10.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

This chapter presents the potential environmental consequences of constructing and operating a new U.S. EPR at the Callaway site. The environmental consequences are evaluated in five sections:

- Unavoidable adverse impacts of construction and operations
- Irreversible and irretrievable commitments of resources
- Relationship between short-term uses and long-term productivity of the human environment
- Benefit-Cost balance
- Cumulative impacts

10.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

This section summarizes adverse impacts of Callaway Plant Unit 2 construction and operation that cannot otherwise be avoided, and for which there may be no practical means of mitigation. Chapter 4 and Chapter 5 provide supporting details.

10.1.1 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF CONSTRUCTION

Most construction related environmental impacts can be avoided or minimized through the application of best management construction plans and conformance with applicable Federal, state and local regulations that protect the environment. Callaway Plant Unit 2 requires use of a site footprint where permanent structures and roads are located. Construction activities, on the other hand, can be managed in ways that limit long-term loss of habitat and impacts to workers and the public.

Construction impacts and potential minimizing measures are discussed in Section 4.6, and Table 10.1-1 summarizes the potential environmental impacts of construction and their minimization. Considering the planned minimization measures, the level of unavoidable adverse impacts from construction is expected to be SMALL.

10.1.2 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS OF OPERATIONS

Operational impacts of Callaway Plant Unit 2 are discussed in Chapter 5. Expected impacts and their mitigation are summarized in Table 10.1-2. Unavoidable impacts are limited to operation of the cooling water systems and the generation of additional non-radioactive and radioactive waste. Actions to minimize these impacts include use of collector well river intake system, closed-cycle cooling and waste minimization. As a result, the unavoidable adverse impacts of operation are also expected to be SMALL.

10.1.3 SUMMARY OF UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS FROM CONSTRUCTION AND OPERATIONS

Construction and operation will require the disturbance of approximately 626 acres (253 hectares) of land for construction, of which 612 acres (248 hectares) will be permanently committed to power plant structures, transmission corridors, new plant roadways, parking, and plant laydown. Up to 14 acres (6 hectares) temporarily impacted by construction activities will

be restored following construction to reduce the size of the footprint affected during operations. The infrastructure required for Callaway Plant Unit 2 will be consistent with existing site use, with the exception of the collector will river intake system. Both the collector well river intake system for makeup water and the effluent pipeline to the Missouri River will be common to Callaway Plant Units 1 and 2. No new transmission corridors will be required to support Callaway Plant Unit 2 operations. However, 6.7 miles (10.8 km) of existing corridors and rights-of-way will be widened by about 150 ft (46 m).

Protection of surface and subsurface water resources during construction will require use of Best Management Practices to limit construction related erosion and sedimentation of surface waters. Water quality monitoring will be conducted as required to comply with the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit to be issued by the Missouri Department of Natural Resources (MDNR) to verify that control measures are adequate. Groundwater used during construction and operations will be obtained from existing AmerenUE deep wells.

Certain natural resources on site will be affected including unavoidable encroachment on the Missouri River flood plain, some wetlands, and farmland of statewide importance as defined on Table 4.1-2. Activities within these areas will conform to applicable state and federal regulations to ensure that impacts are limited and controlled. It is anticipated that two new storm water runoff ponds will be constructed to replace those lost to the construction of permanent laydown areas and for runoff control from the laydown area. Should construction requirements dictate that additional ponds be filled, appropriate mitigation measures will be implemented. Long term impacts to aquatic resources are expected to be reduced through the use of a collector well river intake system to supply make up water, thereby eliminating the need for surface water intakes.

Construction of permanent Callaway Plant Unit 2 structures, such as the reactor and turbine buildings and the cooling towers, will take place on previously disturbed land. Construction activities outside of previously disturbed areas will affect land currently forested or cultivated. There may be sensitive archaeological and architectural sites located in the construction area, particularly in the Missouri River flood plain, and their discovery, protection, and/or mitigation of impacts will be administered through cooperative efforts with the Missouri State Historic Preservation Officer (SHPO).

Measures to promote public health and safety will be implemented during construction and operation. The temporary increase in workforce during construction will require actions to minimize traffic congestion. At the peak of construction, more than 5,000 construction workers could potentially access the site on a regular basis, in addition to the traffic demand imposed by regular deliveries of equipment and materials. The Callaway Plant Unit 1 employee access road will be relocated on County Route 459 and new access to a new construction contractor parking area will be connected to County Routes 428 and 459 and an access road from County Route 448. According to the current site plan, during construction of Callaway Plant Unit 2, there will be three independent access routes into the facility for plant workers and construction personnel. Ameren has evaluated options such as shift staggering in order to alleviate the short term impact, congestion, and delay that may occur at peak transition times (e.g. morning shift change). The maximum possible traffic demand will occur at the peak of construction in year 2016. During the morning shift change, there are 4,000 estimated vehicle trips in or out of the facility as a result of workers/vehicles transitioning. Workers may include regular plant employees, outage workers for Callaway Plant Unit 1, construction labor, and specialty craft workers engaged in constructing Callaway Plant Unit 2. There is sufficient two way roadway capacity into the plant to support 3,600 vehicles per hour without substantial

backup or delay. The outage worker population adds considerably to the labor force, (more than 1,200 estimated workers). Since a refueling outage occurs approximately every 18 months, and only lasts for about two months, the impact of outage workers on traffic congestion would be temporary. During the peak period, assisted traffic control may be helpful, staging traffic control officers (e.g. local police, security personnel, etc.) at key locations to direct and keep traffic moving. Also, two lane roadways under the immediate control of the plant could be directed to one way at peak periods, doubling road capacity until traffic was more dispersed on local access roads. In the interest of worker safety, should this approach be implemented, one access road in and out of the plant would be maintained in the event a response due to a medical emergency is necessary.

Non-routine construction noise, such as blasting, will be limited to day time. Measures to control fugitive dust and emissions from equipment will be implemented. Emissions from the testing of diesel engines will conform to applicable Missouri and related federal emission standards.

Radiological dose to workers on site and to the general public have been calculated and are estimated to be within applicable regulatory limits. Continuing monitoring of radioactivity in the environment surrounding the Callaway site will be used to confirm that radiological consequences of station operation are maintained within applicable environmental and health based standards. While some radioactive solid wastes will be created during the operational period of Callaway Plant Unit 2, efforts to control and limit their production will be implemented.

Impacts associated with the Callaway Plant Unit 2 cooling water makeup and discharge systems include construction and operation of the collector well river intake system and operation of the Missouri River outfall. Construction of the Callaway Plant collector well river intake system for Callaway Plant Unit 2 will take place on-shore within the Missouri River flood plain and on farmland of statewide importance, potentially resulting in the discovery of archaeological sites and impacts on wetlands. Water removed from the caissons during collector well construction will be returned to the river. A discharge pipe carries combined effluent from Callaway Plant Units 1 and 2. There is a possible need to deepen the Missouri River access to the existing barge slip by dredging to permit oversize equipment to be delivered by waterborne transport. Dredging activities will conform to applicable State and U.S. Army Corps of Engineers regulations, including proper disposal of dredge spoils.

Since Callaway Plant Unit 2 employs closed-cycle cooling water systems that conform to the U.S. Environmental Protection Agency (EPA) Phase I Clean Water Act 316(b) regulations, the impact of withdrawal of cooling water from the Missouri River/Missouri River Alluvial Aquifer (Aquifer) will be SMALL. The use of a collector well river intake system will eliminate the potential for impingement and entrainment of aquatic biota.

Evaporative loss from the cooling towers will create a visible plume. The extent of the plume will vary seasonally. The average plume length would range from 0.36 miles (0.6 km) in the summer season to 2.6 miles (4.2 km) in the winter season. The annual prediction for average plume length would be 1.2 miles (2.0 km). The median plume lengths would range from 0.23 miles (0.37 km) in the summer season to 0.97 miles (1.6 km) in the fall. The annual median plume length is 0.34 miles (0.56 km). The median plume length is not expected to reach the site boundary. The maximum predicted incremental increase in salt deposition due to operation of the Callaway Plant Unit 2 cooling towers is estimated to be 0.00014 lbs per acre (0.00016 kg per hectare) per month. This is far below the NUREG-1555, Section 5.3.3.2 (NRC, 1999) significance level. The noise from Callaway Plant Unit 1, along with the addition of Callaway Plant Unit 2, is

not greater than the normal operational noise occurring at other nuclear power plants. AmerenUE believes that background or ambient sound levels at the Callaway Plant site, with its rural setting, would likely compare to the ambient sound level of a farm, 44 decibels, or to that of a small town or quiet suburban area, 46 to 52 decibels (EPA, 1974).

A portion of the Callaway Plant Unit 2 cooling towers water will be discharged back into the Missouri River as blowdown to maintain the quality of the cooling water as it is recirculated. The maximum blowdown water temperature rise will be approximately 12°F (6.7°C). The resulting thermal plume is predicted to be SMALL and will achieve compliance with Missouri ambient water quality criteria for the protection of aquatic life beyond the limits of a mixing zone within the mixing zone limits established in Missouri regulations. The cooling tower blowdown will be combined with other discharge streams before entering the Missouri River. The combined discharge will contain small amounts of chemicals used in plant systems and small quantities of radioactive liquids. Concentrations of these waste water constituents will be limited by NPDES permit requirements and applicable NRC radiological release limitations.

10.1.4 REFERENCES

EPA, 1974. "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," U.S. EPA, March, 1974

NRC, 1999. Environmental Standard Review Plan, NUREG-1555, Nuclear Regulatory Commission, October 1999.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 1 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Land Use	Approximately 626 acres (253 hectares) of land will be disturbed of which 612 acres (248 hectares) will be permanently committed to power plant structures, offsite transmission system, and roads for Callaway Plant Unit 2 until decommissioning.	Comply with applicable federal, state and local construction permits/approvals. Clear only areas necessary for installation of power plant infrastructure and implement construction Best Management and Storm Water Protection Plans. Limit activities in the 100 year flood plain to those associated with the collector well intake system. Limit activity in the transmission corridor to that necessary to increase the corridor width. Minimize constructing transmission towers in wetland areas. Implement a Site Resource Management Plan. Use of existing, but widened transmission corridor right-of-way. Implement Storm Water Pollution Prevention Plan (SWPPP), including sediment and erosion control. Implement Spill Prevention Control and Countermeasures (SPCC) Plan. Use site Resource Management Plan and Best Management Practices (BMP) to protect resources such as wetlands and streams in vicinity; Obtain individual U.S. Army Corps of Engineers 404 Permit; comply with BMP requirements.	612 acres (248 hectares) of land will be occupied by nuclear plant infrastructure until decommissioning.
	Potential to disturb archaeological and architectural sites during construction	Undertake extensive archaeological survey of site prior to construction (completed). Review significance of previously identified sites with the Missouri State Historic Preservation Officer (SHPO) and develop plans to avoid and/or minimize impacts to these sites. Develop procedures compliant with Federal and State laws to protect cultural, historical or paleontological resources or human remains in the event of discovery during construction. The Cultural Resources Discovery Plan prepared for monitoring the installation of test wells and observation wells used during the collector well feasibility study in 2007 and approved by the SHPO will serve as the basis for further efforts.	Small potential for destruction of unanticipated historic and/or cultural resources.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 2 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Hydrologic and Water Use	Construction has the potential to change drainage characteristics, flood handling, and erosion and sediment transport.	Implement BMP and Storm Water Pollution Prevention (SWPPP) Plans according to applicable Local and State regulations to limit erosion and contamination of surface waters. Comply with the U.S. Army Corps of Engineers 404 Permit.	Potential erosion of sediments into surface waters and local, temporary depression in the water table due to dewatering activities.
	Construction will require approximately 550 gpm (2,080 lpm) of groundwater withdrawal.	Monitor groundwater water levels. Following construction, use of groundwater will be reduced. Storm water runoff ponds will assist with storm water and sediment control.	Temporary localized drawdown of the aquifer and redirection of recharge source water during construction.
	Surface and subsurface water quality could be affected by construction activities.	Implement BMP and SWPPP. Monitor water quality in construction impoundments as required by the Construction General Permit to be issued by MDNR and compare to applicable criteria and historic data. Comply with the U.S. Army Corps of Engineers 404 Permit requirements. Use site Resource Management Plan to protect resources such as wetlands and streams in vicinity. Implement Spill Prevention, Control, and Countermeasures (SPCC) Plan.	Potential for contamination of groundwater.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 3 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Aquatic Ecology	One existing onsite storm water runoff pond, three isolated ponds, and two small streams will be permanently affected by construction of the laydown areas; others may experience temporary impairment resulting in elimination and/or displacement of aquatic species.	Implement BMP and SWPPP to limit erosion and sedimentation. Construct two new storm water runoff ponds to collect and manage runoff from the Unit 2 laydown area. Use site Resource Management Plan and BMP to protect resources.	Aquatic resources in the pond will be permanently lost.
	Missouri River aquatic life may be affected due to increased suspended sediment from potential dredging for the barge slip access and construction of the collector well system.	Dredging of the access to the barge slip, if necessary, will be confined to a small area and will quickly recolonize. Implement SWPPP, including sediment and erosion control. Comply with the U.S. Army Corps of Engineers 404 Permit requirements. Implement SPCC Plan. No aquatic endangered species are expected to be impacted.	Benthic organisms in the dredged areas will be temporarily removed.

Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 4 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Terrestrial Ecology	Vegetation loss will occur in certain construction areas, including deciduous forest, cropland, and wetlands habitats.	Restore land or provide offsetting habitat for land impacted by Callaway Plant Unit 2 construction and not identified as permanent facilities per Section 4.1. Perform activities in wetlands in accordance with permit requirements of Section 404 of the Clean Water Act. Facilities will be sited to limit wetland encroachment. Use site Resource Management Plan and BMP to protect resources. Preserve aesthetically outstanding tree clusters, as practical; harvest merchantable timber; use or recycle other woody material, as appropriate; develop restoration plan. Obtain individual U.S. Army Corps of Engineers 404 Permit; comply with BMP requirements.	A limited amount of deciduous forest and cropland will be lost. A portion of onsite wetlands will be lost.
	Designated bird species may be displaced or disturbed.	Manage forest habitat specific to key bird species to limit habitat fragmentation. Consult with appropriate agencies regarding avoidance and appropriate mitigation measures, if necessary, for bald eagle and northern harrier nesting areas. Minimize lighting, as practicable and allowed by regulation.	Habitat may be lost in widened offsite transmission corridors.
Socioeconomic	Construction workers, existing employees and local residents could be affected by increased dust, noise, emissions and traffic.	Onsite noise will be maintained within applicable OSHA noise-exposure limits. Train construction workers and employees in use of appropriate personal protective equipment Develop fugitive dust and vehicle emissions control strategies in conformance with best management practices. Ameliorate traffic congestion by relocating site access road from Callaway County Route 459 and addition of access roads to construction worker parking area from County Routes 459 and 428 and by implementing a Traffic Management Plan. Comply with applicable U.S. EPA and Missouri Department of Natural Resources (MDNR) air quality regulations. Install new site perimeter and access road.	No unavoidable impacts.

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Table 10.1-1—Construction-Related Unavoidable Adverse Environmental Impacts

(Page 5 of 5)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
	Public services supporting construction activities and expanded work force may be impacted.	Available housing is adequate and many skilled laborers will be commuting from outside the region of influence. Minor aggregate socioeconomic impacts anticipated; mitigation not required.	No unavoidable adverse impacts.
Radiological	Construction workers will be exposed to small doses of radiation from existing units.	All doses will be within 10 CFR 20.1301 limits. Implement ALARA practices at construction site.	Small doses to construction workers.
Atmospheric and Meteorological	Construction will cause increased air emissions from traffic and construction equipment, and fugitive dust.	Train construction workers and employees on appropriate personal protective equipment. Develop fugitive dust and vehicle emissions control strategies in conformance with air quality standards and best management practices. Equipment maintenance plans. Comply with applicable U.S. EPA and MDNR air quality regulations.	No unavoidable adverse impacts.
Environmental Justice	No disproportionate impacts to low income or minority groups were identified.	None.	No unavoidable adverse impacts.
Non-radiological Health Impacts	Risk to workers from accidents and occupational illness.	Contractor to implement site-wide construction health and safety program prepared for and approved by AmerenUE.	Industrial worker accidents may occur.

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Table 10.1-2—Operations-Related Unavoidable Adverse Environmental Impacts

(Page 1 of 2)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Land Use	The Callaway Plant Unit 2 footprint will permanently occupy a portion of the Callaway Plant site that is largely already disturbed.	Limit area required during design and construction.	Land use is consistent with current operations at the site.
	Operation of the new unit will increase radioactive and non-radioactive waste disposal in landfills and onsite in long-term storage facilities.	Implement a waste minimization, pollution prevention program to limit waste generation.	Some land will be dedicated to offsite and onsite waste storage and will not be available for other uses.
Hydrologic and Water Use	Circulating Water Supply system and Essential Service Water Supply system makeup water will be withdrawn from Missouri River/Missouri River Alluvial Aquifer potentially affecting local hydrology.	Implement collector well system to reduce impacts to the Missouri River.	No unavoidable impact.
			CWS and ESWS cooling water makeup taken from the Aquifer will largely be consumed through evaporative loss.
Aquatic Ecology	Missouri River cooling water withdrawal will result in impingement and entrainment.	Implement subsurface collector well system for makeup water withdrawal.	No unavoidable impact.
	Thermal plume may impact aquatic species abundance and distribution.	Meet all applicable state and federal regulatory requirements regarding the discharge of heat. The outfall was designed to rapidly disperse the thermal discharge.	A small thermal plume will be created.
	Biofouling and other process control chemicals will be discharged.	Meet all applicable state and federal Clean Water Act and NPDES permit regulations and limitations.	Chemicals will be discharged in small quantities.
Terrestrial Ecology	Operation of the cooling tower would result in a visible plume and salt deposition.	Use natural draft cooling tower with drift eliminators to limit evaporative loss and deposition.	The tower plumes will be visible from beyond the site boundary
	Bird collisions with the tower may occur.	Install cooling towers beyond forest species preferred habitat areas. Use of lower lighting.	No unavoidable adverse impacts.

Table 10.1-2—Operations-Related Unavoidable Adverse Environmental Impacts

(Page 2 of 2)

Impact Category	Adverse Impact	Mitigation Measures	Unavoidable Adverse Environmental Impacts
Socioeconomic	Operating nuclear plants emit low noise.	Studies demonstrate noise levels on and offsite will meet acceptable limits.	No unavoidable adverse impacts.
	The additional transmission line has potential to cause electric shock	Design to NESC code to minimize potential impacts.	No unavoidable adverse impacts.
	Cooling tower and plume may impact existing site aesthetics.	Site contours and the forest canopy limit visibility. The new facilities will be consistent with existing uses.	The cooling tower plumes will be visible from offsite areas.
	An additional 363 permanent staff will increase traffic during shift changes.	New access roads will limit traffic congestion. Existing roads have sufficient capacity to handle increased work force.	No unavoidable adverse impacts.
	Air quality could potentially be affected due to onsite diesel generators.	Conform to state and federal emission standards and permit requirements.	No unavoidable adverse impacts.
	Population increases due to added staff may affect public services.	Existing capacity exists to absorb the increased population related services.	No unavoidable adverse impacts.
Radiological	Potential doses to members of the public from releases to air and surface water.	All releases will be well below regulatory limits.	No unavoidable adverse impacts.
	General public and worker exposure to radiation during incident-free transport of fuel and wastes.	Detailed analysis performed in accordance with 10 CFR 51.52(b), yielding conservative results.	No unavoidable adverse impacts.
Atmospheric and Meteorological	The cooling tower plume will traverse the site.	Use of cooling tower drift eliminators to limit drift losses.	During certain times of the year, the plume will be visible offsite.
Environmental Justice	No disproportionately high or adverse impacts on minority or low income populations are predicted	None required.	No unavoidable adverse impacts.
Non-radiological Health Impacts	Potential growth of infectious organisms within the Circulating Water System and Essential Service Water System cooling towers.	Apply best management biocide treatment to limit growth and dispersal of harmful organisms.	No unavoidable adverse impacts.
	Risk to workers from occupational related accidents and illnesses.	Implement site-wide Safety and Medical Program.	Some accidents are likely to occur.

10.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section describes the expected irreversible and irretrievable environmental resource commitments used in the construction and operation of Callaway Plant Unit 2. The information contained in this section satisfies the requirements of 10 CFR 51.45(b) (5) (CFR, 2007) and 10 CFR 51, Appendix A to Subpart A (CFR, 2007), with respect to consideration of irreversible and irretrievable commitment of resources (CFR, 2007).

Irreversible resource commitments are those that could not be restored at a later time to pre-existing conditions. Irretrievable resources are materials that will be used that could not, by practical means, be recycled or restored for other uses.

10.2.1 IRREVERSIBLE ENVIRONMENTAL COMMITMENTS

Irreversible environmental commitments resulting from installation of Callaway Plant Unit 2 in addition to materials used for nuclear fuel fabrication and onsite structural components include:

- Surface water and groundwater;
- Land;
- Aquatic and terrestrial biota, and
- Releases to air and surface water.

10.2.1.1 Surface Water And Groundwater

Water will be withdrawn from the Missouri River/Missouri River Alluvial Aquifer (Aquifer) in an estimated 85%/15% ratio to support the Circulating Water Supply System (CWS) and Essential Service Water Systems (ESWS). Some of this water will be consumed as a result of evaporative loss from the cooling towers. The remainder will be returned to the Missouri River. The average amount of water lost from the CWS cooling towers due to evaporation is expected to be approximately 17,600 gpm (66,640 lpm). Evaporative loss from the ESWS cooling tower will average approximately 940 gpm (3,560 lpm) during normal operation. Because evaporative loss is consumptive, it will be unavailable for other uses.

The onsite water courses and wetlands that will be filled or otherwise modified to accommodate the construction of Callaway Plant Unit 2 represent a small fraction of the areas occupied by these natural resources. While the fractional area to be affected is small, those areas included within the Callaway Plant Unit 2 construction footprint will be permanently unavailable for reclamation in the future.

Groundwater withdrawals will be needed to support construction and operation of Callaway Plant Unit 2. Groundwater that is removed from the aquifer to support construction will be consumed or managed as surface water runoff. The impact to this resource will be temporary and small. Groundwater removed during operations represents one half of one percent of the total water used to support Callaway Plant Unit 2 operations. Approximately twenty percent of the groundwater withdrawn is for domestic use and is returned to the environment following treatment and is available for reuse. The balance of the groundwater resource use is consumptive and it will not be available for other uses.

10.2.1.2 Land Use

Land designated for use in and support of the generation and transmission of electrical power including the storage of radioactive and non-radioactive waste on and offsite is dedicated to that use and will be unavailable for other uses during the operational period. Following decommissioning and the development of permanent offsite radioactive storage, the onsite areas could be reclaimed.

10.2.1.3 Aquatic And Terrestrial Biota

Construction of Callaway Plant Unit 2 will require the removal of deciduous forest and cropland entirely on AmerenUE owned property and will encroach on wetlands. Construction of associated transmission facilities will require some clearing of mixed deciduous forest both on and off AmerenUE property. These areas will be permanently occupied by plant and transmission system structures during operations and will be unavailable for reclamation. However, the construction areas represent a small percentage of the overall site acreage and do not contain any unique or otherwise protected aquatic, terrestrial, or wetland species.

10.2.1.4 Releases To Air And Surface Water

Radioactive materials, air pollutants and chemicals will be released to the environment during routine operations of Callaway Plant Unit 2. Since these releases will conform to applicable Nuclear Regulatory Commission, U.S. Environmental Protection Agency and the State of Missouri regulations, their impact to the public health and the environment would be limited. Routine long-term monitoring of radioactivity in the environment and the measurement of chemical concentrations discharged will be performed to verify regulatory compliance.

10.2.2 IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irretrievable commitments of resources during construction of Callaway Plant Unit 2 will be similar to that required for other major energy construction projects. Studies performed for the U.S. Department of Energy have summarized the amount of materials historically consumed for nuclear power plant construction (DOE, 2004a) (DOE, 2005).

