Chapter 10 Environmental Consequences of the Proposed Action

Section 102(c) of the National Environmental Policy Act (NEPA) specifies three special NEPA requirements that an Environmental Impact Statement (EIS) must evaluate. This chapter evaluates these three requirements, listed below, as well as a benefit-cost analysis (BCA), associated with constructing and operating Fermi 3. The three requirements, as well as the BCA, are evaluated in the following four sections:

- Unavoidable Adverse Environmental Impacts (Section 10.1)
- Irreversible and Irretrievable Commitments of Resources (Section 10.2)
- Relationship between Short-term Uses and Long-term Productivity of the Human Environment (Section 10.3)
- Benefit-Cost Balance (Section 10.4)

10.1 Unavoidable Adverse Environmental Impacts

This section presents the unavoidable adverse environmental impacts of constructing and operating Fermi 3. Unavoidable adverse impacts are those environmental impacts that remain after implementation of practical mitigation measures, or for which no practical mitigation measure exists. This section describes unavoidable adverse impacts of construction (Chapter 4) and operation (Chapter 5) of Fermi 3 and the associated transmission system. The rated power of Fermi 3 is 4500 megawatts thermal (MWt), and the gross electrical power is 1600 megawatts electric (MWe).

The 345 kV transmission system and associated corridors are exclusively owned and operated by ITC*Transmission*. Detroit Edison has no control over the construction or operation of the transmission system. Since the transmission corridors are controlled and operated by ITC*Transmission*, the impacts and measures discussed are considered as typical.

10.1.1 Unavoidable Adverse Environmental Construction Impacts

Construction impacts are described in detail in Chapter 4. Construction impacts (temporary and permanent), as well as measures and controls to reduce or eliminate the adverse impact, are summarized in Table 4.6-1. This section describes those adverse impacts associated with the construction of Fermi 3 and the associated transmission system that cannot be avoided. Impacts are generally relatively small and short-term, and effects can be either partially mitigated, or may dissipate after construction is complete.

Anticipated impacts and the mitigation measures that may reduce these impacts are summarized in Table 10.1-1. Unavoidable adverse impacts from construction of the new unit and onsite and offsite transmission corridors for Fermi 3 include those impacts associated with land use, hydrological and water use, ecological resources (terrestrial and aquatic), socioeconomics, radiation exposure, atmospheric and meteorological dynamics, and environmental justice.

10.1.2 Unavoidable Adverse Environmental Operational Impacts

Operational impacts of Fermi 3 are discussed in detail in Chapter 5. Operational impacts (temporary and permanent), as well as measures and controls to reduce or eliminate the adverse impact, are summarized in Table 5.10-1. This section describes those adverse impacts associated with the operation of Fermi 3 and the associated transmission system that cannot be avoided.

Operational impacts endure over a longer period of time than construction impacts, and some effects of operation are long-term. Impacts are generally relatively small and are associated with land use, hydrological and water use, ecological resources (terrestrial and aquatic), socioeconomics, radiation exposure, atmospheric and meteorological dynamics, and environmental justice. These expected impacts and the mitigation measures and controls that may reduce these impacts are summarized in Table 10.1-2.

10.1.3 References

None.

Table 10.1-1 Unavoidable Adverse Environmental Impacts of Construction (Sheet 1 of 5)

Impact Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impact
Land Use	Construction of new buildings and impervious surfaces clears vegetation, disturbs area soils, and increases stormwater runoff. Soils are stockpiled onsite. Land is not available for other uses. Many of these impacts continue into the operational phase.	Limit ground disturbances to the smallest amount of area practical to construct Fermi 3 (approximately 290 acres). Use Best Management Practices (BMPs) and minimize footprint of the designated construction area.	Disturbance of 290 acres of land occupied by one ESBWR unit and ancillary structures. Mitigation measures allow most of this land to return to its pre-disturbed state. Much of the land is currently dedicated to Fermi 1 and 2 uses.
		Restrict soil stockpiling and reuse to designated areas within the construction footprint on the Fermi site.	
		Conduct ground-disturbing activities in accordance with permit requirements. Implement erosion control measures described in the Fermi 3 Soil Erosion and Sedimentation Control (SESC) Plan.	
		Limit vegetation removal to those areas designated for construction activities. Restore temporarily disturbed areas to allow their inclusion in the Detroit River International Wildlife Refuge on the Fermi site.	
		The material to be dredged will be disposed in the onsite Spoil Disposal Pond, which is isolated from the surrounding environment. If it becomes necessary to remove the dredged material from the Spoil Disposal Pond, the dredged material would be subjected to chemical analysis to ascertain if the material can be disposed via land application or if an alternate disposal method is required.	

Table 10.1-1 Unavoidable Adverse Environmental Impacts of Construction (Sheet 2 of 5)

Impact Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impact
	Construction of new transmission towers and stringing of new line in a new (maintained) corridor will cause a reduction in agricultural land use and habitats. Much of these impacts continues into operational phase and constitutes a long-term commitment of resources.[1]	Limit vegetation removal and construction activities in the new portion of the 345 kV route to Milan Substation to the existing maintained corridor. Revegetate disturbed areas with native species. Restrict transmission corridor/ROW access for construction vehicles to designated routes.[1] Minimize potential impacts through avoidance and compliance with permitting requirements, BMPs, and applicable laws and regulations Minimize land use impacts through the use of an existing transmission corridor, use of a maintained ROW for the new 10-mile portion of the line, and use of existing access roads.[1] Plan and schedule construction activities to minimize temporary disturbance/ displacement of crops and interference with farming activities.	Long-term commitment of land for the transmission corridor. Mitigation measures allow some of the disturbed land to be returned to its pre-disturbed state, and allow agricultural uses to continue on portions of the corridor.[1]
	Construction debris is disposed in permitted landfills; this will occur through the construction phase.	Establish waste minimization program to reduce the volume of debris that is generated. Recycle debris, where possible.	Some land is used to the long-term disposal of construction debris and is not available for other uses. This impact constitutes a commitment of land.
Hydrological and Water Use	Construction and ground disturbing activities could erode soils and increase sedimentation in area surface waters, degrading water quality. These impacts are temporary and short-term.	Comply with applicable permits, plans, and regulations. Minimize area and duration of disturbance, identify controls to minimize onsite and offsite erosion, and establish an inspection and maintenance schedule.	Minimal or no unavoidable adverse impact.
	Construction equipment spills of petroleum or other chemicals that could enter area surface waters. This impact occurs through the construction phase.	Implement measures and controls contained in the Pollution Incident Prevention Plan (PIPP) that would be prepared specifically for Fermi 3 construction activities.	Minimal or no unavoidable adverse impact.

Table 10.1-1 Unavoidable Adverse Environmental Impacts of Construction (Sheet 3 of 5)

Impact Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impact
Terrestrial Ecology	Vegetation clearing and grading would disturb/destroy habitat and displace/kill wildlife. Some of these impacts would dissipate after construction is complete, while others would continue through the operations phase.	Minimize disturbance to habitat and species, as practical. Use previously disturbed areas as practical during construction.	Minimal or no unavoidable adverse impact.
	Construction near or in threatened and endangered (T&E) species' habitat could remove habitat or T&E species.	Mitigate State threatened species (American lotus).	Unavoidable adverse impact that could be mitigated through transplanting.
	Construction noises may startle animals, displacing them temporarily. This impact will occur intermittently through construction.	Minimize noise levels by using modern equipment designed to reduce noise.	Minimal or no unavoidable adverse impact.
	Birds may collide with tall construction equipment.	Impact is expected to be small. No mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impact.
	Wetlands may be impacted by construction.	A wetland delineation was performed to determine wetland resources. Wetland impacts are minmized through planning. Impacts are mitigated through the wetland mitigation monitoring plan, developed in consultation with the USACE and MDEQ during the wetlands permitting process.	Potential for unavoidable adverse impacts.
Aquatic Ecology	Shoreline/bed/benthic erosion from construction/dredging near Lake Erie could degrade aquatic habitat (short-term impacts).	Implement measures in the SESC Permit/MDEQ NPDES Permit. Implement measures outlined in the U.S. Army Corps of Engineers (USACE) Permit.	Minimal or no unavoidable adverse impacts.
	Possible spills from construction and/or construction equipment could degrade aquatic habitat (short-term impacts).	Implement measures and controls contained in the PIPP that would be prepared specifically for Fermi 3 construction activities.	Minimal or no unavoidable adverse impacts.

