FINAL

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Environmental Assessment for Decontamination and Decommissioning of the Juggernaut Reactor at Argonne National Laboratory – East Argonne, Illinois

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Chicago Operations Office
Argonne Area Office
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Acronyms

ALARA	as low as reasonably achievable
ANL-E	Argonne National Laboratory – East
ASA	Auditable Safety Analysis
CFR	Code of Federal Regulations
CH	contact-handled
DOE	U.S. Department of Energy
EA	environmental assessment
ESH	Environment, Safety, and Health
HEPA	high-efficiency particulate air
LLW	low-level radioactive waste
mrem	millirem (1/1000th of a rem)
NEPA	National Environmental Policy Act
NTS	Nevada Test Site
OSHA	Occupational Safety and Health Act
PCBs	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
RH	remote-handled
TSCA	Toxic Substances Control Act

Environmental Assessment for Decontamination and Decommissioning of the Juggernaut Reactor at Argonne National Laboratory – East, Argonne, Illinois

1.0 Background

The U.S. Department of Energy (DOE) is proposing to decontaminate and decommission the Juggernaut Reactor located at Argonne National Laboratory-East (ANL-E) in Argonne, Illinois. DOE has prepared this environmental assessment (EA) in accordance with the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321 et seq., and applicable regulations (Title 40, Code of Federal Regulations [CFR] Parts 1500 – 1508 and 10 CFR Part 1021). This section describes the facility and its current status. The primary source for the information in this section is the *Characterization Report for Building 335 Juggernaut Reactor Facility* (ANL 2001).

1.1 Facility History

The Juggernaut Reactor (Figure 1-1) was a light-water moderated and cooled, graphite-reflected research reactor with a rated thermal power of 250 kilowatts. It operated from 1962 through 1970. The purpose of the facility was to provide neutron flux levels of medium intensity for research and development experiments for the fast reactor development program. At the time of reactor shutdown in April 1970, the reactor fuel (93 percent uranium-235) and the two neutron sources were removed. The reactor vessel and all associated piping have been drained and dried, filters have been cleaned, and ion exchange resins have been removed. The reactor was placed in safe dry storage.

The reactor structure is octagonal in shape, 6 meters (21 feet) wide between opposite faces and 3 meters (10 feet) tall. The Juggernaut featured an internal graphite thermal column and a water-cooled annular core positioned within an aluminum reactor vessel. Located radially outward from the reactor vessel, the reactor components include a graphite core reflector, sections of the water-cooled lead thermal shield, the reactor graphite assembly, and the bulk biological shielding that houses the horizontal experimental facilities. Located axially above the annular core, the

