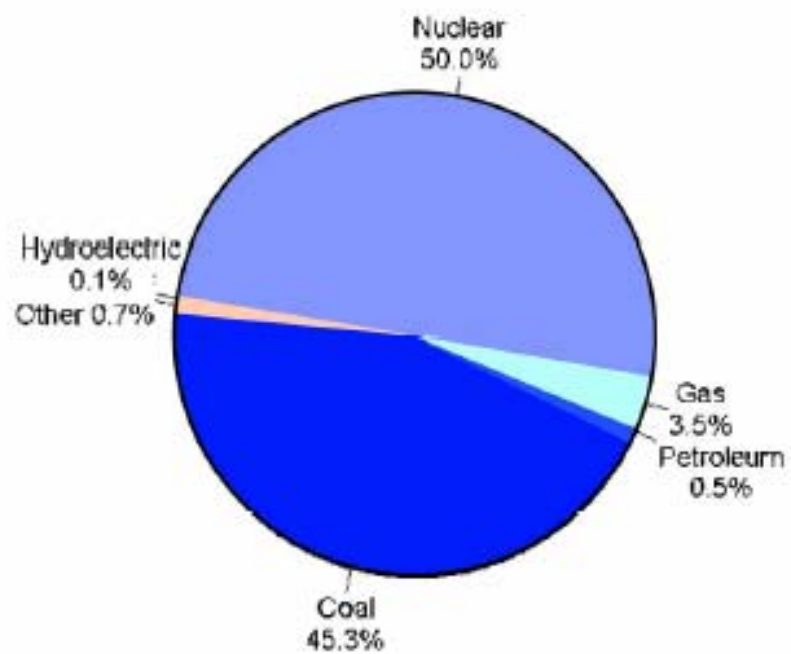
Figure 9.2-1
Industry Generating Capacity in
Illinois by Primary Energy Source,
1999



Legend

Not to Scale

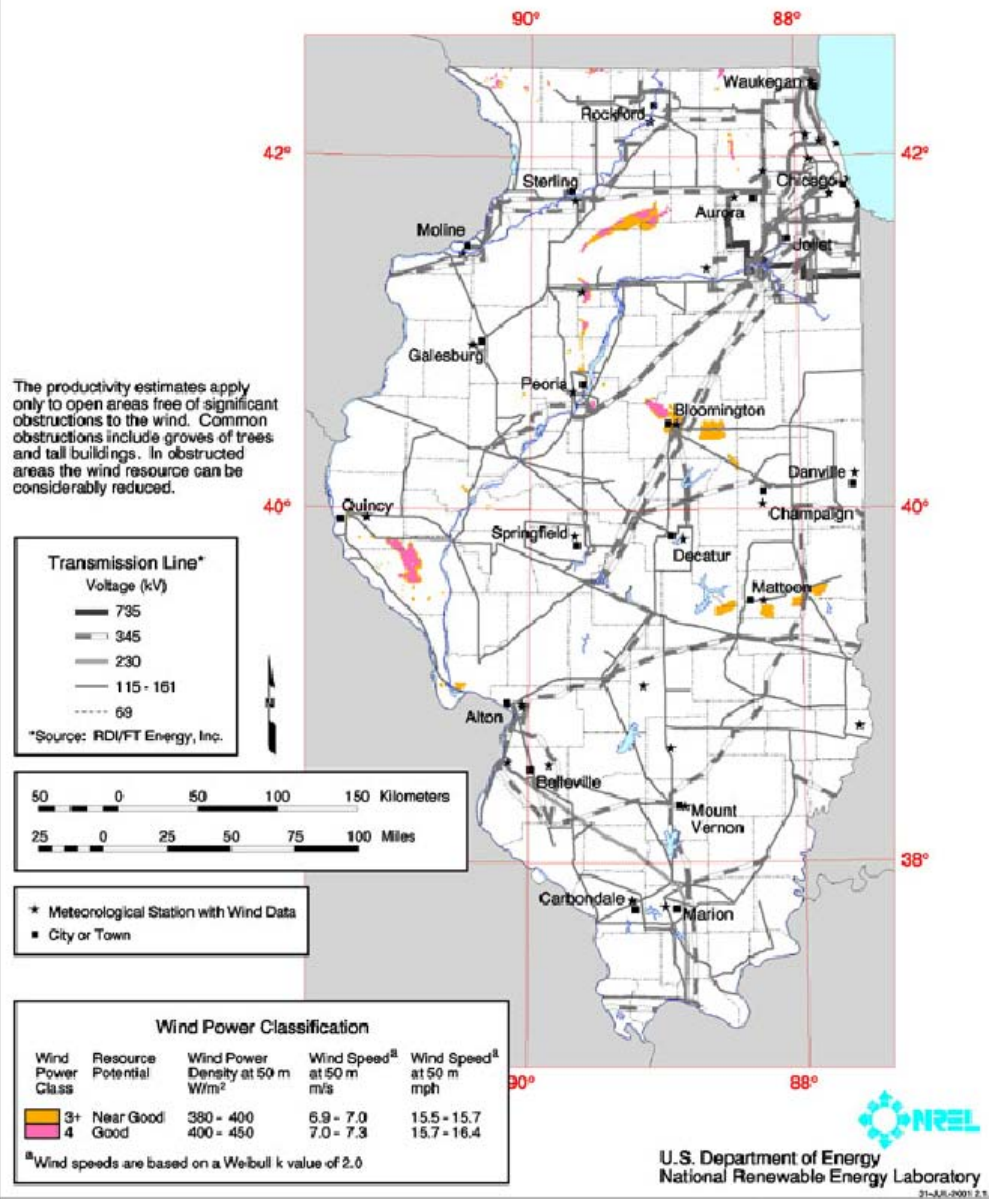
Figure 9.2-2
Industry Generation Utilization in
Illinois by Energy Source, 1999



