5.0 Environmental Consequences

This section describes the potential environmental impacts of implementing the proposed action and the no action alternative.

5.1 Proposed Action

Under the proposed action, impacts could occur from (1) decontamination and decommissioning activities, (2) natural hazards and accidents, and (3) transportation of wastes. Sections 5.1.1 through 5.1.3 discuss the potential impacts that could occur. Section 5.1.4 discusses the potential for other direct, indirect, cumulative, or long-term impacts to occur if the proposed action were implemented. Sections 5.1.5 and 5.1.6 discuss regulatory compliance and pollution prevention efforts under the proposed action.

5.1.1 Decontamination and Decommissioning

This section describes potential impacts to sensitive species, air quality, human health, noise, and waste disposal capacity from decontamination and decommissioning activities. Potential socioeconomic impacts and environmental justice considerations are also addressed.

5.1.1.1 Sensitive Resources

Decontamination and decommissioning activities would occur within Building 335 or immediately outside of the building in previously disturbed areas. For this reason, no impacts would be expected to current land use, biological resources (including sensitive, threatened, or endangered species or their critical habitat), visual resources, wetlands, or floodplains. The proposed action would not affect cultural or archeological resources because Building 335 is not eligible for listing on the National Register of Historic Places and all decontamination and decommissioning activities would be conducted within the area disturbed during the construction of Building 335.

5.1.1.2 Air Quality

Criteria Air Pollutants. The proposed action would result in only minor releases of dust and combustion gases from power equipment.

Hazardous Emissions. Due to the small quantities of hazardous asbestos waste that would be generated, the potential for hazardous emissions to the atmosphere would be extremely small. Any such emissions would be limited to minor amounts of dust containing asbestos. These emissions would be controlled through high-efficiency particulate air (HEPA) filters.

Radioactive Emissions. The potential for radioactive emissions to the atmosphere would be extremely small. Any such emissions would be limited to minor amounts of dust containing radionuclides from the generation of radioactive wastes. These emissions would contain primarily cobalt-60, Europium-152, and Europium-154. These emissions would be controlled through HEPA filters.

5.1.1.3 Human Health (Worker and Public)

Decontamination and decommissioning activities would result in the exposure of workers to radiation and exposure of the public to very small quantities of radioactive materials. This exposure could result in an increased risk of a latent cancer fatality. In addition, workers could suffer fatalities or nonfatal injuries or illnesses as a result of industrial accidents. The discussion below describes the potential for these human health impacts.

Radiological Impacts to Workers. The only radiological effect on non-project workers on the ANL-E site would be from radiological emissions (Section 5.1.1.2). Personnel exposures are expected to average 430 mrem per project worker with a maximum exposure dose of 770 mrem to a project worker (Table 5-1). Protective clothing, personnel monitoring devices, and area radiation monitors with alarm capability would be used in conjunction with the project “as low as reasonably achievable” (ALARA) program to keep personnel exposures reasonable.

Table 5-1. Radiological Exposure to Project Workers.

Activity	Number of workers	Duration (Hours per worker)	Area Exposure Rate (mrem/hr)	Total Exposure (person-mrem)
Remove Bio Shield	5	160	2.2	1,760
Remove Reactor Core	3	24	32	2,304
Remove lead shielding	3	110	2.2	726
Remove concrete under reactor	3	40	0.35	42
All other operations	10	1,025	0.035	358.8
			Project Total	5,190.8

Worker exposures to radiation under normal conditions are controlled under established procedures that require doses to be kept as low as reasonably achievable and that limit any individual's dose to less than 2 rem per year (DOE 1999). A draft project ALARA Plan has been tentatively prepared which will identify an administrative control limit substantially below the 2 rem per year limit (ITS 2004c). Based on an occupational risk factor of 5×10^{-4} fatal cancers per person-rem (DOE 2002a), workers engaged on this proposed project would incur a 0.003 risk of a latent cancer fatality, or 2 chances in 10,000 that any one of the 12 workers would die from cancer caused by exposure to radiation as a result of this decontamination and decommissioning effort.