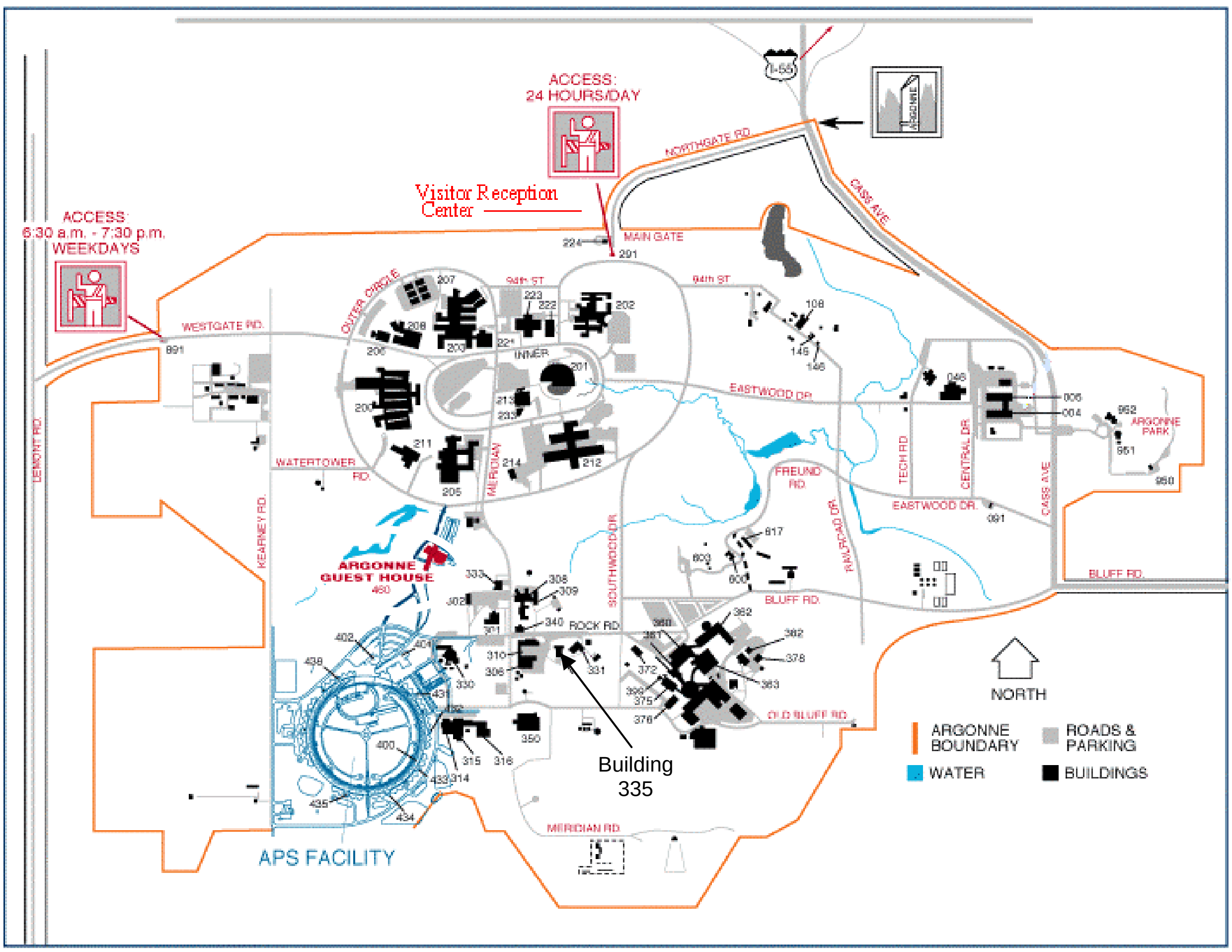
Figure 1-1. Juggernaut Reactor, inside Building 335

reactor components include a water reflector, a section of the water-cooled lead thermal shield, and removable concrete plugs and blocks that outline various vertical experimental facilities.

After reactor shutdown, all peripheral reactor experimental equipment was removed. Metal covers to the reactor experimental ports, vertical stringers, core grid, storage holes, thermal columns, and beam ports were welded shut to restrict access. Plywood sheeting was installed over the reactor’s biological shield. A plywood deck was installed on top of the reactor and tile was applied to increase the usable floor space. The entire reactor biological shield and plywood sheeting were painted. Following reactor shutdown, the reactor room was used for numerous nonradiological experiments. The equipment used for these experiments has since been removed.

1.2 Facility Description

The Juggernaut Reactor is located in the high bay area of Building 335 at ANL-E (see Figure 1-2). Building 335 is a "T" shaped structure consisting of two connected buildings. Forming the crossbar of the "T" configuration is a 12- by 30-meter (40- by 100-foot), two-story brick building that houses offices, shops, laboratories, and utilities (see Figure 1-3). The other component of this building is an 18- by 24-meter (60- by 80-foot) prefabricated metal structure housing the Juggernaut Reactor (see Figure 1-4). Figure 1-5 shows the floor plan of Building 335.



Source: ANL 2003a.