Table 10.1-1 Unavoidable Adverse Environmental Impacts of Construction (Sheet 4 of 5)

Impact Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impact
Socioeconomics	Construction workers and local residents are exposed to an increase in noise, dust, exhaust, and emissions from construction and related equipment. These impacts continue through construction.	Implement standard noise control measures for construction equipment (silencers). Limit the types of construction activities during nighttime and weekend hours. Establish a construction noise monitoring program.	Small unavoidable impacts.
		Use dust control measures such as watering, stabilizing disturbed areas, and covering trucks.	
	Construction workers and local residents experience traffic that continues through the construction phase.	Detroit Edison has performed a Level of Service analysis (Reference 10.2-8). Consultations were made with the Michigan Department of Transportation (MDOT) and the Monroe County Road Commission. Improvements include: signal installations and signal modifications, staggering worker shifts, bussing employees from off-site, minor lane additions and/or a second entrance to the site.	Small unavoidable impacts.
	Influx of construction workforce (short-term).	Housing shortages could be mitigated by new home construction. This action is not under the control of the applicant.	Minimal or no unavoidable adverse impacts.
	Initially, public services, infrastructure, and area schools are strained by the short-term population influx.	Increased tax revenues can fund additional services, improvements, and schools (or portable classrooms) to mitigate the effects of populations. These actions are not under the control of the applicant.	Some services may be slightly strained and schools could experience crowding. The potential for effect is minimal and short-term.
Radiological	Construction workers may be exposed to radiation sources (through direct radiation, gaseous effluents, or liquid effluents) from the routine operations of Fermi 2.	Monitor doses received by workers to ensure they are within regulatory limits. The site will be in accordance with all radiation safety regulations to ensure that the construction workers are protected.	Small unavoidable adverse impact of radiation exposure for construction workers from existing unit.

Table 10.1-1 Unavoidable Adverse Environmental Impacts of Construction (Sheet 5 of 5)

Impact Category	Adverse Impact	Potential Actions to Mitigate Impacts	Unavoidable Adverse Impact
Environmental Justice	Some activities affect minority or low-income populations.	There is no disproportionate impact on minority or low income populations.	No unavoidable adverse impacts that require mitigation.

Notes:

1. The 345 kV transmission system and associated corridors are exclusively owned and operated by the ITC*Transmission*. The applicant has no control over the construction or operation of the transmission system. The construction impacts are based on publicly available information and reasonable expectations on the configurations and practices that ITC*Transmission* is likely to use based on standard industry practice. Such efforts would likely include transmission design considerations and Best Management Practices that would minimize the effects on land use.

Table 10.1-2 Unavoidable Adverse Environmental Impacts of Operation (Sheet 1 of 4)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impact
Land Use	Commitment of approximately 290 acres (permanent and temporary) for uses related to Fermi 3 onsite , and 1069 acres with the transmission corridor.[1] This impact will occur for the operational life of Fermi 3.	The major plant structures are located, for the most part, on areas that were environmentally altered for construction and operation of Fermi 1 and Fermi 2. Uses are consistent with land use plans. Some of the disturbed land is revegetated following construction and after maintenance activities in the corridor.	Continued commitment of land use for the operational life of Fermi 3.
	Operation of Fermi 3 increases radioactive and nonradioactive wastes that are stored onsite (temporarily) and disposed of in permitted disposal facilities or landfills. Mixed waste generation and disposal occurs long-term through operation.	The established waste minimization program minimizes waste.	Land dedicated for the disposal of Fermi 3 waste is not available to other uses. This effect is long-term.
	New Independent Spent Fuel Storage Installation (ISFSI) for Fermi 3 will increase quantity of spent fuel storage onsite.	The ISFSI is sited to minimize radiation exposure to plant staff.	Land dedicated for spent fuel storage is not available to other uses for the operational life of Fermi 3.
	The cooling tower is visible from nearby locations and constitutes a small visual impact. The transmission corridor also constitutes a small visual impact.[1] These impacts occur through the operational phase.	Station operation does not contribute an additional impact to the viewshed, and no measures or controls are necessary.	The viewshed continues to be impacted over the operational phase but no more so than at the present.
	Archeological sites could be obscured or damaged through ground-disturbing activities related to operation and maintenance. This potential exists through the operational phase.	The shoreline is sensitive for archaeological resources. Shoreline stabilization may be required if NRHP-eligible archaeological resources are encountered during station operation. Continued station operation is unlikely to impact significant archaeological sites, and no measures or controls are necessary.	Minimal or no unavoidable adverse impacts.

Table 10.1-2 Unavoidable Adverse Environmental Impacts of Operation (Sheet 2 of 4)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impact
Hydrological and Water Use	Consumptive use of Lake Erie surface water represents a commitment of water resources. This commitment continues through the operation of Fermi 3.	No mitigation measures are expected to be necessary.	Water lost to evaporation (and thus not returned to Lake Erie) represents an unavoidable impact. Evaporated water is unavailable for other purposes.
	Although not expected, dreging may be necessary to deepen the barge canal from Fermi 3 to the navigation channel. Periodic maintenance dredging could be required to remove sediment from the intake bay. The dredging activities would result in a temporary increase in turbidity in Lake Erie.	Maintenance dredging occurs approximately every 4 years. Impacts to the water quality from turbidity are temporary. Lake Erie quickly assimilates turbid waters. No mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impact.
	The discharge of process liquid radwaste to Lake Erie.	Prior to its release, liquid radwaste is monitored for radioactivity, as is the outfall to Lake Erie. Water quality affects are expected to be small and mitigation measures are not needed.	Minimal to no unavoidable adverse impact.
	Blowdown from cooling tower operations.	Constituents discharged directly or indirectly to Lake Erie are expected to be at or below NPDES permitted levels. They are projected to be very low based on the dilution effects of Lake Erie.	
	Cooling water discharges to Lake Erie results in a thermal plume throughout the operational life of Fermi 3. The maximum effluent temperature is 86°F.	The thermal plume will be minimal when compared with the breadth of the western basin of Lake Erie.	Minimal or no unavoidable adverse impact.
Terrestrial Ecology	Operating noise has minor impact to wildlife.	The potential effect is expected to be minor, and mitigation is not expected to be necessary.	Minimal or no unavoidable adverse impact.
	Small quantities of waste salts and chemicals are discharged into the atmosphere for the duration of operation.	Concentrations are not high enough to adversely impact soil, air, or vegetation. No mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impact.
	Birds may collide with the cooling towers or power lines.	Collisions do not present a substantial problem, and mitigation is not expected to be necessary.	Minimal or no unavoidable adverse impact.

Table 10.1-2 Unavoidable Adverse Environmental Impacts of Operation (Sheet 3 of 4)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impact
Aquatic Ecology	Some species are killed by impingement or entrainment by the intake system.	The low intake velocity (≤ 0.5 fps), appropriate intake screen design, and closed cycle cooling system significantly reduce adverse effects from impingement and entrainment.	There is a small impact to aquatic species. The closed-loop cooling system reduces the effects on aquatic species.
	Scouring at the intake structure temporarily reduces water quality. This effect will occur episodically for the duration of operation.	Intake equipment is situated and used in a manner that reduces scouring and turbidity. Riprap is configured around the discharge pipe to prevent intake scouring.	Minimal or no unavoidable adverse impacts.
	Discharge of wastewater effluent and potential for chemical or petroleum spills near water that could affect aquatic organisms over the operational life of Fermi 3.	The NPDES permit limits are established to prevent adverse effects to aquatic species. Consolidated environmental emergency response plans currently implemented for Fermi 2 would apply to Fermi 3.	Minimal or no unavoidable adverse impacts.
	During certain times of the year, blowdown is discharged at temperatures exceeding the water quality standard for the duration of operation.	The diffuser minimizes the size of the thermal mixing zone, in both lateral and vertical extent. No additional mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impacts.
Socioeconomics	The population of nearby counties will grow as Fermi 3 begins operation. This growth increases traffic, school populations, and places additional burden on community infrastructure and services. These impacts are short-term and are expected to dissipate over time.	As needed, fund additional community facilities and infrastructure, police, and fire protection through increased revenues that result from housing construction. No further mitigation measures are deemed necessary.	Minimal or no unavoidable adverse impacts.
	Air pollution, emissions, and effluents can affect humans in the primary impact area.	Emissions are within limits allowed by the permits. Monitor the release of waste emissions and effluents. No additional mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impacts.