For a typical new 1,300 MWe nuclear power plant, it can be estimated that reactor building steel-plate reinforced structures would require 12,239 cu yds (9,357 m^3) of concrete and 3,107 tons (2,819 tonnes) of rebar. Approximately 2,500,000 lin ft (762,000 m) of cable would be required for the reactor building, and 6,500,000 lin ft (2,000,000 m) of cable and up to 275,000 ft (84,000 m) of piping for the unit. Based on historical information from operating reactors (DOE, 2005), it is estimated that pressurized water reactors between 1,000 and 1,300 MWe require a total of approximately 182,900 cu yds (139,800 m^3) of concrete to construct the reactor building, major auxiliary buildings, turbine generator building and the turbine generator pedestal. A total of 20,512 tons (18,608 tonnes) of structural steel was typically required.

Concrete would be the most significant mass consumed irretrievable material for plant construction. The National Ready Mix Concrete Association reports annual domestic ready mixed concrete production at a level of 460 million cubic yards (352 million cubic meters), which represents a $30 billion industry. Concrete is environmentally sustainable in a variety of ways. The ingredients of concrete (water, aggregate, and cement) are abundant and take a lesser toll in their extraction than other construction materials. Concrete manufacturing often uses recycled industrial (non-hazardous) waste byproducts such as blast furnace slag, fly ash, and other materials used in the concrete mix. At the end of its useful life (i.e. demolition), concrete itself is recyclable. Upon crushing, the rebar steel can be recovered and the aggregate used for new concrete mixtures. Since the materials for concrete are so readily available,

concrete products and ready-mixed concrete can be made from local resources and processed near a jobsite. Local shipping minimizes fuel requirements for handling and transportation (NRMCA, 2008b).

Steel in the form of rebar and structural steel would be the second most irretrievable mass consumed material for plant construction. The International Iron and Steel Institute reports worldwide raw steel production has exceeded more than a billion metric tons (1.1 billion short tons) since 2004. Production has been growing at a rate of about 9% annually. Steel is a highly recyclable commodity. At the end of the useful life of the facility, most of the steel used in construction would be amenable to recycling including rebar in concrete and structural steel components. The irretrievable commitment of steel to the project would mainly result from the disposal of radiologically irradiated/contaminated components that cannot be decontaminated such as the reactor pressure vessel.

Some of the higher end components of the plant are fabricated using various grades of high performance stainless steel. Purchasing Magazine reported in January 2008, stainless steel production in the first three quarters of 2007 at 20.9 million metric tons (23 million short tons) (Purchasing, 2008). Stainless steel as a high performance corrosion resistant material is also more likely to be used in the parts of the plant where nuclear materials are handled and radiation is highest, thus making much of this material unavailable for recycle. This loss of material would represent a permanent irretrievable commitment of resources. However, stainless steel is a readily available commodity and this loss would not be considered significant.

Another major commodity and resource committed to the project as noted would be cabling and wiring. Much of this would contain copper. The International Copper Study Group (ICSG), established in 1992, is an intergovernmental organization with 23 member countries including the United States, China, Japan, and Russia (ICSG, 2008a). The ICSG reports projections for 2008 indicating a small surplus of around 85,000 metric tons (93,700 short tons) (0.5% of usage), and projections for 2009 indicate a larger surplus of around 430,000 metric tons (474,000 short tons) (2.2% of usage). World copper mine production in 2007 rose by 3% to 15.5 million metric tons (17.1 million short tons), an increase of 465,000 metric tons (513,000 short tons) from that in 2006. Mine production is expected to increase by 955,000 metric tons (1,052,000 short tons) (+6%) to 16.4 million metric tons (18.1 million short tons) in 2008, and a further increase of 1.5 million metric tons (1.65 million short tons) (9%) to 17.9 million metric tons (19.7 million short tons) in 2009 is expected (ICSG, 2008b). At the end of the useful life of the facility, copper utilized in plant construction would be highly amenable to recycling (excepting any material that might become permanently radiologically contaminated). Thus, the irretrievable commitment of this resource is minimal.

High performance zirconium alloy is used as the fuel rod cladding material to contain the enriched sintered uranium fuel pellets that fuel the Callaway Plant Unit 2 reactor. These rods will be fabricated and clad using AREVA alloy M5®, a ternary alloy containing mostly zirconium, with niobium, and oxygen (Mardon, 1997). Zirconium is a manufacturing material that is readily available. It is typically found in the form of zircon containing sands and other mineral forms. Resources of zircon in the United States included about 14 million tons associated with titanium resources in heavy-mineral sand deposits. Phosphate and sand and gravel deposits have the potential to yield substantial amounts of zircon as a future byproduct. Eudialyte and gittinsite are zirconium silicate minerals that have a potential for zirconia production. Identified world resources of zircon exceed 60 million tons (USGS, 2007). This material is irreversibly lost in this application even if the spent fuel rods are recycled. The zirconium eventually becomes part of the fuel reprocessing waste which is stabilized and sent for permanent long-term disposal.

The rated gross electrical output for Callaway Plant Unit 2 is 1,710 MWe. This is approximately 30% higher than the largest plant referenced in the historical data. However, these historical estimates are representative of the quantities of materials that will be consumed during construction. Historical data for materials consumed for domestic nuclear power plant construction in the 1970s is summarized in Table 10.2-1 (DOE, 2005).

While these quantities are large, their use provides a cost-effective allocation of resources given that energy from nuclear power plants is now increasingly cost competitive (DOE, 2004a) (DOE, 2005). Furthermore, nuclear energy provides environmental benefits consistent with current concerns relative to overall life cycle environmental effects caused by fuel extraction, emission of air pollutants and solid waste disposal typically associated with fossil fuel (DOE, 2004b) (WNA, 2005).

Irretrievable resources include uranium and the energy used to fabricate fuel. However, available supplies of uranium suggest that there is a considerable degree of security of supply to ensure the continued operation and expansion of nuclear power for the foreseeable future (NEA, 2002) (WNA, 2006).

While a given quantity of material consumed during construction and operation of Callaway Plant Unit 2 will be irretrievable, except for materials recycled during decommissioning, the impact on their availability is expected to be SMALL.

10.2.3 REFERENCES

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Table 10.2-1—Summary of Historical Data – Materials Consumed by Nuclear Power Plant Construction in the United States During the 1970's

	BWR 1074-1308 MWE	PWR 1116-1311 MWE	LWR 1074-1311 MWE
Building Volume			
Building Volume 1,000,000 ft^3 (1,000,000 m^3)	14.6 (0.41)	15.9 (0.45)	15.3 (0.43)
Concrete (Reactor Building, Major Auxiliary Buildings, Turbine Generator Building, Turbine Generator Pedestal, Other)			
Concrete 1,000 yds^3 (1,000 m^3)	195.7 (149.6)	182.9 (139.8)	188.7 (144.3)
Concrete yds^3/net KW (m^3/net KW)	173.2 (132.4)	152.8 (116.8)	162.1 (123.9)
Concrete yds^3/building 1,000 ft^3 (m^3/building 1,000 ft^3)	12.5 (9.6)	11.3 (8.6)	11.8 (9.0)
Structural Steel (supports, shield plate, miscellaneous steel)			
Structural Steel Tons (MT)	13,642 (12,376)	20,512 (18,608)	17,389 (15,775)
Structural Steel lb/net KW (kg/net KW)	23.9 (10.8)	34.1 (15.5)	29.5 (13.4)
Structural Steel TN/building 1,000 ft^3 (MT/building 1,000 m^3)	0.94 (.024)	1.30 (0.033)	1.13 (0.029)

BWR – Boiling water reactor

PWR – Pressurized water reactor

LWR – Light water reactor

10.3 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY OF THE HUMAN ENVIRONMENT

The Callaway Plant Unit 2 environmental report provides information associated with the environmental and socioeconomic impacts of activities that occur during construction and operation. These activities are considered short-term for purposes of this section and include that period through prompt decommissioning. Long-term is considered to be that period from construction to end of plant life and beyond for delayed decommissioning. This section reviews the extent to which the project use of the environment precludes any future, long-term use of the site.

The information contained in this Section satisfies the requirements of 10 CFR 51.45(b) (4) (CFR, 2007) and 10 CFR 51, Appendix A to Subpart A (CFR, 2007), with respect to consideration of irreversible and irretrievable commitment of resources.

10.3.1 CONSTRUCTION AND LONG-TERM PRODUCTIVITY

Section 10.1 summarizes the potential unavoidable adverse environmental impacts of Callaway Plant Unit 2 construction including measures being implemented to minimize those impacts. While some impacts will remain following construction, none should preclude the future use of the site following decommissioning.

Callaway Plant Unit 2 is being constructed on the nuclear power plant site occupied by Callaway Plant Unit 1. As a result, construction related activities and permanent structures will be consistent with established site use. Construction activities will occupy a footprint larger than the permanent structures required for operations because of the need for additional temporary work force parking, equipment and material lay-down areas and construction buildings.

The acreage to be disturbed includes forest and cropland, previously disturbed land, and surface waters in the form of storm water runoff ponds and wetlands. Plans call for reclaiming those areas affected by construction to the extent practicable. It is anticipated that two new storm water runoff ponds will be constructed to manage storm water flow during construction and these ponds will remain and continue to serve in that capacity during operations. These minimization measures limit terrestrial impacts and protect long-term productivity.

Groundwater and surface waters will be temporarily disturbed during construction due to water withdrawal. Following completion of construction these impacts will cease and groundwater should recharge to pre-construction levels with no long-term loss of surface or subsurface water resources.

Potential archaeological and architectural sites located in the construction area will be managed in cooperation with the Missouri State Historic Preservation Office (SHPO) so that appropriate actions are implemented to minimize impacts to cultural resources. The highest potential for discovering archaeological and architectural sites exists in the Missouri River flood plain where construction of the collector well river intake system will take place. The Cultural Resources Discovery Plan prepared for monitoring the installation of test wells and observation wells used during the collector well feasibility study in 2007 and approved by the SHPO will serve as the basis for further cooperative efforts.

Construction of the Callaway Plant Unit 2 collector well river intake system will take place on-shore within the Missouri River flood plain and will involve some disturbance to wetlands and farmland of Statewide importance as defined on Table 4.1-2. Some limited dredging of

river sediments may be required to deepen the access to the existing barge dock to permit heavy equipment delivery on barges. The ecological impacts of access channel dredging, if required, are expected to be SMALL.

Noise above ambient levels will occur onsite due to some construction activities. Non-routine construction noise, such as blasting, will be limited to day time. Since construction noise is temporary, there would be not long-term impacts.

Temporary traffic increases will occur due to the numbers of additional workers required to support construction. The existing employee access road will be relocated on County Route 459 and access to a new contractor parking area will be constructed from County Routes 428 and 459 and an access road from County Route 448. The area surrounding the Callaway site is rural. By implementing a traffic control plan and providing multiple access points to parking areas, impacts to local traffic patterns will be minimized during this period and through operations and decommissioning.

Economic benefits during construction accrue from the need for temporary housing and local spending. It is predicted that while this benefit is substantial, it will represent a small increment to the total economic base of the Callaway site three-county area.

10.3.2 OPERATION AND LONG-TERM PRODUCTIVITY

The potential unavoidable adverse environmental impacts of Callaway Plant Unit 2 operation are also summarized in Section 10.1 along with minimization measures. Some impacts will occur during Callaway Plant Unit 2 operations but will largely terminate upon plant shut down and any residual environmental issues resolved during decommissioning such that long-term uses of the site are not precluded.

Environmental impacts during operations are largely related to operation of the CWS system and ESWS and the generation of radioactive wastes. Impacts of the cooling water systems stem from withdrawal of water from the Aquifer via the on-shore collector well river intake system, evaporative loss from the systems' cooling towers and the return of cooling water back to the Missouri River.

The use of closed-cycle cooling systems will substantially reduce these potential impacts such that during and following operations there would be no long-term loss of ecological productivity of aquatic resources in the Missouri River. By using collector wells with intake laterals approximately 80 ft (24 m) below grade, the potential for entrainment and impingement of aquatic species by the intake structure is eliminated.

Discharge of the thermal plume and associated power plant chemical additives, including a small treated liquid radioactive waste stream will meet applicable permit regulatory requirements during operations and are not expected to have any long-term consequences for water quality in the Missouri River. Due to the use of closed-cycle cooling, the thermal plume is predicted to occupy a comparatively small area. Similarly, the concentrations of chemicals released will be limited and will quickly disperse in river waters with little or no long-term accumulation.