Figure 1-2. Map of Argonne National Laboratory-East, Argonne, Illinois

Figure 1-3. Building 335, front view

Figure 1-4. Building 335, rear view showing reactor building and cooling tower

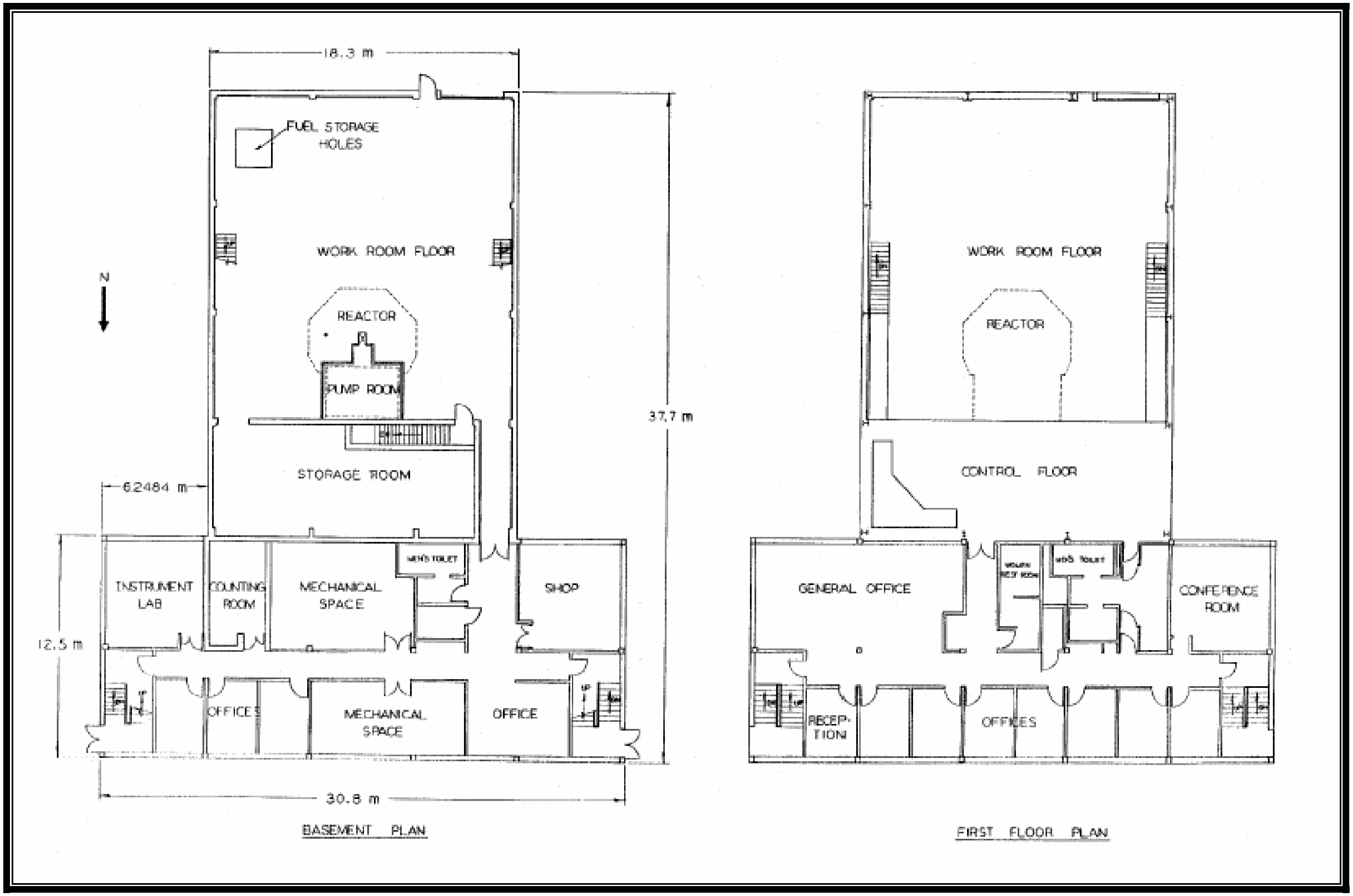


Figure 1-5. Building 335, floor plan

The high bay area housing the Juggernaut Reactor is intact and in good condition. The area is equipped with a 17-meter (56-foot) span overhead crane rated at 9 metric tons (10 tons). In the southeast corner of the reactor room 25 stainless steel tubes, 13.3 centimeters (5¼ inches) in diameter are vertically embedded in the concrete floor slab. There is no record of spent fuel assemblies having been stored in the tubes.