Table 10.1-2 Unavoidable Adverse Environmental Impacts of Operation (Sheet 4 of 4)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Impact
	Potential adverse impact to traffic flows on highways and access roads to the Fermi site. Traffic at the site and on surrounding roadways would increase as operational staff for the two units commute to the Fermi site.	Detroit Edison has performed a Level of Service analysis (Reference 10.2-8). Consultations were made with the Michigan Department of Transportation (MDOT) and the Monroe County Road Commission. Improvements include: signal installations and signal modifications, staggering worker shifts, bussing employees from off-site, minor lane additions and/or a second entrance to the site.	Small unavoidable impacts.
	Episodic loud noises are generated by Fermi 3 operation and routine maintenance on corridors may impact adjacent workers and residents for the duration of operation.	Noise levels do not typically exceed background levels. Sound attenuation measures (as part of facility and transmission corridor equipment design) reduce noise impacts.[1] Protective equipment is provided to employees. No mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impacts.
Radiological	Discharges of small amounts of radioactive liquid and gases within regulatory limits.	Potential doses to workers and public will be within regulatory limits. No mitigation measures are necessary.	Small unavoidable adverse impact of radiation exposure.
Atmospheric and Meteorological	Cooling towers emit water vapor plumes that cause fogging/icing, cloud formation, plume shadowing, humidity, and additional precipitation.	The occurrence of plumes and fogging are low. Use Best Available Technology for installing and operating the cooling tower. No mitigation measures are expected to be necessary. The plumes cause little to no effect on humans or surrounding vegetation. No mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impacts.
	Small quantities of waste salts and chemicals are discharged into the atmosphere.	No mitigation measures are expected to be necessary.	Minimal or no unavoidable adverse impacts.

Notes:

1. The 345 kV transmission system and associated corridors are exclusively owned and operated by the ITC*Transmission*. The applicant has no control over the construction or operation of the transmission system. The construction impacts are based on publicly available information and reasonable expectations on the configurations and practices that ITC*Transmission* is likely to use based on standard industry practice. Such efforts would likely include transmission design considerations and Best Management Practices that would minimize the effects on land use.

10.2 Irreversible and Irretrievable Commitments of Resources

This section describes the expected irreversible and irretrievable environmental resources used during construction and operation of Fermi 3. Environmental resources are considered "irreversible" when they are changed by the construction or operation of Fermi 3 and cannot be restored at some later time to the resource's pre-construction or pre-operation state (such as the permanent use of land). Irretrievable resources are generally materials (such as petroleum) that are used for Fermi 3 in such a way that the materials could not be, by practical means, recycled or restored for other uses.

Impacts from construction and operation of Fermi 3 will be similar to that of any major construction project, and the expected loss of resources used in construction is anticipated to be of small consequence with respect to the availability of such resources. The main resource irretrievably committed by operation of Fermi 3 is uranium, which is available in sufficient quantities such that the irreversible and irretrievable commitment of uranium would be of small consequence. The irreversible and irretrievable commitments of resources and materials resulting from construction and operation of Fermi 3 are discussed below and summarized in Table 10.2-1.

10.2.1 Irreversible Environmental Resource Commitments

Irreversible environmental commitments resulting from construction and operation of Fermi 3 encompass the following:

- Land Use Productivity
- Alteration of Terrestrial and Aquatic Habitat and Biota
- Socioeconomic Changes
- Degradation of Water and Air Quality
- Resource Commitments of the Uranium Fuel Cycle

10.2.1.1 Land Use Productivity

As described in Chapter 4 and Chapter 5, construction and operation of Fermi 3 temporarily and permanently modifies land uses on the Fermi site. Land uses onsite and in the transmission corridor are committed to Fermi 3 facility and electrical transmission uses, and are largely unavailable for other uses. Approximately 125 acres from Fermi 3 are lost to other uses until after decommissioning of Fermi 3 (Fermi 2 occupies approximately 172 acres). Once Fermi 3 ceases operations and is decontaminated and decommissioned in accordance with U.S. Nuclear Regulatory Commission (NRC) requirements, the land that supports the facilities may be returned to other industrial or non-industrial or similar uses.

Fermi 3 generates radioactive, chemical, and nonhazardous waste during operations that requires storage and disposal. Chemical wastes are accumulated onsite and transferred offsite to licensed/permitted facilities. Hazardous, mixed, and radioactive wastes are disposed of in permitted landfills or facilities. An irreversible commitment of land occurs because this land cannot be used for other purposes.

10.2.1.2 **Alteration of Terrestrial and Aquatic Habitat and Biota**

Construction activities disrupt or destroy flora and fauna in areas of and adjacent to the Fermi 3 site and the associated transmission corridor. As discussed in Section 4.3, approximately 59 acres (temporary) and 2 acres (permanent) of the Lagoona Beach Unit of the Detroit River International Wildlife Refuge (DRIWR) will be affected by construction. Fermi 3 construction activities will permanently convert 2.75 acres of wetland and 7.28 acres of open water to Fermi 3 uses, which constitutes an irreversible commitment of resources. Fermi 3 construction activities will temporarily impact 39.44 acres of wetlands that could return to their pre-construction condition.

American lotus specimens that occur along the western edge of the South Lagoon will be affected by the construction of the Fermi 3 cooling tower. The American lotus will be subject to a construction mitigation strategy to be established through consultation with MDNR, as discussed in Subsection 4.3.1.2.1. Specific plants that perish during transplanting, or specimens located below-ground that are not identified for transplanting and consequently perish during construction, will be irreversibly committed. Healthy populations of American lotus, however, exist across this area of Michigan.

Minimal impact on mammals, reptiles, and aquatic species occur during construction and operation of Fermi 3. Although losses of these individual species represent an irreversible commitment of resources, the overall populations of terrestrial and aquatic biota will remain healthy at the site and in the region.

10.2.1.3 **Socioeconomic Changes**

Short-term and long-term changes in the population and the local socioeconomic structure of Monroe County, and perhaps neighboring counties, will occur as a result of Fermi 3. Construction and operation of Fermi 3 will lead to an increase in population of these areas, which in turn, will spur increased housing construction and increased tax revenue. Impacts to infrastructure, schools, and community services will be mitigated by using the increased tax revenue to fund necessary improvements. Changes in noise levels, traffic congestion, and crime rates may only be partially mitigated resulting in potentially long-term changes in the overall community character.

10.2.1.4 **Degradation of Water and Air Quality**

In order to minimize environmental impacts, Detroit Edison intends to operate Fermi 3 as a zero-release radioactive liquid effluent plant. However, Fermi 3 will be configured for monitored radioactive liquid effluent releases, should it become necessary. Such releases will be in compliance with all applicable regulations and all necessary permits will be obtained.

Water quality can become slightly degraded as treated effluents containing small quantities of chemical and radioactive constituents enter area surface waters. Some chemical constituents are easily broken down and dissipate quickly; however, others may persist for longer periods of time. Radionuclides also vary in how long they remain in an area, depending on their half-life and total suspension time in the air.