Evaporative loss of water from the cooling towers represents a consumptive use during operations but will cease following plant shutdown. Salt deposition during cooling tower operations is not predicted to be the cause of vegetative impacts, yet this potential impact will also cease following shutdown. Studies of vegetative impacts of the Callaway Plant Unit 1 cooling tower performed between 1985 and 1993 concluded that salt deposition from cooling

tower drift did not impact local vegetation. The Callaway Plant Unit 2 cooling towers will not add substantially to the salt deposition from the existing Callaway Plant Unit 1 cooling tower.

Emission of fossil fuel combustion byproducts will increase during the periodic testing of the Callaway Plant Unit 2 diesel engines. The amount of emissions will be governed by applicable state permits and federal standards for air pollutants. Since the emissions are periodic and transient, and will cease following Callaway Plant Unit 2 shutdown, long term impacts to air quality are not expected.

Radiological releases will be controlled according to applicable state and federal standards to ensure protection of terrestrial and aquatic biota, and protection of workers and the general public. Onsite storage of radioactive wastes will be temporary and ultimately removed from site. Reclamation of the site including removal of any radioactive contamination will occur such that future long-term uses of the site are not precluded.

Socioeconomic benefits to the counties surrounding the Callaway site will result from increased personal taxes, additional spending and housing. While the relative impact to the economic base is small, some benefit will continue up to and through decommissioning, particularly where increased tax revenues have been used to enhance public infrastructure and services. Property taxes paid to Callaway County would be substantial. Annual Callaway County property taxes during construction should exceed $115 million and will stabilize at an annual estimate of $17 million for Callaway County. These projected revenues are expected to exceed the local school and County needs during construction period and in 2018 and beyond.

10.3.3 SUMMARY OF RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The construction and operation of Callaway Plant Unit 2 will result in some limited short-term and unavoidable impacts to the environment. Minimization measures have been to limit both the short-term impacts of construction and those that may occur during the operational life of Callaway Plant Unit 2. Benefits accrue from the production of electricity and increases in the tax base that could support public infrastructure and services. Following site decommissioning, it is expected there will be no long-term impacts on productivity or the human environment that would preclude alternative uses of the site.

10.3.4 REFERENCES

CFR, 2007. Title 10, Code of Federal Regulations, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, 2007.

10.4 BENEFIT-COST BALANCE

This section describes the benefit-cost balance resulting from the construction and operation of Callaway Plant Unit 2. It was prepared in accordance with the guidance provided in NUREG-1555 (NRC, 1999) i.e., "Environmental Standard Review Plan" (ESRP). Section 10.4.1 describes the benefits of the project; Section 10.4.2 discusses the costs associated with the project; and Section 10.4.3 provides a benefit-cost balance summary.

The information contained in this Section satisfies the requirements of 10 CFR 51.45(d) (NRC, 2007) and 10 CFR 51, Appendix A to Subpart A (CFR, 2007), with respect to consideration of irreversible and irretrievable commitment of resources.

10.4.1 BENEFITS

This section discusses the benefits resulting from the construction and operation of Callaway Plant Unit 2. The information provided in this section was prepared in accordance with the guidance provided in NUREG-1555, ESRP 10.4.1 (NRC, 1999). Information provided in this section includes a summary of the following information:

- The evaluation that was performed to determine if there is sufficient demand for new electric power in Missouri;
- The evaluation that was performed to determine an electric power generation source (i.e., coal, gas, nuclear, solar, wind);
- The evaluation that was performed to choose a location for the selected electric power generation source; and
- Benefits that the new electric power generation facility will provide.

Table 10.4-1 summarizes the benefits and costs of the action. Section 10.5 summarizes the potential cumulative adverse environmental impacts at the site. These benefits and costs include:

- Identification of appropriate plant production benefits;
- Calculation of the plant average annual electrical-energy generation in kilowatt-hours (kWh);
- Evaluation of the reliability of the electrical distribution system;
- Identification of other project benefits, including state and local tax revenues, regional productivity, enhancement of recreational and aesthetic values, environmental enhancement, creation and improvement of local roads or other facilities, and intangible benefits (e.g., reduced dependence on scarce fossil fuels);
- Quantification of benefits in monetary or other appropriate terms;
- Evaluation of the significance of the benefits on a political boundary or regional basis; and
- Assessment of any potential social or economic impacts as a result of the project construction and operation.

The potential cumulative adverse impacts at the site resulting from construction of a new power plant are summarized in Section 10.5.

10.4.1.1 Need for Power

As discussed in Section 8.4, the Missouri Public Service Commission (PSC) noted in its latest adequacy supply report (MDPSC, 2007) that the need for in-state generating capacity is increasing rapidly. The PSC assessed the following factors as contributing to its growing concern about reliability and power supply:

- Missouri's growing reliance on imported electricity.

- Need for infrastructure additions and new transmission.
- Energy efficiency, wholesale, and retail opportunities.

Missouri's Growing Reliance on Imported Electricity

Missouri's dependence on out-of-state generation resources will likely increase over the next 5 to 10 years because of both growth in electricity demand and the possible de-rating or retirement of existing generating units. Both Missouri utilities and MISO are forecasting electricity demand to grow by between 1% and 2% per year.

Need for Infrastructure Additions and New Transmission

Further contributing to uncertainty in the power supply adequacy outlook is that over the next 10 years only a small number of new electricity generators will likely be built in Missouri.

In addition, federal and Missouri regulations require sharp reductions in sulfur dioxide, nitrous oxide, and mercury emissions from fossil-fired generating plants. Some of the older generating units may have difficulty in satisfying the stricter emission limits or may be unable to satisfy them at all. If they are unable to comply, it is possible they would discontinue operations.

Even units that achieve compliance may see net energy output reduced because of parasitic losses associated with operation of the emission control equipment. Other states in MISO have also put in place strict air emission requirements, with similar potential effects on fossil-fired generating units. Missouri has also joined the Regional Greenhouse Gas Initiative (RGGI), which will place further limitations on fossil-fueled generation.

Energy Efficiency, Wholesale, and Retail Opportunities

More efficient use of electricity is occurring in Missouri. Electricity demand growth has been moderate despite economic growth. Since restructuring legislation was implemented, electric consumption in Missouri has increased at an average annual rate of 2.5%. The recent increase in wholesale electricity rates will likely reduce this rate of electric load growth. Both the Missouri utilities and the Missouri Independent Transmission System Operator (MISO) are forecasting that, over the next 10 years, electricity demand growth will be about 1.5% per year. Regional efforts under MISO, such as load response programs to encourage consumers to voluntarily reduce consumption, also contribute to efficiency. The long-term objective of these efficiency programs is to establish market conditions so that demand response and generation are, in effect, competing with one another.

10.4.1.2 Energy Alternatives

The following paragraphs provide a summary of the evaluation that was conducted in Section 9.2 to determine a suitable electric generating power source to meet the demand for new power in the AmerenUE service area. The evaluation identified alternatives that would 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, as well as any combination of these alternatives. In addition, alternatives that would not require new generating capacity were evaluated, including initiating energy conservation measures and Demand-Side Management (DSM), reactivating or extending the service life of existing plants within the power system, and purchasing electric power from other sources.

The evaluation indicated that neither a coal-fired nor a gas-fired facility would appreciably reduce overall environmental impacts relative to a new nuclear plant. Furthermore, a coal-fired

and a gas-fired facility would entail a significantly greater environmental impact on air quality than would a new nuclear plant. The analysis indicated that wind and solar facilities in combination with fossil facilities could be used to generate baseload power. However, wind and solar facilities in combination with fossil facilities would have higher costs and larger land requirements than a new nuclear facility and therefore are not preferable to a new nuclear facility.

Based on environmental impacts, it has been concluded that neither a coal-fired, nor a gas-fired, nor a combination of alternatives, including wind and solar facilities, would appreciably reduce overall environmental impacts relative to a new nuclear plant; therefore making nuclear power a suitable electric power generation source.

10.4.1.3 Alternative Locations for the Proposed Facility

The following paragraphs provide a summary of the evaluation that was conducted in Section 9.3 to identify a preferred location for the new nuclear power facility. The objective of the evaluation was to verify that no obviously superior location for the siting of a new nuclear unit exists.

After reviewing alternate sites that were identified by a process reasonably calculated to identify sites that are among the best alternates available, the evaluation concluded that none of the alternate sites is environmentally preferable to the preferred location for the new nuclear facility; co-location with the existing nuclear facility at Callaway. Alternate sites were selected because they met the criteria outlined in NUREG-1555, Section 9.3 (III) (4c) (NRC, 1999) as discussed in Section 9.3.1.2. In addition, evaluations were done on two greenfield sites identified as the Paynesville greenfield site, and the Lamine greenfield site. These are undeveloped agricultural properties. The sites were evaluated based on potential impacts to land use, air quality, water, terrestrial ecology and sensitive species, aquatic ecology and sensitive species, demographics, and historic, cultural, and archaeological resources. The results of this screening level summary are summarized on Table 10.4-1.

The evaluation concluded that the preferred location for the new nuclear facility is co-location with an existing nuclear facility. Siting a new reactor at an existing nuclear facility offers a number of benefits:

- By co-locating nuclear reactors, the total number of generating sites is reduced.
- No additional land acquisitions are necessary, and the applicant can readily obtain control of the property. This reduces both initial costs to the applicant and the degree of impact to the surrounding anthropogenic and ecological communities.
- Site characteristics, including geologic/seismic suitability, are already known, and the site has already undergone substantial review through the National Environmental Policy Act (NEPA) process during the original selection procedure.
- The environmental impacts of both construction and operation of the existing unit are known. It can be expected that the operational impacts of a new unit should be comparable to those of the operating nuclear plant.
- Co-located sites can share existing infrastructure, reducing both development costs and environmental impacts associated with construction of new access roads, waste disposal areas, and other important supporting facilities and structures. Construction

of new transmission corridors may be reduced because of the potential use of existing corridors.

- Existing nuclear plants have nearby markets, the support of the local community, and the availability of experienced personnel.

The analysis concluded that greenfield sites could be dismissed from further evaluation based on high potential adverse environmental impacts. Development of the brownfield sites would offer no advantages and would increase both the cost of the new facility and the severity of impacts. Development of any of the four alternative sites selected for study offers no environmental advantages over locating the new nuclear facility at the existing Callaway site.

10.4.1.4 Benefits of the Facility

Locating the proposed new nuclear facility at the Callaway site will afford benefits to the local economy. AmerenUE, the Callaway site owner will pay property taxes on the new unit for the duration of the operating licenses. AmerenUE, the Callaway site owner estimates that property tax payments could total approximately [$115] million during the construction period. It is estimated that property tax payments will stabilize with an estimated $17 million to Callaway County once the plant is placed in service. Most people consider large tax payments a benefit to the taxing entity because they support the development of infrastructure that supports further economic development and growth.

Approximately 870 people are employed at the Callaway Plant Unit 1 facility. It is anticipated that construction will require a peak workforce of approximately 3,950 people and operation of the new facility would require a skilled workforce of 363 people. New jobs within approximately a 50 mile (80 km) radius of the plant would be created by the construction and operation of the new facility. Many of these jobs would be in the service sector and could be filled by unemployed local residents, lessening demands on social service agencies in addition to strengthening the economy. It is anticipated that the new jobs would be maintained throughout the life of the plant.

Construction and operation of the new facility at the Callaway site would generate an economic multiplier effect in the area. The economic multiplier effect means that for every dollar spent an additional $0.65 of indirect economic revenue would be generated within the region of influence (BEA, 2005). The economic multiplier effect is one way of measuring direct and secondary effects. Direct effects reflect expenditures for goods, services, and labor, while secondary effects include subsequent spending in the community. The economic multiplier effect due to the increased spending by the direct and indirect labor force created as a result of the construction and operation of the nuclear reactor unit would increase economic activity in the region, most noticeably in Callaway County with lesser, but noticeable, effects in Boone and Cole Counties.

Given concerns in the State of Missouri about climate change and carbon emissions, Callaway Plant Unit 2 serves an important environmental benefit need by reducing carbon emissions in the State. Upon operation, Callaway Plant Unit 2 would produce significantly lower carbon emissions compared to a coal-fired generating plant of comparable size. Several studies of life cycle emissions of nuclear power plants compared with other energy generating technologies have been performed. Life cycle emissions include those associated with the uranium fuel cycle, construction, operation, and decommissioning of the plant. The results of these studies estimate life cycle carbon dioxide emissions from a nuclear power plant ranging from 0.7 percent to 3.1 percent of the carbon dioxide emissions from a coal fired plant of comparable size, and comparable to those of a hydroelectric plant. (Paul J. Meier, 2002; Frans H. Koch, 2000;

AEA Technology, 2005). The costs of climate change, which have been quantified, will have a significant impact on the global and national economies.