Nonradiological Impacts to Workers. Based on Bureau of Labor Statistics (BLS 1996a; BLS 1996b) and the required work effort estimated to complete decontamination and decommissioning (12,000 worker hours), no workplace fatalities (risk of 7×10^{-8} or 1 chance in 14,000,000) and about 1 nonfatal injury or illness (risk of 0.6) would be expected.

Radiological Impacts to the Public. The calculated dose rate for members of the public would be 1.36×10^{-7} mrem per year, using the CAP88 model (EPA 1992). This is equivalent to a latent cancer fatality risk of 8×10^{-14}, or 1 chance in 12 trillion.

5.1.1.4 Noise

Noise would be associated with the operation of machinery and equipment such as portable generators, hydraulic breakers, jackhammers, concrete saws and scrabblers, portable HEPA

filters, and forklift trucks. Receptors of such noise would be persons who work in or near Building 335. Noise would not affect persons beyond the ANL-E site and its buffer zone (Waterfall Glen Nature Preserve) because of the distances involved. Workers in areas posted for hearing protection would be required to wear plug-type personal protective equipment.

5.1.1.5 Waste Disposal Capacity

LLW. Approximately 140 cubic meters (5,000 cubic feet) of CH-LLW would be generated by the proposed action in the form of activated concrete and metal and contaminated paper, cloth, and plastic. In addition, approximately 7 cubic meters (250 cubic feet) of RH-LLW from the reactor and core assembly would be generated. Although not likely, approximately 550 cubic meters (19,500 cubic feet) of contaminated soil could also require disposal as CH-LLW. The major isotopes are cobalt-60, Europium-152, and Europium-154. LLW would be packaged and shipped to DOE disposal sites at Hanford or at NTS, or to Envirocare, a commercial LLW disposal site, in accordance with Waste Management Operations procedures and DOE policies and procedures. These disposal sites have adequate capacity to receive this waste.

Mixed LLW. The proposed action would generate approximately 6 cubic meters (200 cubic feet) of mixed waste, predominantly in the form of lead shielding and pieces and lead-based paint. This waste would be shipped to Envirocare, where it would be treated and disposed of. If mixed PCB waste were generated, it would be disposed of at Envirocare or at Perma-Fix/Materials & Energy Corporation.

Contaminated Oil. Approximately 114 liters (30 gallons) of contaminated oil, considered to be mixed LLW, would also be generated. This waste would be shipped to Envirocare, where it would be treated and disposed of.

Asbestos and PCB Wastes. The proposed action would generate approximately 6 cubic meters (220 cubic feet) of asbestos and approximately two 208-liter (55-gallon) drums of PCB waste. This hazardous waste would be disposed of through a contract vendor in accordance with applicable ANL-E Waste Management Operations procedures and state asbestos and Toxic

Substances Control Act (TSCA) requirements. A contract vendor that would have adequate capacity to dispose of this waste would be selected. The disposal facility for PCB and asbestos waste would be a special waste landfill within 160 kilometers (100 miles) of ANL-E.

Solid Wastes. Approximately 46 cubic meters (60 cubic yards) of conventional solid wastes would be generated. These wastes would be disposed of at a local, permitted special landfill within 160 kilometers (100 miles) of ANL-E that had adequate capacity.

Sanitary and Laboratory Wastewater. The proposed action would involve approximately 10 outside contractor personnel for about 8 months. They would represent a very small increase in wastewater handling requirements, well within the excess handling capacity of the laboratory system. Small amounts of laboratory wastewater generated during the project would be collected and sampled to determine if it meets laboratory wastewater discharge requirements or if it would need to be sent to Waste Management Operations in Building 306 for processing. In either case, ANL-E has adequate waste handling capacity to manage the wastewater.

5.1.1.6 Socioeconomics

Implementation of the proposed action would require approximately 12 additional workers for an 8-month period. This additional, temporary workforce requirement would not impose any impacts to the local economy, housing, schools, or other social services.