Legend

Not to Scale

Illinois - Wind Resource Map Best Areas

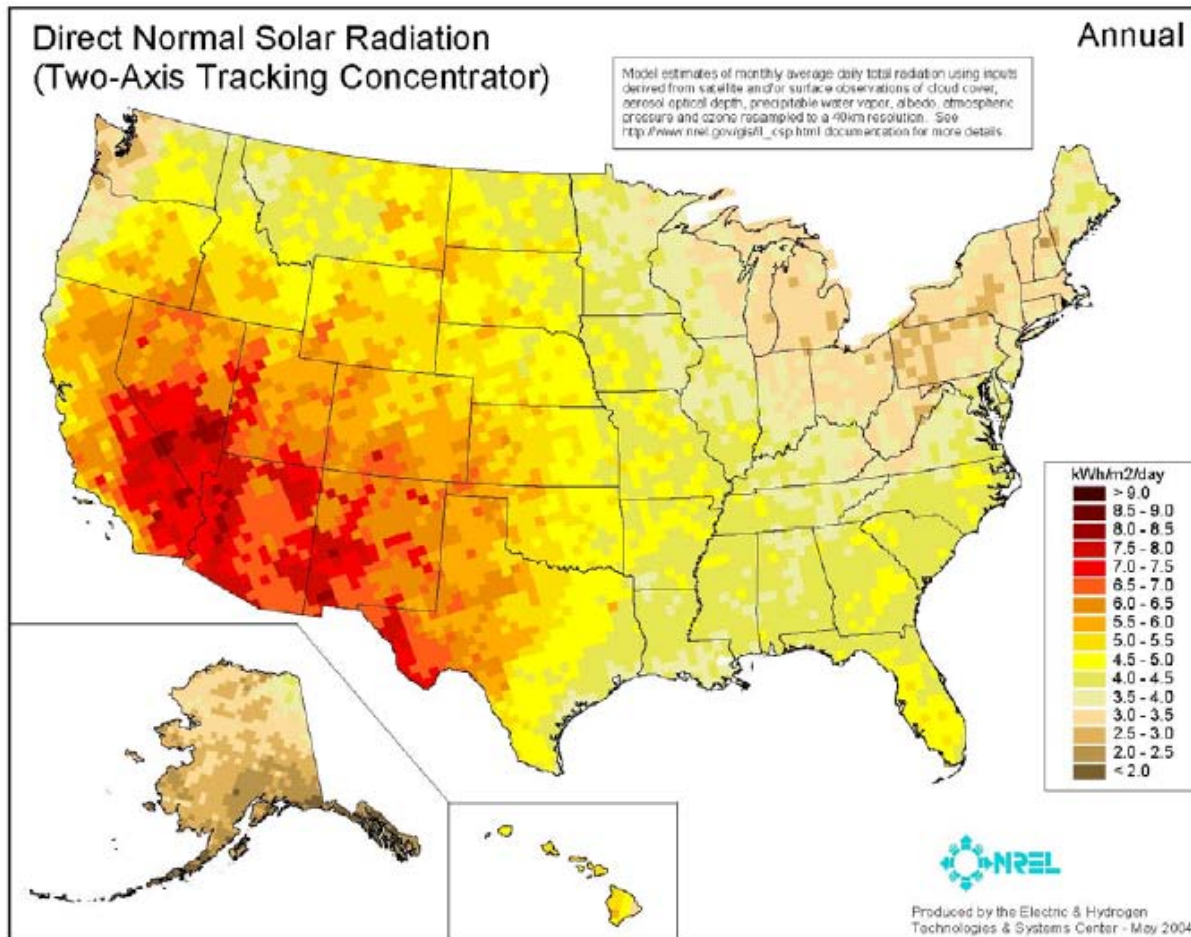


**Figure 9.2-3
Illinois Wind Resource Map**

Source: USDOE, 2004

Not to Scale

Figure 9.2-4
Direct Normal Solar Radiation
Map



Source: USDOE, 2004

Not to Scale