A 3- by 5-meter (10- by 15-foot) pump room is located in the basement at the north end of the reactor housing structure. A stairwell in the west sector of the main floor allows access to the pump room, which contains the reactor auxiliary systems dump/storage tank, heat exchanger, associated pumps, valves, and piping.

1.3 Current Status

The Juggernaut Reactor is no longer in use and has been in safe shutdown condition since 1970. From January 2001 to September 2001, DOE conducted a characterization of the Juggernaut Reactor Facility to evaluate the presence of radiological contamination and the presence of any non-nuclear hazardous or toxic material (ANL 2001).

Beta-gamma contamination is the predominant radiological hazard identified throughout the facility. As shown in Table 1-1, the primary contaminant was found to be Europium-152, although various other nuclides consistent with the research believed to have been performed were found in smaller quantities. The total isotopic inventory is conservatively estimated to be less than 20 curies.

In addition, most of the reactor surfaces were painted with a lead-based paint. Asbestos-containing material has also been identified in the cooling tower pipe insulation, floor tile, and floor tile mastic.

Table 1-1. Radionuclides Present or Anticipated in the Juggernaut Reactor Facility

Isotope	Contaminant Levels (in curies)	Sample Location of Highest Concentration	Areas Found	Remarks
Cobalt-60	0.345	Graphite from thermal columns	Graphite, concrete, and reactor core	Predominant radionuclide
Europium-152	15.9	Graphite from thermal columns	Graphite and concrete	Reoccurring radionuclide
Europium-154	0.436	Graphite from thermal columns	Graphite and concrete	Reoccurring radionuclide
Potassium-40	0.345	Graphite from thermal columns	Graphite and concrete	Reoccurring radionuclide
Cesium-137	0.00623	Southeast Beam Port	Beam port smears	Loose contamination found on smears
Americium-241	0.00623	Southeast Beam Port	Beam port smears	Loose contamination found on smears
Bismuth-214	unknown	Equally Distributed	Water samples	Anticipated radionuclide
Activated Cadmium 113M	unknown		Control rods	Anticipated radionuclide
Radon-226	unknown	Sump Pit	Water samples	Anticipated radionuclide

Source: ANL 2001, Section 9.1.

Key findings from the 2001 Characterization Report (ANL 2001) are:

- The predominant radionuclides detected were Europium-152, Europium-154, Potassium-40, and Cobalt-60.
- General area dose rates are below 1 millirem (mrem) per hour adjacent to the reactor in the high bay area.[1]

1.4 Public Involvement

DOE sent the Draft EA to the State of Illinois Office of the Governor for comment on December 16, 2003, and received one comment from the Illinois Emergency Management Agency. That

[1] A dose of 1 mrem will result in an increased risk of a latent cancer fatality of 5 chances in 10 million.

letter is included in Appendix B. In response to that agency's concern regarding the radiological condition of the concrete and soil at the base of the fuel storage tubes, DOE has committed to surveying the tubes for contamination prior to filling them with concrete.

2.0 Purpose and Need for Agency Action

The purpose and need for the proposed action is to protect human health and the environment from risks posed by inactive and surplus contaminated DOE facilities. In addition, remediation would allow for the future beneficial use of the facility. Residual radioactivity from neutron activation is present in the reactor vessel, reactor structural components, and shielding structures. The proposed action is needed to ensure the protection of the health and safety of the public, DOE and contractor employees, and the environment, consistent with DOE Order 5400.5, Radiation Protection of the Public and the Environment.