Air quality can also become slightly degraded as chemical and radioactive air emissions enter the atmosphere. The degree of impact depends on how quickly a chemical or radioactive constituent breaks down and is filtered out of the air.

Chemical and radioactive emissions and effluents occur in accordance with applicable permits and are regularly monitored. As a result, water and air quality are not expected to be substantially impacted.

10.2.1.5 **Resource Commitments of the Uranium Fuel Cycle**

The Uranium Fuel Cycle is defined as the total of those options and processes associated with the provision, utilization, and ultimate disposition of fuel for nuclear power reactors. This cycle inherently contributes to environmental effects. Table 5.7-2 presents environmental effects related to uranium mining, conversion, and enrichment; fabrication of nuclear fuel; use of this fuel; and disposal of the spent fuel.

10.2.2 **Irretrievable Commitments of Material Resources**

Irretrievable environmental commitments resulting from construction and operation of Fermi 3 encompass the following:

- Construction Materials
- Water Consumption
- Energy Consumption
- Uranium Fuel Consumption

10.2.2.1 **Construction Materials**

The irretrievable commitment of material resources during construction of Fermi 3 would be generally similar to commitments associated with other large power-generating facilities, such as hydroelectric and coal-fired power plants that are constructed throughout the United States. A U.S. Department of Energy report (Reference 10.2-1) estimates the materials used during new reactor construction. The report provides the following new reactor construction estimates:

- 460,000 cubic yards of concrete
- 46,000 tons of reinforcing steel
- 25,000 tons of structural, decking and miscellaneous steel
- 260,000 feet of large bore pipe (greater than 2.5 inches)
- 430,000 feet of small bore pipe
- 222,000 feet of cable tray
- 1,200,000 feet of conduit
- 1,400,000 feet of power cable
- 5,400,000 feet of control wire

- 740,000 feet of process and instrument tubing for a GEN III+ reactor

Table 10.2-2 compares these estimates of common irretrievable commitments of materials against overall production. While the amount of materials used in construction is large, the irretrievable commitment of construction materials in these quantities would be of small consequence given the availability of such resources.

10.2.2.2 **Water Consumption**

Lake Erie is the primary source of water for Fermi 3. As discussed in Section 5.2, the maximum withdrawal from Lake Erie to support operations of Fermi 3 is approximately 34,000 gpm which is equivalent to 49 MGD. Just over half of this withdrawal, 25 MGD, is returned to Lake Erie under normal operating conditions. Therefore, the resulting water loss from Lake Erie is approximately 24 MGD. Lake Erie has an average flow rate of about 130,400 MGD, and Fermi 3 has a daily water consumption of 24 MGD. The net water loss from the normal operation of Fermi 3 represents 0.019 percent of the total daily flow for Lake Erie.

Given the small water loss from Lake Erie, the longevity of Lake Erie as regional water supply and surface water resource is not affected by the additional Fermi 3 water consumption. While impacts to Lake Erie are small, about 24 MGD of Lake Erie water is consumed by Fermi 3 and, thus, will be unavailable for other uses.

10.2.2.3 **Energy Consumption**

Construction and operation of Fermi 3 requires energy (fuels and electricity) to be consumed. Overall, the total amount of energy consumed during construction and operation is small in comparison to the total amount of energy consumed in the United States. Although energy is irretrievably committed during construction and operation, it is important to note that Fermi 3 produces far more energy than is required to construct and operate the unit. As such, use of fossil fuel supplies is reduced or avoided by the operation of Fermi 3.

10.2.2.4 **Uranium Fuel Consumption**

Uranium is irretrievably committed by the operation of Fermi 3. The U.S. Department of Energy estimates that production of uranium concentrate by the United States increased 10 percent in 2007 compared with 2006 production estimates (Reference 10.2-2). Estimates indicate that sufficient uranium resources exist in the United States to fuel all operating reactors, reactors under construction, and reactors being planned for the next 10 years at a uranium oxide cost (1996 dollars) of $30.00/lb or less. These quantities of uranium can be supplied from the resource categories designated as reserves and estimated additional resources—the two most certain resource categories (Reference 10.2-3).

The World Nuclear Association, which studies supply and demand of uranium, states that the world's present measured resources of uranium (5.5 Mt), in the cost category somewhat below present spot prices and used only in conventional reactors, are enough to last for over 80 years. There was very little uranium exploration between 1985 and 2005, so the significant increase in exploration that is currently being conducted could readily double the known economic resources. On the basis of analogies with other metal minerals, a doubling in price from present levels could be expected to create about a tenfold increased in measured resources over time (Reference 10.2-4). The uranium that would be used to generate power at Fermi 3, while irretrievable, would not affect the long-term availability of uranium worldwide.

10.2.3 **References**

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10.2-2 Energy Information Administration, "Domestic Uranium Production Report Quarterly," Data for 4th Quarter, 2007, http://www.eia.doe.gov/cneaf/nuclear/dupr/qupd.html, accessed 13 May 2008.

10.2-3 Energy Information Administration, "Uranium Industry Annual 1996," April 1997, http://tonto.eia.doe.gov/FTPROOT/nuclear/047896.pdf, accessed 13 May 2008.

10.2-4 World Nuclear Association, "Supply of Uranium," March, 2007, http://www.world-nuclear.org/info/inf75.html, accessed 18 July 2008.

10.2-5 National Ready Mix Concrete Association, http://www.nrmca.org/concrete/2008.htm, accessed 13 May 2008.

10.2-6 U.S. Census Bureau, Economics and Statistics Administration, "Steel Mill Products: 2006", Issued July 2007, http://www.census.gov/industry/1/ma331b06.pdf, accessed 13 May 2008.

10.2-7 U.S. Census Bureau, Economics and Statistics Administration, "Insulated Wire and Cable: 2006", Issued June 2007, http://www.census.gov/industry/1/ma335j06.pdf, accessed 13 May 2008.

10.2-8 The Mannik and Smith Group, "Traffic Study: Fermi Nuclear Power Plant, Unit 3 Expansion," Prepared for Detroit Edison, November 10, 2009.

Table 10.2-1 Summary of Irreversible and Irretrievable Commitment of Environmental Resources (Sheet 1 of 2)

Environmental and Material Resources	Irreversible	Irretrievable
Land Use Productivity	Land committed to the operation of Fermi 3, the transmission corridor[1], and waste disposal is unavailable to other uses. After decommissioning, the land that supports the Fermi 3 facilities may be returned to other industrial or non-industrial uses.	
Alteration of Terrestrial and Aquatic Habitat and Biota	Construction temporarily or permanently alters habitat near the Fermi 3 site and in the transmission corridor.[1] Some habitat areas are revegetated and return to their pre-construction state during operation. Individual specimens of American lotus perish during construction.	
Socioeconomic Changes	Short-term and long-term changes in the population and the local socioeconomic structure of Monroe County, and perhaps neighboring counties, occur. Some impacts on infrastructure and services are temporary, while others may irreversibly change the socioeconomic character and structure.	
Degradation of Air and Water Quality	Small adverse alterations of air and water quality occur as chemical and radioactive air emissions and water effluents are released.	
Construction Materials		Materials are irretrievably committed to the construction and operation of Fermi 3. These materials cannot be reused or recycled if they become contaminated or irradiated during operation.
Water Consumption		Cooling water taken from Lake Erie is lost through evaporation. The overall impact to Lake Erie is relatively small; however, this quantity of water is not available for other uses.
Energy Consumption		Fuels and electricity is consumed during the construction and operation of Fermi 3.

Table 10.2-1 Summary of Irreversible and Irretrievable Commitment of Environmental Resources (Sheet 2 of 2)

Environmental and Material Resources	Irreversible	Irretrievable
Uranium Fuel Consumption		The operation of Fermi 3 contributes a relatively small increase in the depletion of uranium.

Notes:

1. The 345 kV transmission system and associated corridors are exclusively owned and operated by the ITC*Transmission*. The applicant has no control over the construction or operation of the transmission system. The construction impacts are based on publicly available information and reasonable expectations on the configurations and practices that ITC*Transmission* is likely to use based on standard industry practice. Such efforts would likely include transmission design considerations and Best Management Practices that would minimize the effects on land use.