Total proposed action costs would be $2.4 million. This expenditure would take place over 8 months and would represent less than 0.5 percent of ANL-E's annual operational expenditure of approximately $550 million (ANL 2002). Thus, the economic impact of the proposed action would be minor in the context of ANL-E and extremely small in the context of the regional economy.

There would be no social impacts such as those related to relocation of residents or impacts on lifestyle and living conditions.

5.1.1.7 Environmental Justice Considerations

The impacts of the proposed action would not extend beyond the site boundaries. In addition, the population demographics surrounding the ANL-E site are not considered to be minority or low-income on the basis of national and Illinois thresholds for minority and low-income populations. While the greater Chicago area (within 80 kilometers [50 miles] of ANL-E) is ethnically and racially diverse, with areas containing a high proportion of minority populations, these areas would not be affected by the proposed decontamination and decommissioning of the Juggernaut Reactor Facility.

5.1.2 Natural Hazards and Accidents

This section addresses the potential environmental impacts that could occur at the Juggernaut Reactor Facility as a result of natural hazards or accidents. An auditable safety analysis (ASA) is being prepared for the proposed action; a draft analysis was available during the preparation of this EA (ITS 2004a) and its conclusions are summarized in this section. However, if the draft ASA is revised with regard to the scenarios and information provided in the EA, DOE will revisit the analysis in the EA to ensure its continued accuracy. DOE also prepared a draft health and safety plan that describes the occupational health and environmental controls that would be in place if the proposed action were implemented (ITS 2004b).

5.1.2.1 Natural Hazards

Natural hazard phenomena include wind/tornado, earthquakes, and floods. Although each of those could introduce significant energy sources, the estimated time period for decontamination and decommissioning activities is very short compared to frequencies of those events (the theoretical probability of a 150-mile-per-hour tornado strike at ANL-E is 3.0×10^{-5} per year, a recurrence interval of one tornado every 33,000 years). A tornado of significant force to release radioactivity is highly unlikely to occur during the decontamination and decommissioning activities but was evaluated as the bounding natural phenomena event.

The probability of a tornado with sufficient wind speed to damage Building 335 is 1×10^{-4}, a recurrence interval of one tornado every 10,000 years (ANL-E 2003h). Although the roll-up door to the main floor of the facility would not withstand the pressure differential of a tornado of significant force and would blow outward, the amount of loose hazardous and radioactive material in the area at any one time would be small and would consist only of materials discussed in Section 5.1.1.5.

The bounding scenario would be that the metal high bay structure would fail and blow outward due to the pressure differential of a design basis tornado. The amount of dispersible activity (e.g., from small contaminated debris, dust particulate, refuse, filtration media, etc.) would depend on the stage of the project and consist of small amounts of low level waste. Demolition of the concrete biological shield would likely create the most amount of dispersible activity. Larger components (e.g., reactor vessel, lead shielding, cooling system components, etc.) would be unlikely to disperse because of their size and weight. Cooling system components would be highly unlikely to disperse because of their weight and physical location below grade.

The bounding scenario would assume the amount of dispersible activity likely to be at least 2 orders of magnitude less than the total amount of activity in the facility, which is less than 20 curies. Since the total amount of activity in the facility is less than the threshold quantities (TQs) for a Hazard Category 3 Nuclear Facility found in DOE-STD-1027-92 (ITS, 2004a), the assumed dispersible activity would produce a radiological effective whole body dose of less than 1 mrem. This dose is insignificant compared with the DOE-STD-1027-92 standard of 10 rem. The 1027 standard lists TQs for radionuclides that *when exceeded* would result in "significant localized radiological consequences" as defined in the standard.

Mild tornados have struck the ANL-E site, with minor damage to power lines, roofs, and trees. During the decontamination and decommissioning activities, packaged radioactive material may be temporarily staged in the Building 335 yard area. These materials would be secured and packaged in strong tight containers (waste bins) which weigh in excess of 5,000 pounds.

Remote-handled waste will be stored in lead-shielded casks which have a 35,000-pound gross weight while empty. Mild tornados would not affect materials stored in the Building 335 yard.