3.0 Description of the Proposed Action and No Action Alternative

This section describes the elements of the proposed action, including anticipated air emissions and waste volumes. It also describes the no action alternative as required by NEPA-implementing regulations (10 CFR § 1021.321(c)).

3.1 Proposed Action

The proposed action is the decontamination and decommissioning of the Juggernaut Reactor, which includes activities such as disassembly, size reduction, waste packaging, and transportation of waste to offsite disposal sites. In addition, DOE would perform supplemental sampling and facility characterization, including (1) taking radiological readings in Building 335 and the immediate reactor vicinity; (2) sampling for lead-based paint on reactor and support components; (3) sampling for asbestos in tiles and pipe insulation; (4) wiping samples from interior walls and piping around the reactor, high bay area, and control/pump room; and (5) surveying the stainless steel tubes. Table 3-1 lists the elements of the proposed action by area.

The majority of the work would be performed inside Building 335. The only planned outdoor demolition work would be the removal of the cooling tower and concrete storage pads. However, if soil contamination were found under the reactor vessel, bio-shield, or cooling tower, this soil would be excavated and removed.[2] The proposed action would be expected to take 8 months to complete and would require about 12,000 worker-hours (approximately 12 temporary workers).

A final status release survey would be conducted to confirm that radiological release criteria for the building were met in accordance with DOE Order 5400.5. Completion of the proposed action would allow the Building 335 high bay area and associated facilities to be released for unrestricted use.

[2] Based on DOE's experience with decontamination and decommissioning of other small research reactors at ANL-E, soil contamination is not anticipated. DOE would sample for soil contamination if radiological contamination below the bio-shield were found to extend completely through the concrete. For purposes of analysis, DOE has estimated the maximum volume of contaminated soil that may need to be removed and disposed of as low-level radioactive waste (LLW). If soil were to be excavated, DOE anticipates that groundwater would be encountered, resulting in the generation of additional waste volumes.

Table 3-1. Elements of the Proposed Action

Juggernaut Reactor Facility Area	Proposed Action Activity
All Project Areas	• Remove and package for disposal all asbestos-containing materials.
	• Remove the associated electrical supply panel and all electrical components associated with the reactor and auxiliary systems.
	• Remove all unneeded, nonelectrical utilities, including high- and low-pressure air supplies, gas piping, and laboratory water supply piping associated with the reactor and associated systems.
	• Survey and package lead for disposal as mixed waste.
	• Package all miscellaneous materials and equipment as low-level radioactive waste (LLW) or mixed LLW.
	• Remove and dispose of peeling paint and paint coverings, contaminated or suspect contaminated areas of the floor, walls, and ceiling.
	• Remove contaminated concrete flooring not to exceed structural integrity of the facility.
	• Decontaminate all surfaces to below release criteria.
	• Perform 100% wipe-down and final status release survey.
Reactor and High Bay	• Remove bio-shield and package as LLW.
	• Remove reactor and core assembly; package as LLW (some parts expected to require management as remote-handled waste).
	• Remove lead shielding and pieces; package as mixed LLW.
	• Remove contaminated concrete flooring under reactor and package as LLW.
	• Remove concrete pad around storage holes and package as LLW.
	• Fill in storage holes and stainless steel tubes with concrete.
	• Remove asbestos tile and mastic on second level of high bay control room and dispose of as asbestos waste.
	• Remove wood planking and railing around reactor and dispose of as LLW.
	• Decontaminate and wipe down 100% of high bay floors, walls, and ceiling.
	• Perform final status release survey of high bay.
Pump Room	• Remove storage tanks, piping, valves, motors, and associated systems.
	• Decontaminate area as needed after removal.
	• Wipe down 100% of floors, walls, and ceilings.
	• Perform final status release survey of pump room.
Ventilation Duct	• Wipe down 100% of high bay ventilation duct exterior.
	• Perform final status release survey of ventilation duct.
Outside Facilities	• Remove asbestos insulation from cooling tower piping.
	• Locate and remove cooling tower energy sources at supply point origin.
	• Remove and package cooling tower, systems, and components; package as LLW.
	• Remove and dispose of cooling tower concrete pad.
	• Remove and dispose of south-side concrete pad as LLW.
Final Facility Condition Post Final Status Survey	• Replace high-efficiency particulate air (HEPA) filters for pump room and high bay.
	• Replace all diamond plating high bay cable trough covers with same gauge material.
	• Replace removed concrete flooring and resurface flooring to original as-built specification.
	• Fill in high bay storage holes with concrete, smooth surfaces, and meet original floor loading capacity.
	• Install floor tile in high bay second-floor control room.
	• Replace sump pump and piping with pumps with backup and fix groundwater leak from ventilation system.
	• Replace high bay second-floor railing with Occupational Safety and Health Act (OSHA)-compliant railings.
	• Replace high bay ladders associated with high bay pit and overhead HEPA bank with OSHA-compliant ladders.
	• Grade and reseed area where south-side and cooling tower pads would be removed.