Table 10.2-2 Commitment of Materials

Material	Quantities Used GEN III+	U.S. Production Estimated per Year
Concrete	460,000 cubic yards	413,251,000 cubic yards
Reinforcing Steel	46,000 tons	6,969,893 metric tons
Structural, Decking & Misc Steel	25,000 tons	5,297,920 metric tons (structural shapes-heavy)
Large Bore Pipe (greater than 2.5 inches in diameter)	260,000 feet	1,195,812 metric tons (carbon steel: cold rolled line pipe)
Small Bore Pipe	430,000 feet	1,151,882 metric tons (alloy steel: oil country goods and line pipe; mechanical tubing
Process & Instrument Tubing	740,000 feet	203,540 metric tons (stainless steel: pressure tubing, mechanical tubing, & other pipe and tubing)
Power Cable	1,400,000 feet	315,030 thousands of pounds (copper-containing)
Control Wire	5,400,000 feet	308,173 thousands of pounds (aluminum – containing)

Source: Reference 10.2-1, Reference 10.2-5, Reference 10.2-6, Reference 10.2-7

10.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

This section presents a discussion of the Fermi 3 short-term uses of the environment and their relationship to long-term environmental productivity. This discussion includes an evaluation of the extent to which the proposed project's use of the environment would preclude options for future use of the environment. For the purposes of this section, “short-term” refers to the period from start of construction to end of plant life, including prompt decommissioning, and “long-term” refers to the period extending beyond the end of plant life, including the period up to and beyond that required for delayed plant decommissioning.

Short-term uses of the environment for the construction and operation of Fermi 3 include the unavoidable adverse impacts identified in Section 10.1. These uses include the development of land that would not be available for other uses until the facilities are decommissioned, impacts to lands that provide habitat for wildlife, the consumptive use of water during construction, the loss of aquatic biota at the intake structure and barge slip during construction of these structures, the loss of aquatic biota at the intake structure during plant operations, and temporary impacts to the aquatic ecosystem due to periodic maintenance dredging at the intake bay during the life of the project and possibly maintenance dredging of the barge canal from Fermi 3 to the navigation channel. Other short-term uses of the environment include the irreversible and irretrievable commitments of resources identified in Section 10.2, with the exception of those commitments that involve the consumption of depletable resources as a result of plant construction and operation, which would be considered long-term uses of the environment.

10.3.1 **Benefits of Construction and Operation**

The benefits of construction and operation of Fermi 3 are evaluated and presented in Section 10.4. The principal short-term benefit of construction and operation of a new unit would be the production of electrical energy and the economic productivity of the site. The jobs created by the construction and operation of a new facility would represent a significant input of resources to the local economy. In addition, tax revenues from the facility would present an economic stimulus to Monroe County, the region, and the State of Michigan.

The areas to be developed for Fermi 3 are adjacent to Fermi 2; therefore, the use of the land is precluded from commercial development and agriculture. In the absence of Fermi 3, some proposed construction areas at the site could potentially be used for silviculture or wildlife habitat. However, the economic benefit of the electrical production project would be relatively LARGE compared with the productivity from any other potential uses.

Additional benefits from the construction and operation include the reduction of air pollutant emissions and greenhouse gases. Modern nuclear reactors produce relatively small levels of pollutant air emissions when compared to the principal viable energy alternatives, coal and natural gas (Reference 10.3-1). Currently, nuclear power is the only available and proven technology that provides a viable alternative to fossil-fired plants for baseload electrical generation without emitting large volumes of greenhouse gases (Reference 10.3-2).

10.3.2 Construction of Fermi 3 and Long-Term Productivity

Section 10.1 summarizes the potential unavoidable adverse environmental impacts of construction of Fermi 3 as well as mitigation measures to reduce the impacts. While some impacts will remain following construction, none should preclude the future use of the site following decommission.

Fermi 3 is being constructed on the existing Fermi nuclear power plant site. Thus, construction activities and permanent structures will be consistent with the established use of the site. Construction activities will occupy an area somewhat larger than the permanent structures required for operations because of the need for additional construction work force parking, equipment and material lay-down areas, and temporary construction buildings for the contractors.

The acreage to be disturbed includes existing grassland, shrubland, thicket, lowland hardwood, woodlot, coastal shoreline forest, and coastal emergent wetland. Current plans call for replanting those areas affected by construction. Areas available for restoration are shown in Figure 4.3-2 and are identified as temporary impact areas. The restoration would alleviate any adverse impact to these communities by planting species native to the region and appropriate for the area being re-vegetated. These mitigation measures will limit terrestrial impacts and protect long-term productivity.

Groundwater and surface water (Lake Erie) will be temporarily impacted during construction due to dewatering activities for building foundation construction and surface water withdrawal for construction activities (e.g., concrete batch plant). Once construction is complete these temporary impacts will cease and the groundwater should recharge to pre-construction levels with no long-term loss of subsurface water resources. Due to Lake Erie's vast capacity, the withdrawal of construction water will have no long-term loss of this surface water resource.

Potential archaeological sites located in the construction area for Fermi 3 will be managed in cooperation with the Michigan State Office of Historic Preservation. Appropriate mitigation measures will be implemented as needed.

Construction of the new barge facilities, intake structure, and discharge structure will temporarily disturb sediments within the embayment area. Once construction is complete these temporary impacts to the aquatic ecology will cease and they will not affect the long-term ecological productivity of Lake Erie in the vicinity of the Fermi site.

10.3.3 Operation of Fermi 3 and Long-Term Productivity Impacts

The maximum long-term impact to productivity from other uses of the land within the Fermi site would result if the facility were not decommissioned in a timely manner. The result of any delay in decommissioning would be that the land occupied by facility structures would not be available for any other use. Compliance with the requirements in 10 CFR 50.82 dictates that a nuclear facility would be decommissioned in a timely manner following the end of its useful life. Typical of current industry approaches for multi-unit sites, the decommissioning of Fermi 3 would be expected to include other facilities on-site. It is reasonable to expect that the site would be released for unrestricted use and that such actions would be undertaken in a timely manner, thus minimizing the impact to long-term productivity.

The loss of forested and wetland habitats would be considered a long-term preemption because it is unlikely that the current soil productivity supporting this habitat would be restored in a reasonable time frame. It is likely that the site would be used for other industrial uses following decommissioning and not be reverted back to use as wildlife habitat. There are no other significant land use preemptions.

As stated in Section 10.4, the operation of Fermi 3 would also result in a long-term benefit to air quality and CO_2 levels (which many scientists believe contributes to global warming) through emissions avoidance by not relying on natural gas-fired, coal-fired, or other fossil-fueled electrical generation.

The uranium fuel provides a short-term supply of relatively clean energy. Spent uranium fuel must be managed as a high-level radioactive waste and either reprocessed or, more likely, isolated in a geological repository. This represents a long-term commitment of the disposal area and geological formation.

Overall, the enhancement of regional productivity resulting from the electrical energy produced by Fermi 3 would not be equaled by any other use of the site. In addition, most long-term impacts resulting from land use preemption by plant structures would be eliminated by removing these structures or by converting them to other productive uses.

10.3.4 **Summary of Relationship between Short-Term Uses and Long-Term Productivity of the Human Environment**

The short-term and long-term benefits of the construction and operation of Fermi 3 outweigh the short-term and long-term impacts to environmental productivity. The short-term benefit of the production of electrical energy and the economic productivity of the site would be relatively LARGE compared with the productivity of the Fermi site from any other probable uses. The construction and operation of Fermi 3 would result in the positive long-term enhancement of regional productivity through the generation of electrical energy, with benefits that would likely extend beyond the life of the project.

Table 10.3-1 compares the project's principal short-term uses to the long-term productivity of the human environment.