No other natural hazard phenomena (e.g., thunderstorms, sleet, and snow) are considered to be mechanisms capable of releasing radioactivity from the Juggernaut Reactor Facility. No tectonic features within 62 miles of ANL-E are known to be seismically active. Historical records indicate that no damaging earthquakes have occurred in a large area surrounding the ANL-E site. Flooding is not considered a mechanism for radiological release at the Building 335 facility during decontamination and decommissioning activities because the site is above the floodplain and soils are deep, well drained, and moderately slow to slowly permeable.

5.1.2.2 Accidents

The ASA identifies the potential for ignition and combustion of the existing graphite reflector/moderator to represent the greatest risk of suspension and release of radioactive material (ITS 2003a). Radioactive material could be dispersed if a fire were to initiate and propagate within the reactor bioshield. The most credible and limiting condition would result from a fire in the graphite reflector material. While this event would represent the limiting case in terms of radiological consequences, its likelihood is extremely small because graphite is extremely difficult to ignite, combustible materials and ignition sources will be controlled, and Fire Department response would preclude large scale combustion.

The ASA also considers the potential for a heavy load drop. The limiting load drop (due to consequences) for the decontamination and decommissioning activities would be during the lifting and/or crane transfer of the Juggernaut Reactor vessel. The vessel represents one of the heaviest individual lifts to be performed as part of the decontamination and decommissioning, and it has the potential for internal contamination. In a bounding event (drop) the vessel would fall on stored/staged radioactive waste. Given that the majority of radioactive materials are entrained in concrete and/or graphite, and the maximum possible levels of surface contamination inside the reactor vessel, the result (quantity of radioactive material released/suspended) of a

bounding drop would be low. A load drop would result in increased minor airborne activity inside the building and some slight increase in the rate of release to the outside atmosphere.

General requirements for minimizing the risk and consequences of accidents associated with the proposed decontamination and decommissioning activities are contained in ANL-E procedures pursuant to requirements in Federal and state regulations and in DOE Orders that protect workers in hazardous environments, as well as the public. These procedures, which are frequently updated, include measures for training, monitoring, and oversight of activities with the potential for accidents.

Specific protections that would be implemented under the proposed action are as follows:

- Radioactive materials would be removed in accordance with ANL procedures. All radiological work would be performed using Radiological Work Permits and in accordance with the requirements of the *Environment, Safety, and Health Manual, Argonne National Laboratory – East* (ESH Manual) (ANL 2003g). Risk of personnel exposure to radiation or the intake of radioactive material would be controlled through the use of protective clothing, including respiratory protective equipment, and the use of trained workers. Personnel radiation and contamination exposure would be maintained at levels as low as reasonably achievable and in accordance with ANL-E administrative radiation control limits.
- Asbestos-containing materials would be removed in accordance with the Occupational Safety and Health Act (OSHA) asbestos standard (29 CFR § 1910.1001) and the ESH Manual (ANL 2003g). Asbestos removal work would be done by ANL-E Waste Management mechanics or by outside contractor personnel who would be trained and certified in asbestos removal work. Air monitoring and health hazard control would be part of this work.
- Lead-containing material would be removed in accordance with the OSHA lead standard (29 CFR § 1910.1025) and the ESH Manual (ANL 2003g).

- Waste containers of hazardous and mixed waste would be segregated in accordance with RCRA requirements.
- Fire prevention measures would be utilized in the decontamination and decommissioning work. In case of fire, fire protection services are provided by the ANL Fire Department 24 hours a day.
- Hoisting and rigging procedures and requirements would significantly reduce the probability of a load drop, thereby reducing the risk of worker injury or radiological release to a significant level.