10.4.2 COSTS

This section summarizes estimated costs for construction and operation of Callaway Plant Unit 2. The information provided in this section was prepared in accordance with the guidance provided in NUREG-1555 (NRC, 1999), ESRP 10.4.2. The discussion below provides sufficient economic information to assess and predict costs and benefits.

Table 10.4-1 summarizes the benefits and costs of the action. Section 10.5 summarizes the potential cumulative adverse environmental impacts at the project site.

10.4.2.1 Monetary - Construction

The phrase commonly used to describe the monetary cost of constructing a nuclear plant is "overnight capital cost." The capital costs are those incurred during construction, when the actual outlays for equipment and construction and engineering are expended; in other words, the cost resulting if one were to pay for 100% of the plant "overnight". Overnight costs are:

- expressed as a constant dollar amount versus actual nominal dollars,
- expressed in $/kW, and
- for the nuclear industry, the overnight capital cost does not include inflation, financing, extraordinary site costs, licensing, transmission or the initial fuel load.

The overnight capital cost for Callaway Plant Unit 2 is estimated to be $2,692/kW (2007 dollars). This is the unlevelized capital cost for Callaway Plant Unit 2. Since Callaway Plant Unit 2 will have a net electrical output of approximately 1,600 megawatts electric (MWe), the cost of construction is estimated to be $4,307 million.

10.4.2.2 Monetary - Operation

Operation costs are frequently expressed as the levelized cost of electricity, which is the price at the busbar needed to cover operating costs and annualized capital costs. Overnight capital costs account for a third of the levelized cost, and interest costs on the overnight costs account for another 25% (UC, 2004). At this time, levelized cost estimates ranging from $31 to $46 per MWh ($0.031 to $0.046 per kWh) has been selected. Factors affecting the range include choices for discount rate, construction duration, plant life span, capacity factor, cost of debt and equity and split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty.

Estimates include decommissioning but, because of the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the levelized cost. In addition, the Energy Policy Act of 2005 instituted a production tax credit for the first advanced reactors brought on line in the U.S. (PL, 2005) that would tend to lower this estimate.

10.4.3 SUMMARY

Table 10.4-1 summarizes the benefits and costs associated with the construction and operation of Callaway Plant Unit 2. Costs that are environmental impacts are those anticipated after

minimization measures are implemented. Section 10.5 addresses the environmental costs and cumulative impacts.

10.4.4 REFERENCES

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Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Construction Cost	It is anticipated that Callaway Plant Unit 2 will have a net electrical output of approximately 1,600 MWe. Using the value of [$2,692] per kW results in a Callaway Plant Unit 2 construction cost of approximately [$4,307 million].	It is anticipated that the installed reactor will be similar to Callaway Plant Unit 2 (net electrical output of approximately 1,600 MWe. Using the value of [$2,692] per kW results in a construction cost of approximately [$4,307 million].	It is anticipated that the installed reactor will be similar to Callaway Plant Unit 2 (net electrical output of approximately 1,600 MWe. Using the value of [$2,692] per kW results in a construction cost of approximately [$4,307 million].	It is anticipated that the installed reactor will be similar to Callaway Plant Unit 2 (net electrical output of approximately 1,600 MWe. Using the value of [$2,692] per kW results in a construction cost of approximately [$4,307 million]	It is anticipated that the installed reactor will be similar to the Callaway Plant Unit 2 (net electrical output of approximately 1,600 MWe. Using the value of [$2,692] per kW results in a construction cost of approximately [$4,307 million]
Operating Cost	$0.031 to $0.046 per kilowatt-hour	$0.031 to $0.046 per kilowatt-hour	$0.031 to $0.046 per kilowatt-hour	$0.031 to $0.0 46 per kilowatt-hour	$0.031 to $0.046 per kilowatt-hour
Land	The Callaway Plant site area is 2,765 acres (1,119 hectares). Co-located on the Callaway Plant site with Callaway Plant Unit 1. Impact on land use is minimal compared to a new site. SMALL	The site area is approximately 1,300 acres (526 hectares), Up to 500 acres (202 hectares) of land will be cleared, graded, and modified to accommodate construction and operation. New infrastructure required to gain site access and for transmission system MODERATE to LARGE	The site area is estimated to be approximately 850 acres (344 hectares), Up to 500 acres (202 hectares) of land will be cleared, graded, and modified to accommodate construction and operation. New infrastructure required to gain site access and for transmission system MODERATE to LARGE	Assumes that a minimum of 500 acres (202 hectares) of land in Osage County is necessary for siting the nuclear plant. Would include land currently used for power generation. The existing plant would be replaced by the nuclear unit. Impact on land use is minimal compared to Greenfield site. MODERATE	Existing site consists of 262 acres (106 hectares) in Lincoln County. Additional land would be acquired to make up the balance of a minimum 500 acre (202 hectare) site required to host a nuclear plant. Assumes that the existing limestone quarry will be closed and replaced by the nuclear power plant. Adjacent residential, commercial and agricultural land will be cleared to make way for the nuclear plant. LARGE
Labor	Add 363 direct new jobs, 202 indirect new jobs to the benefits. SMALL	It is assumed that similar size workforce to that which is presently required to operate Callaway Plant Unit 1 (860 new jobs) will be required. MODERATE (beneficial)	It is assumed that similar size workforce to that which is presently required to operate Callaway Plant Unit 1 (860 new jobs) will be required. MODERATE (beneficial)	It is assumed that similar size workforce to that which is presently required to operate Callaway Plant Unit 1 (860 new jobs) will be required. MODERATE (beneficial)	It is assumed that similar size workforce to that which is presently required to operate Callaway Plant Unit 1 (860 new jobs) will be required. MODERATE (beneficial)

Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Materials	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating material includes uranium	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating material includes uranium	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating material includes uranium	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating material includes uranium	Construction materials include: concrete, aggregate, rebar, conduit, cable, piping, building supplies, and tools. Operating material includes uranium
Equipment	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include all of the necessary components for the facility such as the reactor, turbine, cooling system, water processing/ treatment system, cooling tower, etc.	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include all of the necessary components for the facility such as the reactor, turbine, cooling system, water processing/treatment system, cooling tower, etc.	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include all of the necessary components for the facility such as the reactor, turbine, cooling system, water processing/treatment system, cooling tower, etc.	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include all of the necessary components for the facility such as the reactor, turbine, cooling system, water processing/ treatment system, cooling tower, etc.	Typical construction equipment will include cranes, cement trucks, excavation equipment, dump truck, and graders. Equipment for the new facility would include all of the necessary components for the facility such as the reactor, turbine, cooling system, water processing/treatment system, cooling tower, etc.
Services	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility. Many support services are already in place for Callaway Plant Unit 1.	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.	Support services and supplies would be needed during construction. Security, maintenance, trash removal, and/or landscaping services may be needed during operation of the facility.

Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Water Use	Missouri River/Missouri River Alluvial Aquifer average makeup water demand equals an estimated total 24,160 gpm (91,446 lpm). Average groundwater use is estimated at 103 gpm (390 lpm) for potable use, demineralizer, and fire water makeup. SMALL	Assumed that adequate surface water and ground water resources are available for plant use. SMALL	Assumed that adequate surface water and ground water resources are available for plant use. SMALL	Assumes existing power generating plant will be replaced with the new nuclear unit. Groundwater and surface water resources are abundant and currently used to support power generation. This site may be capable of using a collector well system to provide cooling water makeup and obtain water from the Missouri River/Missouri River Aquifer. SMALL	The Fred Weber Quarry is located in a region of the state identified as having relatively limited surface water and very limited groundwater resources. There are also concerns for water quality and resource protection. Adequate supplies of cooling water are available from the Mississippi River approximately 12 miles (19 km) from the site. It is assumed that it is feasible to obtain water from the Mississippi River, requiring a 12 mile (19 m) conveyance system. Feasibility studies would be performed to evaluate a collector well system and/or use of an aquifer. MODERATE (construction) SMALL (operation)

Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Land Use	Existing Callaway Plant site area is 2,765 acres (1,119 hectares) Co-located on the Callaway Plant site with Callaway Plant Unit 1. Impact on land use is minimal compared to new site. SMALL	Site is located in a sparsely populated area. The site area is approximately 1,300 acres (526 hectares), The land is currently undeveloped. Half the site is classified as "Farmland of statewide importance" and half the site as "prime farmland if drained" No state zoning, land use, farmland preservation plans, regulations, or county or local zoning ordinances restricting that restricting development as a power plant. The impact on land use in this area would be LARGE.	The site is located in a sparsely populated area. The site area is estimated to be approximately 850 acres (344 hectares), requiring purchase. The land to be acquired is currently undeveloped. A farm is located on the property. Approximately half of the site is classified as "not prime farmland," a quarter as "farmland of statewide importance," and the remaining quarter as "all areas are prime farmland". There are no state zoning, land use, farmland preservation plans, regulations, or county or local zoning ordinances that would restrict development as a power plant. The impact on land use in this area would be LARGE.	Would be necessary to purchase at least 300 acres (121 hectares) of land. May require relocation of adjoining commercial and residential establishments. May impact land classified as prime farmland if drained. No barge off-loading facility is located at the site. Union Pacific operates adjacent rail line. MODERATE to LARGE	At least 258 acres (100 hectares) of land would be acquired to accommodate a nuclear power plant on the existing site. Impact on land use includes replacing the quarry with a nuclear power plant, clearing agricultural, residential, and commercial land and converting it for use in power generation LARGE

Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Air Quality	Callaway County is in attainment with all National Ambient Air Quality Standards. Based on the design of the new reactor, siting the unit at this location would have a small impact on air quality. SMALL	Cooper County's status for all National Ambient Air Quality Standards regulated air quality pollutants is designated as in-attainment. Construction activities may result in increased fugitive dust emissions generated by earth moving and material handling activities. An increase in vehicle emissions will result from heavy equipment and engine-driven equipment. Painting, coating, and similar operations will also generate emissions from the use of volatile organic compounds. Construction would have a SMALL temporary impact on air quality and a SMALL impact on air quality during operation.	Lincoln County's status for all National Ambient Air Quality Standards. Construction activities may result in increased fugitive dust emissions generated by earth moving and material handling activities. An increase in vehicle emissions will result from heavy equipment and engine-driven equipment. Painting, coating, and similar operations will also generate emissions from the use of volatile organic compounds. Construction would have a SMALL temporary impact on air quality and a SMALL impact on air quality during operation.	Osage County is in attainment with all National Ambient Air Quality Standards. Adjacent Gasconade County is subject to NO_X limitations. Air quality impacts during construction and operation are similar to other sites. SMALL The site will have a MODERATE beneficial impact in the non-attainment counties to the east leading to an overall beneficial impact.	Lincoln County is in attainment with all National Ambient Air Quality Standards. Adjacent St. Charles County is subject to NO_X limitations. Air quality impacts during construction and operation are similar to other sites. Operation of the nuclear power plant will result in a reduction of overall particulate emissions. The overall impact on air quality is expected to be beneficial. SMALL

Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Terrestrial Biology	Outside the previously disturbed area, the Callaway Plant site is a combination of forest, grassland, and cropland. Approximately 6,600 acres ((2,671 hectares) of AmerenUE owned property is managed by the Missouri Department of Conservation in accordance with an agreement with AmerenUE and is accessible by the public for recreational use. SMALL	There are no Special State Concern wetlands, Federally designated Wilderness Areas, Wildlife Preserves, Sanctuaries, Refuges, National Forests, agricultural preservation lands, or forest legacy lands known to be in the site vicinity. No known state or federally listed species or sensitive habitats are known to be located in the immediate vicinity of the site. The U.S. EPA lists two federally listed species on the Endangered Species Protection Program Database for Cooper County: the Pallid sturgeon and the Topeka shiner. Because the new nuclear plant would be located at a previously undeveloped site, much of the pristine wildlife habitat area would need to be cleared and developed. The impacts to the terrestrial ecosystem at the site would therefore be LARGE and would occur predominantly during the construction of the plant. Construction Best Management Practices would be followed to minimize these impacts.	There are no Special State Concern wetlands, Federally designated Wilderness Areas, Wildlife Preserves, Sanctuaries, Refuges, National Forests, agricultural preservation lands, or forest legacy lands known to be in the site vicinity. No known state or federally listed species or sensitive habitats are known to be located in the immediate vicinity. The U.S. EPA lists four federally listed species on the Endangered Species Protection Program Database for Lincoln County. Because the nuclear power plant would be located at a previously undeveloped site, much of the pristine wildlife habitat area would need to be cleared and developed. The impacts to the terrestrial ecosystem at the site would therefore be LARGE Occuring predominantly during construction Best Management Practices would be followed to minimize these impacts.	No known Federal or State listed species or sensitive habitats are located in the immediate site area. Little wildlife habitat area would need to be cleared and developed, because the new nuclear plant would replace the existing coal fired plant, while the land to be acquired is already developed commercially or agriculturally. SMALL	No known Federal or State listed species or sensitive habitats are located in the immediate site area. The geographical subsection including the site has 116 records of 53 state-listed rare or endangered species, three of which are unique to this subsection. However, little or no additional pristine wildlife habitat would be cleared and developed. Construction impacts will be minimized by implementing Best Management Practices. SMALL

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Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Aquatic Biology	Testing carried out in 2007 confirms the feasibility of using subsurface collector wells to provide the necessary makeup water thereby eliminating the potential for impact and entrainment of aquatic organisms. Mitigation/monitoring with applicable federal, state, and local permitting regulatory entities will occur during construction and operation. SMALL	The U.S. Fish and Wildlife Service identifies 80 palustrine mapped wetland units within a 1-mile (1.6-km) radius of the approximate center of the site. No known state or federally listed aquatic species occur at the site; The U.S. EPA lists the Topeka shiner and the pallid sturgeon fish on the Endangered Species Program Database for Cooper County. An exceptionally high number of state-listed species are associated with the streams of this ecological region. The site is expected to use a Collector Well Intake System to avoid cooling water impingement or entrainment. Site development may impact wetlands in the area. The impact of plant construction on the aquatic ecology is estimated to be MODERATE during construction and SMALL during operation. Impacts as a result of the discharge of cooling water to the Missouri River would be similar to that for the proposed site and would l be SMALL and would comply with permits.	The U.S. Fish and Wildlife Service National Wetlands Inventory Auburn Map identifies fifteen palustrine mapped wetland units within a 1-mile (1.6-km) radius of the approximate center of the site. No known state or federally listed aquatic species occur at the site; however, the U.S. EPA lists scaleshell, Curtis' pearly mussels, pink mucket clams, and pallid sturgeon fish on the Endangered Species Protection Program Database for Lincoln Count. An exceptionally high number of state-listed species are associated with the streams of this ecological region, The site is expected to use a Collector Well Intake System to avoid cooling water impingement or entrainment. Development of the site may impact wetlands in the area. Therefore, the impact of plant construction on the aquatic ecology is estimated to be MODERATE during construction and SMALL during operation. The thermal impacts from operation resulting from cooling water discharge to the Mississippi River is similar to that for the proposed site and would likely be SMALL due to distance from the river and would comply with permits.	No known State or Federally listed threatened or endangered aquatic species in the vicinity of the Chamois site. Because the site is already used for power generation, the impacts of a plant conversion on the aquatic ecology would be temporary. Mitigation/monitoring with applicable federal, state, and local permitting regulatory entities will occur during construction and operation. A collector well system would likely be feasible. SMALL.	No known State or Federally listed threatened or endangered aquatic species occur on the site; however the EPA lists four aquatic species as being present in Lincoln County. MDC lists an exceptionally high number of state-listed species associated with the streams of this ecological region. This assessment assumes that implementation of Best Management Practices during construction and compliance with permit conditions during operation will mitigate potential adverse impacts. SMALL

Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Socio-economic	40,800 Callaway County population (2000 census). $39,100 median household income SMALL The effect of the additional taxes to Callaway County will be LARGE and beneficial.	16,670 Cooper County Population (2000 census). $37,300 median household income The effect of the proposed new facility on the population and demographics of Cooper County, Missouri, is expected to be LARGE and beneficial due to the increases in jobs and taxes for the county.	38,944 Lincoln County population (2000 census) $48,200 median household income Addition of a nuclear power plant would substantially increase the population, real estate prices, and tax base. LARGE (beneficial)	13,100 Osage County population (2000 census) $42,500 median household income Addition of a nuclear power plant would substantially increase the population, real estate prices, and tax base. LARGE (beneficial)	38,944 Lincoln County population (2000 census) $48,200 median household income Addition of a nuclear power plant would substantially increase the population, real estate prices, and tax base. LARGE (beneficial)
Housing	Not anticipated to have negative impact on availability of housing units in the area during construction SMALL	Largely Rural area surrounding proposed site with minimal local infrastructure. Limited availability of temporary or permanent housing for workers. Negative impact on availability of housing for both construction and operations work force. MODERATE to LARGE	Largely Rural area surrounding proposed site with minimal local infrastructure. Limited availability of temporary or permanent housing for workers. Negative impact on availability of housing for both construction and operations work force. MODERATE to LARGE	May be short term negative impact on availability of housing units in the area during construction. Existing power plant operators may be available as the work force for the new nuclear plant. SMALL	May be short term negative impact on availability of housing units in the area during construction SMALL
Local Infrastructure	Increased traffic at beginning and end of shifts may increase traffic on highways to and from plant. Little impact on availability of services; Callaway Plant Unit 2 will be built and operated in a rural area with low population density. SMALL to MODERATE	Plant site is rural and undeveloped. Increased traffic at beginning and end of shifts may increase traffic on highways to and from plant. Potentially significant impact on availability of services until region grows in response to plant's contribution to local economy. MODERATE to LARGE	Plant site is rural and undeveloped. Increased traffic at beginning and end of shifts may increase traffic on highways to and from plant. Potentially significant impact on availability of services until region grows in response to plant's contribution to local economy. MODERATE to LARGE	Increased traffic at beginning and end of shifts expected to increase traffic on highways to and from plant, particularly during construction. Mitigation measures include staggering shifts, ride sharing, and multi-person transport (buses). SMALL to MODERATE (construction), SMALL (operations)	Increased traffic at beginning and end of shifts expected to increase traffic on highways to and from plant, particularly during construction. Mitigation measures include staggering shifts, ride sharing, and multi-person transport (buses). SMALL to MODERATE (construction), SMALL (operations)
Radiological Heath	Radiological exposure below limits to workers and public SMALL	Radiological exposure below limits to workers and public SMALL	Radiological exposure below limits to workers and public SMALL	Radiological exposure below limits to workers and public SMALL	Radiological exposure below limits to workers and public SMALL

Table 10.4-1—Benefit and Costs of the Proposed Project Summarized

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Cost Category	Callaway Plant Site	Lamine Greenfield Site	Paynesville Greenfield Site	Chamois Generating Station Site	Fred Weber Quarry Site
Loss of resources	Loss of resources is discussed in Section 10.1 through 10.3. It is expected that losses will be mitigated to minimize the impact of the loss. SMALL	Loss of resources is expected to be similar to that discussed in Section 10.1 through 10.3. It is expected that losses will be permanent and unavoidable. New construction impact on undeveloped property resources would be higher than on existing site or brownfiled site. MODERATE to LARGE	Loss of resources is expected to be similar to that discussed in Section 10.1 through 10.3. It is expected that losses will be permanent and unavoidable. New construction impact on undeveloped property resources would be higher than on existing site or brownfiled site. MODERATE to LARGE	Loss of resources is expected to be similar to that discussed in Section 10.1 through 10.33. It is expected that losses will be mitigated to minimize the impact of the loss. SMALL	Loss of resources is expected to be similar to that discussed in Section 10.1 through 10.3. It is expected that losses will be mitigated to minimize the impact of the loss. SMALL
Measures and Controls to reduce environmental impact	Costs associated with mitigation will be small, since this unit will be built on an existing nuclear site. Existing mitigation and environmental monitoring programs will be expanded as necessary to account for the new unit. Construction and operational impacts are expected to be small. SMALL	Use of good best management practice and engineering controls will reduce potential impact. Costs associated with mitigation will be more significant at an undeveloped site built on previously undisturbed land. Mitigation and environmental monitoring programs will be developed during engineering design. MODERATE to LARGE	Use of good best management practice and engineering controls will reduce potential impact. Costs associated with mitigation will be more significant at an undeveloped site built on previously undisturbed land. Mitigation and environmental monitoring programs will be developed during engineering design. MODERATE to LARGE	Costs associated with mitigation will be small, since this unit will be built on an existing power generation site. Existing mitigation and environmental monitoring programs will be modified as necessary to account for the new unit in place of the existing coal fired plant. Construction and operational impacts are expected to be small. SMALL	Costs associated with mitigation will be small, since this unit will be built on a previously developed site. Additional land will be acquired, cleared, and developed to support nuclear plant siting needs. Site specific mitigation and environmental monitoring programs will be developed to account for the new unit. Construction and operational impacts are expected to be small. SMALL

10.5 CUMULATIVE IMPACTS

Section 10.1 through 10.3 summarize the adverse environmental impacts from construction and operation of Callaway Plant Unit 2 that are potentially unavoidable, irreversible or irretrievable. Measures to minimize these impacts are also discussed. Section 10.4 compares the environmental and economic costs and benefits of the facility. This section summarizes the potential cumulative adverse environmental impacts to the Callaway region. Cumulative impacts include those that are incremental to past and ongoing activities on the site, along with those that are reasonably foreseeable in the future.

This evaluation of cumulative impacts is based on a comparison between the existing environmental conditions presented in Chapter 2 and the potential adverse environmental impacts of construction and operation detailed in Chapter 4 and Chapter 5, respectively. The evaluation also considers continued operation and license renewal of Callaway Plant Unit 1.

Callaway Plant Unit 2 will be co-located on the existing nuclear power plant site currently occupied by Callaway Plant Unit 1. Callaway Plant Unit 1 occupies approximately 160 acres (65 hectares) permanently committed to plant structures, switchyard, and infrastructure, while Callaway Plant Unit 2 construction is expected to utilize 195 acres (79 hectares) permanently committed to plant structures, switchyard, and infrastructure.

The Callaway site is located in Callaway County, Missouri, approximately 10 miles (16 km) southeast of Fulton and 80 miles (129 km) west of the St. Louis metropolitan area. The Missouri River flows in an easterly direction approximately 5 miles (8 km) south of the site at its closest point. The elevations of 530 ft (162 m) above mean sea level (msl) on the north and south sides of the river define the Missouri River floodplain, which is about 2.4 miles (3.9 km) wide in this area.

The Callaway site is situated in an area of gently rolling upland, once part of an old glacial till plain. Erosion and downcutting of the Missouri River and its tributary streams have dissected the plain, leaving a nearly isolated plateau of approximately 8 sq miles (21 sq. km). The plateau has a maximum elevation of 858 ft (262 m) msl. The overall drop in elevation between the crest of the plateau and the Missouri River is about 340 ft (104 m).

Surface drainage to the east and northeast is to Logan Creek. Mud Creek is a major drainage way from the south and southwestern side of the site. Auxvasse Creek, a major tributary to the Missouri River located about 2 miles (3.2 km) west of the site area, intercepts surface drainage from the western and northern flanks of the plateau.

AmerenUE owned property includes the 2,765 acre (1,119 hectares) Callaway site area, a peripheral area surrounding the Callaway site area of 2,454 acres (993 hectares), and the approximately 2,135 acre (864 hectares) corridor area, which contains the water intake and blowdown lines and provides road access to the river. The collector well river intake system, including the collector wells and associated Pumphouse, piping and access roads will occupy an additional 115 acres (47 hectares) on the north shore of the river at river mile 117 (188 km).

The 50 mile (80 km) radius surrounding the site includes all or parts of 22 counties in the State of Missouri.

Dominant existing land uses within 8 miles (13 km) of the Callaway site include grassland (17.1%), deciduous forest (53.0%), and cropland (17.1%). This is reflective of the regional land use within a 50 mile (80 km) radius of the Callaway site (32.2% grassland, 34.5% deciduous forest, and 24.2% cropland).