10.3.5 **References**

10.3-1 Massachusetts Institute of Technology, “The Future of Nuclear Power, An Interdisciplinary MIT Study,” 2003, http://web.mit.edu/nuclearpower/, accessed 15 February 2008.

10.3-2 University of Chicago, “The Economic Future of Nuclear Power; A Study Conducted at The University of Chicago,” August 2004, http://www.ne.doe.gov/np2010/reports/NuclIndustryStudy-Summary.pdf, accessed 15 February 2008.

Table 10.3-1 Comparison of Short-Term Uses to Long-Term Productivity (Sheet 1 of 3)

	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Land Use	The construction and operation of Fermi 3 would preclude these lands from being available for other uses.	Construction and operation of Fermi 3 does not necessarily represent a long-term impact to productivity of the human environment as the land might be available for other uses after the nuclear facility is decommissioned.
	The construction and operation of a new transmission route[1] would convert 242 acres of agricultural land use and wildlife habitat.	The construction and operation of new transmission lines does not result in any significant impact to agricultural land use or wildlife impact. New transmission lines will use existing transmission corridor infrastructure to the maximum extent possible. The acreage might be available again for agriculture production and wildlife habitat if the transmission lines are decommissioned upon decommissioning of the nuclear facility.[1]
Hydrological and Water Use	Construction is expected to require an anticipated maximum quantity of 600,000 GPD from Lake Erie. The water withdrawal from Lake Erie for the operation of Fermi 3 is approximately 34,000 gpm. The Frenchtown Township, which obtains its water from Lake Erie, will be the source of potable water for Fermi 3. The daily potable water consumed during construction is approximately 8700 gallons per day. Construction of the building foundations will require dewatering of groundwater.	The consumptive use of water during construction and operations does not result in any significant long-term impacts to water resources. Upon decommissioning of Fermi 3, the water would be available for other uses. Dewatering activities will not affect the long-term productivity of the groundwater aquifer. Dewatering is a temporary activity.

Table 10.3-1 Comparison of Short-Term Uses to Long-Term Productivity (Sheet 2 of 3)

	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Ecological		
--Terrestrial Flora and Fauna	The construction of Fermi 3 and its associated infrastructure results in the impacts to habitat for plants and animals. Fermi 3 construction will permanently impact 27 acres of undeveloped land, inclusive of wetlands, designated wildlife refuge, forest land, and grassland. The potential for impacts to wildlife is small but, for instance, could include the temporary displacement of animals due to noise or bird collisions with tall equipment.	The construction of Fermi 3 and the associated offsite transmission lines would result in the long-term loss of biologically productive habitat as soil conditions could take hundreds of years to redevelop. Temporarily disturbed sites would be replanted with native vegetation following completion of the project. The wildlife species found on the Fermi site, in the region, and along the transmission route are not rare and would recover from displacement by the project. Wetlands impacts will be mitigated as required by USACE and the MDNR.
--Aquatic	Impacts to the aquatic ecosystem due to construction of a new intake structure and barge slip; and dredging at the intake bay.	The construction and operation of Fermi 3 does not result in any significant long-term impacts to biota or their habitats. Upon decommissioning of Fermi 3, the use of the intake structure and dredging would cease; thus, it is anticipated the aquatic ecosystems would return to a natural state.
Socioeconomic	Electrical power generation.	The long-term benefits of electrical power generation include helping to meet growing industrial, commercial, and residential baseload needs; the effects of which are expected to live beyond the life of the project. Additional long-term benefits include those related to air emissions avoidance by not relying on natural gas-fired or coal-fired electrical generation to meet energy demands.
	Increased state and local tax revenues, plant expenditures, and employee spending in the community during construction and operations results in both short-term and long-term growth in the local economy.	Tax revenues, plant expenditures, and employee spending leads to long-term growth in the local and regional economy, infrastructure (e.g. roads), and services that may continue after Fermi 3 is decommissioned.

Table 10.3-1 Comparison of Short-Term Uses to Long-Term Productivity (Sheet 3 of 3)

	Short-Term Uses and Benefits	Relationship to Maintenance and Enhancement of Long-Term Environmental Productivity
Irradiated Spent Fuel	The uranium provides a short-term supply of relatively clean energy	The spent fuel must be managed as a high-level radioactive waste and either reprocessed or isolated in a geological repository. Storage of the waste in a geological repository represents a long-term commitment of the disposal area and geological formation.
Other Radioactive Waste	The radioactively contaminated reactor vessel and equipment are required for the short-term production of nuclear energy	The contaminated waste would be disposed in a low level radioactive waste facility. This represents a long-term commitment of the disposal area.

Notes:

1. The 345 kV transmission system and associated corridors are exclusively owned and operated by the ITC*Transmission*. The applicant has no control over the construction or operation of the transmission system. The construction impacts are based on publicly available information and reasonable expectations on the configurations and practices that ITC*Transmission* is likely to use based on standard industry practice. Such efforts would likely include transmission design considerations and Best Management Practices that would minimize the effects on land use.

10.4 Benefit-Cost Balance

This section summarizes the benefits and costs associated with construction and operation of Fermi 3. Benefits are discussed in Subsection 10.4.1. Costs are discussed in Subsection 10.4.2. A summary is provided in Subsection 10.4.3. The benefits and costs associated with construction and operation of the proposed Fermi 3 are summarized in Table 10.4-1 and Table 10.4-2, respectively. Section 9.2 addresses different alternatives to the proposed project.

10.4.1 Benefits

The evaluation of monetary and non-monetary benefits associated with construction and operation of Fermi 3 are described in this section and summarized in Table 10.4-1.

10.4.1.1 Monetary Benefits

The States of Michigan and Ohio and the counties surrounding Fermi 3 would experience an increase in the amount of taxes collected from labor, services, construction materials, and supplies purchased for the project. These projected expenditure increases and financial benefits from construction and operation of Fermi 3 are discussed in Subsection 4.4.2 and Subsection 5.8.2, respectively. The large tax revenues and local expenditures generated from construction and operation of Fermi 3 would benefit the state and local government agencies because they would support the development of infrastructure and services that support the community, and promote further economic development.

There will be employment and income multiplier impacts arising from the construction jobs at the Fermi site and the local expenditures made by the construction workforce and the purchase of materials, supplies, and services during the construction phase. As discussed in Subsection 4.4.2, the RIMS II model was used to analyze the employment and income multiplier impacts to the region.

As discussed in Subsection 4.4.2, the construction of the project is expected to directly create 8,173 man-years of employment and 627.5 million in direct earnings (2008 dollars). Based upon a RIMSII analyses, the 627.5 million in directed earnings is projected to generate a total regional impact of $735.0 million in earnings (2008 dollars). The 8,173 man-years of employment are expected to generate a total of 9,833 man-years of employment in the region.

As discussed in Subsection 5.8.2, the anticipated number of full-time operational employees for Fermi 3 is 900. The 900 full-time positions (including contract staff) will create direct economic benefits to the region, as these will be stable, high paying positions that will be much sought after. The periodic maintenance staff needed to support the refueling and maintenance requirements of Fermi 3 will provide additional direct employment and wage benefits to the vicinity. Over and above the 900 full-time employees, Subsection 5.8.2 assumes that 100 workers represent a levelized, full-time equivalent to the maintenance staff. The average direct salary for the Fermi 3 operational staff is $66,868 (2008 dollars). Over the first 30 years of Fermi 3 operations, the direct earnings for Fermi 3 staff would exceed $2.0 billion (2008 dollars).

In addition, there will also be secondary or indirect jobs created on a long-term basis due to the economic multiplier effects of Fermi 3 operation. As discussed in Subsection 5.8.2, these employment and earnings impacts were estimated with the RIMS II model. The RIMS II model results indicate that, over a 30-year period, more than 42,804 manyears of employment and approximately $2.34 billion in earnings will be generated within the region. For the primary impact area, Fermi 3 operations would constitute a MODERATE to LARGE benefit.

10.4.1.2 **Non-Monetary Benefits**

The following discussion considers the non-monetary benefits of constructing and operating Fermi 3.