5.1.3 Transportation

To bound the impacts, DOE analyzed the impacts of the transportation of the maximum volume of wastes that could be generated by the proposed action. All transportation of wastes for offsite disposal would be conducted by truck. It is anticipated that approximately 14 truckloads of LLW (assuming no excavation of contaminated soil was required), 1 truckload of mixed LLW, and 3 truckloads of hazardous waste would leave the ANL-E site for shipment to disposal sites throughout the 8-month duration of the project. This compares to the annual average of about 35 shipments of LLW (including mixed LLW) and 40 shipments of hazardous waste from ANL-E and represents a 24-percent increase in LLW and hazardous waste shipments.[4]

Potential LLW and mixed LLW disposal sites are the Hanford Site, NTS, and Envirocare. Transportation of these waste types to the Hanford Site would result in the highest estimated impact of the three potential disposal sites because Hanford would involve the greatest travel distance from ANL-E and impacts are a factor of vehicle-miles traveled.

Hazardous waste containing PCBs or contaminated oil would be shipped to the Perma-Fix/Materials & Energy Corporation or to Envirocare. Transportation of waste to Envirocare would result in the highest estimated impact of the two potential disposal sites

[4] If excavation of contaminated soil were required, approximately 550 cubic meters (19,500 cubic feet) of LLW would be generated. This would require an additional 29 shipments of LLW. ANL-E waste shipments would increase by 60 percent.

because Envirocare would involve the greatest travel distance from ANL-E and impacts are a factor of vehicle-miles traveled.

Hazardous waste containing asbestos would be shipped to a special waste landfill located within 160 kilometers (100 miles) of ANL-E.

Approximately 218,000 to 291,700 round-trip vehicle-kilometers would be traveled to dispose of all of the waste types that would be generated by the proposed action (including contaminated soil), depending on the disposal site used. Based on national average rates of 0.35 accidents and 0.015 fatalities per million kilometers (DOE 2002b), the proposed waste shipments would result in an estimated 0.10 risk of an accident (1 chance in 10) and 0.0043 risk of a fatality (1 chance in 230). The risk of fatality would be due to crash impacts, not as a result of cargo hazard. This risk is likely to be substantially lower because DOE would not expect to generate contaminated soil that would require shipment and disposal as LLW.

5.1.4 Other Potential Direct, Indirect, Cumulative, or Long-Term Impacts

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions" (40 CFR § 1508.7). All of the foregoing impact analyses take into consideration ongoing ANL-E actions. The incremental impact of the proposed action would not be significant if added to all other past, present and reasonably foreseeable future actions. Future actions are not anticipated to be conducted within the vicinity of Building 335 during the proposed activities. A future use for the facility is not known at this time. Other activities currently proposed for the ANL-E site include:

- Advanced Photon Source Upgrade (DOE/EA-1455)
- Biocontainment Laboratory (preparation of an EA is pending)

5.1.5 Compliance with Regulations

The proposed action would comply with applicable Federal, state, and local laws. The following environmental laws and regulations would be applicable:

- Construction and operating air permits for Building 335 (Clean Air Act).
- TSCA and State Asbestos Abatement Law for asbestos removal and PCB disposal.
- RCRA Part B permit for additional hazardous and mixed waste storage.
- DOE Order 435.1 governing radioactive waste storage management.
- DOE Order 5400.5 on radiation protection of the public and the environment.
- Department of Transportation regulations, 49 CFR Parts 390-397.

5.1.6 Pollution Prevention

To further the goals of pollution prevention and waste minimization, implementation of the proposed action would require careful waste segregation and would optimize the use of space in waste containers. If possible, the bio-shield blocks would be used as shielding in another facility or as test weights for crane/scale calibration or load testing. Because of the current DOE moratorium on the release of potentially activated materials, recycling of metal components would not be possible.

5.2 No Action Alternative

Under the no action alternative, the Juggernaut Reactor Facility would not be decontaminated and the existing equipment would not be removed. This alternative would preclude the use of this space for other activities and continue the Department's responsibility for the facility.

No measurable exposure would be expected for personnel working inside or outside of Building 335 and around the reactor. Minimal radiation exposure would be expected for surveillance and maintenance personnel inspecting the reactor core occasionally. This alternative would also result in the continued risk of release of material due to accidents or natural hazards. DOE would also continue to incur costs for surveillance and monitoring activities at the facility. For the 12-month period ending in September 2003, annual surveillance and maintenance costs for the Juggernaut Reactor Facility were $78,839.