10.5.1 CUMULATIVE IMPACTS FROM CONSTRUCTION

Construction impacts associated with Callaway Plant Unit 2 include grading and clearing, allocation of land to material lay-down and parking, use of ground and surface waters, equipment noise and emissions, increased traffic and use of public resources. These activities are consistent with those conducted during the construction of Callaway Plant Unit 1. Many of the impacts will be temporary and most can be minimizes through the use of best management construction practices and stormwater pollution prevention planning required under State and Federal regulation.

Groundwater is utilized by Callaway Plant Unit 1 for domestic, plant demineralized, and fire water needs.

Additional impacts on wetlands, surface waters and groundwater resources may occur due to filling and grading, excavation or other activities that change flow patterns such as construction of stormwater runoff ponds, and facilities to receive construction related wastes. It is anticipated that several streams and impoundments will be affected by these activities. Environmental controls will conform to applicable regulations to minimize these effects. Efforts will be undertaken to reclaim areas or provide offsetting habitat for areas not occupied by permanent facilities per Section 4.1.

AmerenUE owned land outside the owner controlled area is accessible by the public subject to use restrictions, including approximately 6,600 acres (2,671 hectares) of the 7,354 acre (2,976 hectare) AmerenUE property. This property, known as the Reform Conservation Area, is managed by the Missouri Department of Conservation (MDC) in accordance with a Management Agreement for the Public Use of Lands (Ameren, 2007A). The agreement allows public recreational use on designated lands within the AmerenUE property boundaries; however, camping and use of firearms (firing a single projectile) are not permitted. The Reform Conservation Area may be closed to the public when the National Security Level reaches "orange" or higher (MDC, 2006).

Seasonal field surveys of the site were undertaken in 2007 to identify important terrestrial species and habitats so that construction planning can include the means to limit encroachment on these areas. A list of the important terrestrial species and habitats identified during the surveys are provided in Table 2.4-2. Important terrestrial species identified include the white tailed deer (important game species), and the Gray and Indiana bats (Federal and State endangered). While no bat surveys were conducted as part of the 2007 field survey, the Gray and Indiana bats have been historically observed in the area and suitable habitat is present. Important bird species identified include three game species (Northern Bobwhite, Mourning Dove and Wild Turkey) and two State Endangered species (Northern Harrier and Bald eagle. No rare, threatened or endangered plant or herpetological species were identified during the field surveys. Two important species, the Ruffed Grouse and the Long-Tailed Weasel were found on site during the 1973 baseline survey, but not in subsequent 1974 and 1975 surveys. Neither of these species was identified in the 2007 surveys.

Similar field surveys were conducted in the rivers, streams, and storm water collection ponds in the area of the site to identify important aquatic species. A list of rare, threatened, and endangered aquatic species historically recorded in rivers and streams in Callaway and Osage Counties appears in Table 2.4-1. One of eight site storm water collection ponds and two drainage pathways will be lost during site preparation activities. Surface water runoff ditches and storm water collection ponds will be constructed to manage storm water during construction. Other construction activities that may affect these natural resources, such as

erosion and waste water discharge, will be managed using best management practices in conformance with applicable State and Federal permits and regulations.

Wetlands at the Callaway site were delineated within the construction zones for Callaway Plant Unit 2, the transmission line, and collector well river intake system in the floodplain of the Missouri River. Jurisdictional wetlands on site are included within the Woody-Dominated Wetland and Herbaceous-Dominated Wetland land cover types. As noted above, modifications will be required to the storm water drainage in the laydown area, including the construction of two new storm water runoff ponds to manage storm water runoff. Mitigating wetlands lost to Callaway Plant Unit 2 site development, including any lost to the construction of the collector well river intake system, will be performed as provided for in agreements with the State of Missouri and the U.S. Army Corps of Engineers (USACE). Any monitoring required during site preparation and construction will follow guidelines developed by the USACE in accordance with conditions specified in required permits. Because of the preventive measures and corrective actions identified above and the short-term nature of construction activities, the cumulative impact on surface and groundwater from Callaway Plant Unit 2 construction in conjunction with the continued operation of Callaway Plant Unit 1 should be SMALL. Impacts to wetlands are judged to be MODERATE, but will be offset through the implementation of corrective measures. By widening the existing offsite transmission right-of-way the amount of land and related natural resources potentially impacted by construction will be minimized.

Several archaeological and architectural surveys have been conducted within the Callaway site over the last twenty five years. Most of the archaeological resources identified on the Callaway site are the result of a 1981 survey which surveyed a total of 5,848 acres (2,367 hectares). As a result of these surveys, a total of 19 sites were identifies as potentially eligible for listing on the National Register of Historic Places and one site is listed on the National Register of Historic Places. All are located at least one mile (1.6 km) from the Callaway Plant Unit 1 cooling tower and are expected to be outside any area to be disturbed by construction. No architectural sites listed or potentially eligible for listing on the National Register of Historic Places were identified on the Callaway site. There is a probability that undiscovered cultural resources are present in the Missouri River floodplain in the area where the collector well feasibility study was conducted in 2007 and where collector well river intake system construction will take place. A Cultural Resources Discovery Plan was prepared, approved by the SHPO, and implemented during installation of test wells and observation wells for the collector well feasibility study. The existing Cultural resources Discovery Plan will be modified as necessary and used to monitor the construction of the permanent collector well river intake system.

No impacts to the Missouri River or aquatic ecology are expected as a result of the construction of the collector well cooling water intake system. Construction activities associated with the collector well river intake system will be carried out on-shore within the Missouri River floodplain. No changes to the discharge structure are required to support Callaway Plant Unit 2.

Dredging of the areas approaching the existing barge dock, if required, may create some suspended sediment and removal of benthic substrate. Activities in navigable waters will conform to applicable State of Missouri and U.S. Army Corps of Engineers regulations.

Potential adverse cumulative impacts to public health and well-being stem from construction related noise, increased vehicular traffic, aesthetics, and emissions. Noise levels will increase during construction with operation of heavy equipment and vehicles. The State of Missouri has not established maximum decibel levels beyond those established for occupational exposure. Estimated noise levels that may occur during construction indicate that due to distance, topography and surrounding forest, levels at the site boundary are expected to meet day-night

noise levels less than 65 dBA at the site boundary, which is considered to be of small significance to the public (NRC, 1996). For onsite workers, it will be necessary to meet Occupational Safety and Health Administration (OSHA) exposure limits through training and use of personal protective equipment. Cumulative impacts are not expected as construction related noise will cease upon completion of the construction activities.

Traffic will increase during construction as workers commute from within and outside Callaway County. The local county roads will experience additional traffic during shift change over. A traffic management plan will be developed in order to minimize traffic related impacts. The Callaway Plant Unit 1 employee access road will be relocated on County Route 459 and access to a new construction contractor parking area will be connected to County Routes 428 and 459 and an access road from County Route 448. No further modifications to the roads will be necessary to support Callaway Plant Unit 2 operation when the number of workers is dramatically reduced. Heavy equipment and plant components will be barged in and taken to the construction area using the heavy haul road (County Route 459) originally built for that purpose during the construction of Callaway Plant Unit 1, thereby avoiding temporary blockage of major State and County roads. Use of the barge slip for delivery of heavy equipment, use of the heavy haul road, and the decrease in workers following construction will limit cumulative impacts of traffic.

Dust, engine exhaust, and other facility operations will result in construction related emissions. Protective actions will be required to ensure that applicable ambient air quality and hazardous pollutant regulations are met. Permits will be obtained as necessary and construction practices, such as dust control, will be implemented so that cumulative impacts onsite from emissions are limited. These impacts will cease following construction.

Topography of the site and its forest canopy will limit visibility of construction activities. Callaway Plant Unit 1 and Callaway Plant Unit 2 occupy portions of a nearly isolated plateau of approximately 8 sq miles (21 sq km) in extent. The plateau has a maximum elevation of 858 ft (262 m) msl. Topographical relief of about 340 ft (104 m) exists between the plateau and the Missouri River which flows in an easterly direction approximately 5 miles (8 km) south of the site at its closest point.

Socioeconomic benefits accrue from capital expenditures as well as the increased number of jobs created during construction and the resultant additional spending. It is estimated that the peak construction workforce will exceed 3,900 full time equivalents. While it is difficult to predict the number of new jobs created for local county residents, it is clear that spending will augment the regional economy.

For example, it is estimated that for each dollar spent an additional $0.65 of indirect revenue would be generated within the region of influence. However, the extent to which construction workers temporarily relocate to the three county region of influence may place some pressure on the availability of housing and public services.

No disproportionate impact on minority or low income populations is expected from Callaway Plant Unit 2 construction activities. Twenty-three out of a total of 171 census block groups in Callaway, Boone, and Cole Counties contained aggregate (total) minority populations. These census block groups are concentrated in or near the major population centers of Fulton (Callaway County), Columbia (Boone County), and Jefferson City (Cole County). In similar fashion, 21 of the 171 census block groups in the three-county Region of Influence contain low income populations. These also are concentrated in or near the major population centers.

Construction workers onsite will receive some radiation dose from the continued operation of Callaway Plant Unit 1. Doses were calculated based on exposure to direct radiation, gaseous effluents, and liquid effluents. Total collective dose during the construction period from all onsite sources is calculated to be approximately 1.8 person-rem (0.018 person-Sieverts). The annual maximum dose was calculated to be 0.209 mrem/yr (0.002009 person-Sieverts/yr) compared to the public dose criteria of 100 mrem/yr year (1,000 µSv/yr).

In summary, the construction of Callaway Plant Unit 2 will not result in long-term cumulative impacts that are inconsistent with existing land use. Activities that occur during construction will be minimized using best management practices and compliance with applicable regulations to limit both short-term and long-term adverse impacts. Furthermore, impacts will cease following completion of Callaway Plant Unit 2 construction and efforts made to reclaim those areas not required for operations.

10.5.2 CUMULATIVE IMPACTS OF OPERATIONS

Potential cumulative adverse impacts from operations include the withdrawal of water from the Missouri River/Missouri River Alluvial Aquifer (Aquifer), discharge of cooling tower blowdown, radiological dose consequences, waste generation, noise changes and socioeconomic changes. Each of these potential impacts is discussed below.

Callaway Plant Unit 2 will utilize closed-cycle cooling, similar to Callaway Plant Unit 1. The CWS cooling towers are circular, wet type, natural draft towers with drift eliminators, and are approximately 550 ft (168 m) high. It is estimated that the Callaway Plant Unit 2 CWS will require approximately 22,300 gpm (84,300 lpm) on average to replace evaporative loss, drift, and blowdown from the two natural draft cooling towers. Blowdown from the CWS to the Missouri River will average approximately 4,700 gpm (17,600 lpm). Maximum CWS cooling water makeup demand is approximately 29,900 gpm (113,100 lpm).

The ESWS will utilize closed-cycle cooling, and will have 4 mechanical draft cooling towers. Each ESWS cooling tower will be a rectilinear structure, 96 ft (29 m) high, by 60 ft (18.3 m) long, by 60 ft (18.3 m) wide. The ESWS cooling towers will typically be supplied with makeup water from the Aquifer. Makeup flow to the ESWS cooling towers during normal operations will be approximately 1,880 gpm (7,100 lpm). Blowdown from the ESWS cooling towers of approximately 940 gpm (3,600 lpm) will be combined with the blowdown from the CWS cooling towers and routed to the Missouri River. Maximum ESWS cooling water makeup demand is approximately 3,800 gpm (14,200 lpm).

Physical impacts of cooling system water withdrawal may include alteration of local hydrology in the immediate vicinity of the collector well river intake system intakes. Hydrodynamic modeling based on the results of the collector well feasibility study conducted during the summer of 2007 concluded that multiple collector wells spaced approximately 1500 ft (460 m) apart will be capable of supplying the combined water needs of Callaway Plant Units 1 and 2. With screened laterals installed at least 80 ft (24 m) below ground surface, it is estimated that 85% of the water will be supplied from the Missouri River and 15% will be supplied from the Missouri River Alluvial Aquifer. Since the amount of cooling water to be withdrawn by the collector well river intake system for use by Callaway Plant Unit 2 represents less than one half of one percent of the seven day average low flow of the Missouri River, there should be no adverse impact to the local hydrology.