The need for new generation is discussed in Chapter 8. Net generating capacity for Fermi 3 is approximately 1500 MWe. Based on an assumed operating capacity factor of 90 percent, this provides an annual average 12,000,000 MW-hrs total generation. The additional generation from Fermi 3 will help maintain system reliability by increasing the availability of baseload power.

As discussed in Section 4.6, it is projected that the construction of Fermi 3 will employ, at peak construction, about 2900 people, 2465 people will be hired locally and 392 families will relocate to the primary impact area. Temporary construction workers and their families increase rental and property demand, spending on goods and services, and sales taxes that benefit the local economy. The operation of Fermi 3 requires additional people, beyond that necessary to operate Fermi 2, whose benefit to the region will extend through the life of the plant.

In addition to providing the new generation capacity and moving towards meeting the projected need for power in the State of Michigan, and the positive regional impacts there are other significant benefits associated with Fermi 3. These other benefits, discussed in Subsection 8.4.2, include:

- Fuel diversity
- Dampened price volatility
- Enhanced reliability
- Reduced reliance on fossil fuels and reduction in associated emissions

Section 9.2 analyzes alternatives to the proposed action, such as coal-fired and natural gas-fired plants. As discussed in Table 10.4-2, Fermi 3 has a SMALL impact due to air emissions. The emissions from coal-fired and natural gas-fired plants would be much greater than Fermi 3.

Section 10.3 describes the relationship between short-term uses and long-term productivity of the human environment. Additional benefits of Fermi 3 include an associated reduction in dependence on foreign energy sources and vulnerability to energy disruptions.

As the nation's import of liquefied natural gas increases, there is a related impact on the “energy security” of the country. With greater reliance and import of natural gas, there is a related economic impact on the nation's balance of trade. Energy generation from Fermi 3 represents a potential for reducing the foreign trade deficit by way of decreased reliance on imported natural gas and other fuels. Lastly, the operation of Fermi 3 has the effect of reducing the rate of depletion of the nation's finite fossil fuel supplies.

10.4.2 **Costs**

The following discussion identifies both internal and external costs associated with the construction and operation of Fermi 3. The term “internal” generally refers to the monetary costs associated with a project, while the term “external” refers to non-monetary environmental costs of constructing and operating a new plant. These costs are summarized in Table 10.4-2.

Many of the cost attributes described in this subsection are detailed in Section 10.1 (Unavoidable Adverse Environmental Impacts), Section 10.2 (Irreversible and Irretrievable Commitments of Resources), and Section 10.3 (Relationship Between Short-term Uses and Long-term Productivity of the Human Environment).

10.4.2.1 **Internal Costs**

This discussion describes the monetary costs of constructing and operating Fermi 3. Internal costs include capital costs of the plant and transmission lines, operating costs, including staffing and maintenance, fuel, and decommissioning costs.

10.4.2.1.1 **Construction**

The projected internal monetary costs related to the construction of Fermi 3 are provided in Part 1 of this COLA.

10.4.2.1.2 **Operation**

The U.S. Department of Energy study (Reference 10.4-1) estimates the annual O&M costs of a 1340 MWe ESBWR plant to be $74,178,482, which is calculated as $6.83 per MW-hr. This cost is expressed in units of electric net generation, or megawatts electric, and reflects all costs that are incurred to operate and maintain the plant. Included in this cost are salaries and benefits for the plant staff, parts, material and equipment costs for maintaining plant equipment, fees, insurance, overhead costs, and short-term contract services.

Nuclear fuel cost and decommissioning are calculated separately. Reference 10.4-2 estimates that the average fuel cost for a nuclear generating plant is $4.64 per MW-hr at a five percent discount rate. A decommissioning cost estimate is provided in Part 1 (General and Administrative Information).

Reference 10.4-2, Chapter 3, includes a comparison of levelized generation costs for coal-fired, natural gas-fired and nuclear power plants. The cost elements in the total levelized generation cost include investment (including refurbishment, decommissioning and interest during construction), O&M and fuel. At a five percent discount rate the total generation cost for nuclear compares favorably with coal and is substantially less than that for natural gas. The generation costs considered in Reference 10.4-2, Chapter 3, for the coal-fired and natural gas-fired plants do not consider projected additional costs placed on carbon emissions. As discussed in Appendix 10 to Reference 10.4-2, consideration of additional costs placed on carbon emissions would increase the total generation costs for coal-fired and natural gas-fired plants. The impact is more significant for coal-fired than for natural gas-fired generation due to the higher levels of carbon emissions associated with coal-fired generation. To summarize, as shown in Reference 10.4-2, the total generation cost associated with nuclear power is equivalent to, or lower, than other baseload load fuel sources, especially when additional costs associated with carbon emissions are included.

Measures to control adverse impacts related to operation are discussed in Section 5.10. There are monetary costs associated with the design and implementation of these measures which include such activities as training employees in environmental compliance and safety; treatment, storage, and disposal of any chemical wastes generated; and acquisition and compliance with required operational permits and environmental requirements.

10.4.2.2 **External Costs**

This discussion describes the external (non-monetary) environmental and social costs of constructing and operating Fermi 3. The environmental impacts of construction and operation of Fermi 3 are described in Section 4.6 and Section 5.10, respectively. Section 10.1 also provides details regarding potential mitigation and the unavoidable adverse impacts after mitigation measures have been considered. Several mitigation measures would be built into the project design, such as scheduling to ensure that construction is completed in the shortest possible time; using construction best management practices to limit erosion, fugitive dust, runoff, spills and air emissions; and providing first-aid stations at the construction site.

10.4.2.2.1 **Land Use**

Approximately 27 acres will be affected by the construction of Fermi 3 as a result of permanent facilities. An additional 162 acres will be disturbed on a short-term basis as a result of temporary activities and construction of temporary facilities and laydown areas. Clearing and removal of trees growing within the Fermi site will be required. Loss of land use is an external cost of the construction of Fermi 3. A detailed description of land use is provided in Section 4.1. As discussed in Subsection 9.2.3, the cost in land use for a nuclear-powered generating plant is about the same as that for a natural gas-fired power plant and less than that for a coal-fired power plant of comparable generation capacity. As discussed in Subsection 9.2.3, when overall land use requirements are considered, the cost in land use for a nuclear-power generation plant is less than that for both a coal-fired and natural gas-fired plant.

10.4.2.2.2 **Hydrological and Water Use**

Section 4.6 and Section 5.2 describe hydrologic alterations for construction and operation, respectively. As discussed in these sections, there are costs associated with providing water for various needs during construction and operation. The majority of water used for Fermi 3 operations would be surface-water drawn from Lake Erie. This water use represents only a small fraction of available water and is judged to be SMALL. There are also costs associated with potable water consumption that will be provided by the Frenchtown Township. Use of surface-water by the site should not impact off-site users in terms of either water availability or water quality. Relatively small levels of non-radioactive and radioactive effluents are introduced into Lake Erie (after treatment). It is noted that Fermi 3 is designed with the capability to recycle 100 percent of the liquid radioactive waste (zero liquid effluent). Detroit Edison intends to operate Fermi 3 with zero liquid effluent. Water quality effects of chemical effluents discharged to Lake Erie during Fermi 3 operations are discussed in Subsection 5.2.2 and are judged to be SMALL. Cooling water blowdown that discharges to Lake Erie will result in a thermal plume. Impacts of the thermal plume on Lake Erie is SMALL and localized.

10.4.2.2.3 **Terrestrial and Aquatic Biology**

Ecological effects related to plant construction and operations are described in Section 4.3 and Section 5.3 respectively. Some cost due to mortality of wildlife during construction is anticipated. Impacts to important habitats such as wetlands onsite may occur within the construction impact area. These are discussed in Subsection 4.3.1.2.2. As discussed therein, measures would be taken to avoid impacts and when that is not possible, impacts would be minimized to the greatest extent possible. Any losses of wildlife are not expected to be large enough to affect the long-term stability of the populations. The cooling system, including the station water intake structure, is designed to reduce loss of aquatic biota as a result of impingement and entrainment. The construction of the new intake structure and dredging for the intake structure, barge slip, and outfall pipe will result in only minor and temporary effects to aquatic biology. As discussed in Subsection 9.2.3 and Table 9.2-7, impacts to terrestrial and aquatic species from nuclear-powered plants are smaller than impacts from comparably sized coal-fired or natural gas-fired power plants. Impacts to terrestrial and aquatic species from Fermi 3 construction and operations are anticipated to be SMALL.