Aquatic impacts attributable to the operation of the Callaway Plant Unit 1 intake structure due to impingement of organisms and entrainment of fish and invertebrate eggs and larvae within the cooling system will be eliminated by replacing the current intake with a collector well river

intake system designed to satisfy the combined needs of the existing Callaway Plant Unit 1 and Callaway Plant Unit 2. Blowdown from the cooling towers is returned to the Missouri River through a submerged discharge pipe equipped with a Tide Flex back flow preventer. The temperature of this discharge will be above ambient creating a thermal plume. Modeling of this plume shows that its size and distribution will meet Missouri State ambient water quality criteria for the protection of aquatic life beyond the limits of a mixing zone covering no more than 4.1% of the width of the river, within the maximum permissible extent of 25% of the width of the receiving stream and is unlikely to cause impacts to aquatic benthos or motile organisms migrating through the area.

Included in the blowdown discharge are chemicals used in biocide treatment and in plant process control. The concentrations discharged will be in conformance with National Pollutant Discharge Elimination System (NPDES) permit conditions and applicable water quality criteria. The discharge will also contain small quantities of radioactive liquids discharged from the Liquid Radioactive Waste Treatment System. Concentrations of radioactive materials will be limited by applicable NRC regulations.

Excess heat within the CWS will be dissipated to the environment using two natural draft cooling towers with drift eliminators installed. A visible plume is created when a portion of the cooling water evaporates as it leaves the tower and undergoes partial condensation. Potential impacts from the resulting plume include fogging, icing, and water and solids deposition. The extent of these impacts was simulated using predictive models. The plume length varies with season, being larger in winter.

The average plume length would range from 0.36 miles (0.6 km) in the summer season to 2.6 miles (4.2 km) in the winter season. The annual prediction for average plume length would be 1.2 miles (2.0 km). The annual median plume length is 0.34 miles (0.56 km). The median plume length is not expected to reach the site boundary. Ground level fogging from natural draft cooling towers does not occur because the visible plume rises well above the cooling tower exit at 550 ft (170 m) and does not intersect with the ground. Similarly, icing on the ground or structures from natural draft cooling towers does not occur because of the very high elevation of the moisture being released from the tower. The relatively small size of the four ESWS towers is not expected to contribute to offsite impacts.

Salt deposition from the CWS cooling tower operations will occur as the makeup water contains dissolved solids in low concentrations. The extent of deposition will be limited through installation of drift eliminators that restrict the amount and size of water particles released from the tower. Model predictions indicate that the maximum salt deposition from the CWS cooling towers is expected to be below NUREG-1555 (NRC, 1999) significance levels for possible vegetation damage.

Cloud shadowing is predicted to occur for 100 hours per year in the highest direction to a distance of about 2.0 miles (3.2 km). The tower would produce a small fraction of an inch of precipitation per month during each of the seasons at the peak location. Increases in the ground level relative humidity from the operation of the cooling towers would not be noticeable.

While the cooling towers installed and operated as part of the Callaway Plant Unit 2 closed-cycle cooling water system will create a visible plume, the cumulative physical offsite impact is not expected to be significant.

Elevated temperatures within cooling tower systems are known to promote the growth of thermophilic bacteria such as Legionella sp., amoeba such as Naegleria sp., and fungi. Thermophilic organisms are typically associated with freshwater and the Nuclear Regulatory Commission (NRC) has linked health issues to power plants that use cooling ponds, lakes and canals, and that discharge to small rivers. Makeup water for the CWS and ESWS towers will be treated with a biocide. Further biocidal treatment of elevated temperature circulating water in the cooling towers will prevent the growth of thermophilic organisms in the CWS and ESWS. As a result, thermophilic organisms are not expected to create a public health concern. Makeup water for the ESWS cooling towers will be supplied from the Aquifer by the collector well river intake system. Biocide treatment will limit the propagation and dispersal of thermophilic organisms in this system including the four mechanical ESWS cooling towers. Blowdown will combine with the discharge of the CWS cooling towers prior to its discharge to the Missouri River.

Cumulative impacts on land use and the terrestrial environment are expected to be minimal given that the final footprint of the Callaway Plant Unit 2 structures will be permanently established following construction. No new offsite transmission corridors will be required; however, 6.7 miles (10.8 km) of the corridor will be widened by 150 ft (46 m) and new transmission towers and lines installed in the widened corridor. Sensitive onsite species that require protection include the bald eagle and the northern harrier.

No terrestrial vegetative and faunal species that are critical to structure and function have been identified. Approximately 6,600 acres (2,670 hectares) of the 7,354 acre (2,976 hectares) AmerenUE property is managed by the Missouri Department of Conservation (MDC) in accordance with a Management Agreement for the Public Use of Lands (Ameren, 1994). This property, known as the Reform Conservation Area, is accessible by the public for recreational purposes, including hunting and fishing subject to limitations. Implementation of the Stormwater Pollution Prevention Plan will also serve to limit future impacts of erosion and inadvertent releases from industrial activities onsite.

Bird mortality from collision is a concern particularly at sites where tall structures such as natural draft cooling towers extend will beyond the tree canopy. The CWS cooling towers to be installed for Callaway Plant Unit 2 will extend 550 ft (168 m) above ground. Forest interior bird species are expected to avoid the immediate area of the cooling towers as they would not find suitable habitat close to the cooling towers, which will be constructed on a cleared, treeless pad. Lights will be installed on the cooling towers to reduce the probability of collision.

The sources of noise from operations include the switchyard, transformers, cooling towers and traffic. It is expected that noise levels at the site boundary from the new Callaway Plant Unit 2 cooling towers will not exceed levels considered to be of small significance to the public (NRC, 1996). Noise from the new onsite switchyard and transformers and offsite transmission lines will be similar to that currently associated with Callaway Plant Unit 1. Taken together, the additional noise associated with Callaway Plant Unit 2 is not expected to result in an adverse cumulative impact.

Air emissions are limited by U.S. EPA standards and permits as well as by OSHA worker health based standards. The primary sources of operational related emissions are the four emergency diesel engines, two station blackout diesel engines, and diesel engine driven fire water pumps. Periodic testing of the diesels is required to ensure their operability. The diesel engines are designed to meet increasingly stringent emission standards.

Additional emissions reductions from the diesel engines may be achieved through the purchase of low sulfur fuels. Carbon dioxide production will be limited to that small amount attributed to testing of the diesel engines. By contrast, Callaway Plant Unit 2 operation would avoid the emission of approximately 1,908,000 CO2e (CO2 equivalent) from coal combustion and 623,000 CO2e from natural gas combustion that would be produced by an equivalent fossil fuel fired plant.

Exposure of the general public to radiation from the operation of Callaway Plant Unit 2 is a function of meteorology, relative location, population density, land use practices, harvest and consumption of food sources, as well as the allowable radiological release limits. Dose consequences result from liquid and gaseous releases and from direct radiation. Each of these potential pathways has been analyzed to ensure that applicable public health exposure limits are met.

In addition, the potential dose from the operation of Callaway Plant Unit 1 has been combined with that for Callaway Plant Unit 2. Results show that applicable NRC exposure limits are met, and that while there are dose consequences resulting from operation of Callaway Plant Unit 2, exposure will remain within applicable limits and will not represent an adverse cumulative impact.

Conservative estimates of radiological dose to biota also demonstrate that exposure to key selected species should result in no observable effects. An existing long-term radiological monitoring program will continue to verify that dose consequences to the general public are as low as reasonably achievable (ALARA).

The uranium fuel cycle will contribute to cumulative impacts from fuel production, transportation, storage and disposal. Related environmental impacts are attributed to land and water use, electrical consumption, chemical effluents, radioactive effluents and waste generation. The cumulative impacts from each of these sources has been reviewed based on an NRC mandated comparative assessment detailed in 10 CFR 51.51(a) (CFR, 2007).

Non-radioactive and mixed-wastes will be produced during Callaway Plant Unit 2 operations. Typically these consist of recyclables, solid waste debris, and sewage. Cumulative impacts will be managed through implementation of waste minimization practices including the procurement process, allocation of material for work, storage and recycling. Wastes that can not be recycled will be stored and disposed of in accordance with applicable state and federal hazardous and non-hazardous waste regulations, and at licensed liquid and solid waste disposal locations. Properly sized and designed onsite facilities for storage will be provided and procedures put in place to deal with potential spills and emergency response.

Socioeconomic impacts (benefits) from long-term Callaway Plant Unit 2 operation result from the increased operational work force, facility taxes, and generation of competitively priced electricity. Three hundred sixty three (363) additional employees will be required to support Callaway Plant Unit 2 operations. Most of these employees are expected to reside primarily within Callaway, Boone, and Cole Counties. The Callaway Plant Unit 2 workforce will result in increased indirect employment of approximately 110 jobs or less than 0.5% of the existing three-county work force.

An overall increase in population is expected as families relocate, acquire housing and utilize public services. It is estimated that the additional workforce will increase population within Callaway, Boone, and Cole Counties by approximately 820 people compared to the 2005

population estimate of 258,624 people. An analysis of available housing suggests that adequate supply is currently available to support the influx of operational employees.

Although some existing police, fire, EMS, and school districts are operating at, or near, capacity, operation of Callaway Plant Unit 2 would only add 315 direct and indirect households to the region of influence. Representatives of these agencies have indicated that this limited addition would either have no or small impact and would not require mitigation.

While there will be an overall socioeconomic benefit from the operation of Callaway Plant Unit 2, the cumulative impact, as a percentage, appears to be SMALL. The reported minority and low income populations in the area are concentrated in or near the major population centers of Fulton (Callaway County), Columbia (Boone County), and Jefferson City (Cole County). No disproportionate impact on these groups is expected as a result of Callaway Plant Unit 2 operation.

As described in Section 2.8, two ongoing projects have been identified within the Callaway site area that may contribute to cumulative socioeconomic and environmental impacts. These two projects are directed toward the restoration of the Missouri River and the wildlife habitat it supports. These projects are the Missouri River Mitigation Project and the Big Muddy National Fish and Wildlife Refuge. The projects are managed by the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service, respectively. Each project independently involves the development of multiple units extending over the length of the Missouri River. The operational 423 acre (170 hectares) Tate Island unit of the Missouri River Mitigation Project is located on the left bank of the river in Callaway and Montgomery Counties between river miles 113 (182 km) and 110 (177 km), approximately 2 ½ river miles (4 km) downstream of the Callaway discharge. The 1,124 acre (455 hectares) St. Aubert Island Unit of the Big Muddy National Wildlife Refuge is located in northern Osage County and is accessible to the public only from the River. Using a collector well river intake system for plant makeup water will positively impact these ongoing projects by lessening stresses on the aquatic ecosystem through eliminating potential impingement and entrainment in the intake system.

Two non-Federal projects will provide additional electrical capacity in the Callaway site region. These involve the addition of two landfill gas-to-energy plants by Columbia Water and Light, the municipally owned utility of Columbia. The first of these projects will generate 3.1 MWe of electrical power from landfill gas at the Allied Waste Landfill in Jefferson City. The second project will generate 2.1 MWe of electrical power from landfill gas at the Columbia Landfill (CWL, 2007). These projects implement the 2004 Columbia renewable energy ordinance for the city's power supply portfolio. The ordinance mandates Columbia Water & Light purchase increasing levels of energy from renewable resources starting in 2008. The cumulative impacts of these projects should be small.

10.5.3 CUMULATIVE IMPACTS SUMMARY

The potential adverse short-term and long-term impacts from the construction and operation of Callaway Plant Unit 2 have been identified and actions to minimize those impacts proposed. Activities to be undertaken during construction and operation of Callaway Plant Unit 2 are consistent with those currently in place for Callaway Plant Unit 1. Except for the portions of the construction footprint related to Callaway Plant Unit 2 facilities laydown areas, contractor parking, widened offsite transmission corridor, and floodplain land devoted to the collector well river intake system, available land use and the terrestrial environment will remain unchanged.

Operation of the new unit will require the use of certain natural resources including water withdrawal from the Aquifer for cooling and will result in the release of process gaseous, liquid and solid wastes, all in conformance with applicable Local, State, and Federal permit requirements and standards. Economic benefits accrue from capital expenditures, additional tax revenue and the jobs created during construction and operation. The environmental assessment demonstrates that cumulative adverse impacts to the vicinity and to the region will be small.

10.5.4 REFERENCES

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CFR, 2007. Title 10, Code of Federal Regulations, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, 2007.

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