Relatively small amounts of air emissions from diesel generators, auxiliary boilers and equipment, and vehicles are generated from nuclear power plant operation.

Cooling towers produce an atmospheric vapor plume. Cooling tower drift deposits some salt on the surrounding vicinity, but the level is unlikely to result in any measurable impact on plants and vegetation (Section 5.4).

Small amounts of chemical effluents are components of the Fermi 3 water discharges into Lake Erie. Relatively small amounts of hazardous wastes would be generated that need to be managed and disposed of pursuant to the Resource Conservation and Recovery Act (RCRA). Section 3.6 discusses non-radioactive waste systems.

10.4.2.2.4 **Chemical and Radioactive Emissions, Effluents, and Wastes**

Operation of Fermi 3 will include minor radioactive air emissions to the atmosphere. Relatively small levels of radioactive effluents may be generated and discharged into Lake Erie.

Low-level radioactive wastes will be generated that need to be stored, treated, and disposed of in a licensed landfill. High-level radioactive spent fuel would be generated that needs to be isolated in an interim spent fuel storage facility, a geological repository for tens of thousands of years, or possibly reprocessed into reusable fuel. FSAR Chapter 11 discusses the radioactive waste management systems.

10.4.2.2.5 **Materials, Energy, and Uranium**

Construction of Fermi 3 will result in an irreversible and irretrievable commitment of materials and energy (Section 10.2). Operation of Fermi 3 contributes to the depletion of uranium.

10.4.2.2.6 **Potential for Nuclear Accident**

The potential effects of various types of nuclear accidents are discussed in Chapter 7. The analysis concluded that the potential environmental impacts from a postulated accident from the operation of Fermi 3 would be SMALL.

10.4.2.2.7 **Socioeconomic Costs**

Section 4.4 and Section 5.8 describe socioeconomic costs related to construction and operation of Fermi 3, respectively. Additional public and social services may be required to meet the demands of people moving into the area during construction and operation of Fermi 3. These impacts are SMALL because of the disbursement of the population and housing impacts over a large and populated area that already has a well developed infrastructure. The positive LARGE socioeconomic benefits from the added employment opportunities (direct and indirect) and expenditures would more than outweigh any negative impacts.

10.4.3 **Summary**

As discussed in Section 8.4, there is a growing baseload demand and growing baseload supply shortfall for the region of interest. Without additional capacity, the electric network will fail to maintain an adequate reserve margin. Fermi 3 will help meet the growing baseload shortfall in the region by supplying an average annual electrical-energy generation of approximately 12,000,000 MW-hrs.

Fermi 3 will generate electricity with significantly reduced CO_2 emissions with respect to comparably-sized coal-fired or natural gas-fired alternatives. Fermi 3 would also have important strategic implications in terms of lessening the dependence of the United States on foreign fuel imports, fuel supply disruptions, and vulnerability to price volatility or politics. While the additional direct and indirect creation of jobs places some minor temporary burden on local services and infrastructure, the annual taxes and revenue generated by the new workers contribute to the local economy and stimulate future growth.

On balance, the benefits of Fermi 3 would significantly outweigh the economic, environmental and socioeconomic costs.

10.4.4 **References**

10.4-1 U.S. Department of Energy, “Study of Construction Technologies and Schedules, O&M Staffing and Costs, Decommissioning Costs and Funding Requirements for Advanced Reactor Designs,” May 27, 2004.

10.4-2 International Energy Agency, Organisation for Economic Co-operation and Development, "Projected Costs of Generating Electricity," 2005 Update, http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1472, accessed 15 February 2008.

Table 10.4-1 Monetary and Non-Monetary Benefits of Fermi 3

Category of Benefit	Description of Benefit
Net Electrical Generating Benefits	
Net Generating Capacity	~1500 MWe
Electricity Generated (operating at 90% capacity)	~12,000,000 MW-hrs (Annual Average)
Taxes and Revenue During Plant Operation Period (Transfer Payments – Not Independent Benefits)	
Estimated Annual Property Taxes	$19.1million
Estimated Annual Direct Sales Taxes	$1.2 million
Estimated Annual Indirect Sales Taxes	$4.5 million
Effects on Regional Productivity	
Construction Workers	Approximately 2900 workers (peak) create an incremental increase of 2060 indirect jobs, within the region. 85% of construction workers are projected to be from existing workforce in the primary impact area.
Operational Workers	Approximately 900 workers create an incremental increase in 640 indirect permanent jobs within the region for at least 40 operating years.
Socioeconomics	Increased tax revenue supports improvements to public infrastructure and social services. The increased revenue spurs future growth and development.
Technical and Other Non-Monetary Benefits	
Fuel Diversity	Reduces exposure to supply and price risk associated with reliance on any single fuel source
Price Volatility	Dampens potential for fuel price volatility
Fossil Fuel Supplies	Offsets usage of finite fossil fuel supplies
Electrical Reliability	Enhances electrical reliability
Emissions Reduction	Significant beneficial impact in terms of avoidance of air emissions as discussed in Section 8.4
Carbon Dioxide (CO_2) Emissions	Baseload generation with no CO_2 emissions
Wastes	Compared with fossil-fueled plants, nuclear plants produce less non-radioactive waste products

Table 10.4-2 Internal and External Costs of Fermi 3 (Sheet 1 of 2)

Category of Cost	Description of Cost
Internal Costs	
Construction (Overnight Cost)	$3000 to $4000 per kW
Operation	$6.83 per MW-hr for O&M $4.64 per MW-hr for fuel cycle
Decommissioning (NRC Minimum)	$518,033,205
External Costs	
Land and Land Use	SMALL Fermi 3 will occupy approximately 125 acres of the 1260 acres existing Fermi site.
Hydrological and Water Use	SMALL There are some costs associated with providing water for various needs during construction and operation. Cooling water will be taken from Lake Erie. Relatively small levels of chemical and/or radioactive effluents will be introduced into Lake Erie. Thermal plume resulting from cooling water blowdown will be discharged to Lake Erie. The effect of consumption of cooling water is relatively small.
Terrestrial and Aquatic Species	SMALL Some cost to wildlife due to mortality during construction operations is anticipated. However, these costs do not affect long term wildlife populations. Wildlife mortality, including aquatic biota, during operations is expected to be minimal.
Radioactive Effluents and Emissions	SMALL Radioactive waste will be generated. The plant will produce radioactive air emissions. Relatively small levels of radioactive effluents may be introduced into Lake Erie.
Chemical and Radioactive Waste	SMALL Storage, treatment, and disposal of high-level radioactive spent nuclear fuel. Commitment of underground geological resources for disposal of radioactive spent fuel.

Table 10.4-2 Internal and External Costs of Fermi 3 (Sheet 2 of 2)

Category of Cost	Description of Cost
External Costs (continued)	
Air Emissions	SMALL Air emissions from diesel generators, auxiliary boilers and equipment, and vehicles that have a small impact on workers and local residents. Cooling tower drift that deposits some salt on the surrounding vicinity, but the salt levels are unlikely to result in any measurable impact on plants and vegetation. Cooling tower atmospheric plume discharge abated with design.
Materials, Energy, and Uranium	SMALL Irreversible and irretrievable commitments of materials and energy, including depletion of uranium.
Potential Nuclear Accident	SMALL Potential risks are small.
Socioeconomics	SMALL Construction of Fermi 3 may pose minor additional costs to public and social services in the area. However, these costs are more than offset by increased tax revenues generated directly and indirectly by plant construction and operation.