Source: (ANL 2003b).

Cleaning supplies, paint, decontamination solutions, and hydraulic fluid would be stored in cabinets designed for that purpose at the work site. Inventories would be kept to the minimum amount expected to be used and would be inventoried periodically.

A characterization of the Juggernaut Reactor Facility was completed in 2001. Based on the sample analyses conducted at that time, the following waste volume estimates are provided.

Contact-Handled (CH) LLW. Approximately 140 cubic meters (5,000 cubic feet) of CH-LLW would be generated, packaged, and shipped to a LLW disposal site in accordance with DOE policies and procedures. Though not likely, up to 550 cubic meters (19,500 cubic feet) of contaminated soil may also be excavated, packaged, and disposed of as CH-LLW. This waste would be shipped to either the Hanford Site in Richland, Washington; Nevada Test Site (NTS) in Mercury, Nevada; Envirocare, a permitted and regulated commercial site in Clive, Utah; or a combination of those sites.[3]

Definitions

CH-LLW has an outer surface dose rate no more than 200 mrem per hour and requires no additional shielding or special handling. Contact-handled waste primarily emits alpha particles that are easily shielded by a sheet of paper or the outer layer of a person's skin.

RH-LLW has an outer surface dose rate of greater than 200 mrem per hour and must be handled and transported in shielded casks. Remote-handled waste primarily emits gamma radiation, which is very penetrating and requires concrete, lead, or steel to block it.

MLLW contains hazardous components regulated under the Resource Conservation and Recovery Act and radioactive components regulated under the Atomic Energy Act. Some LLW is mixed.

Remote-Handled (RH) LLW. Approximately 7 cubic meters (250 cubic feet) of RH-LLW, consisting of parts of the reactor and the core assembly, would be generated, packaged, and shipped in accordance with DOE policies and procedures to either Hanford or NTS.

Mixed LLW. Mixed LLW in the form of lead shielding and pieces and lead-based paint would be accumulated during this project. Approximately 6 cubic meters (200 cubic feet) would be expected to require packaging and shipment, which would be conducted in accordance with applicable regulations and DOE policies and procedures. These wastes would be shipped to

[3] For purposes of analysis, DOE assumed all the LLW would be shipped to Hanford, NTS, or Envirocare.

Envirocare or the Perma-Fix/Materials & Energy Corporation in Oak Ridge, Tennessee, for treatment and disposal.

Contaminated Oil. Up to 114 liters (30 gallons) of contaminated oil could also require treatment and disposal. These mixed wastes would be shipped to Envirocare or the Perma-Fix/Materials & Energy Corporation in Oak Ridge, Tennessee, for treatment and disposal.

Aqueous Radioactive Liquid Waste. Up to 380 liters (100 gallons) of residual aqueous radioactive liquid waste may be found in facility piping. In addition, if contaminated soil were found, DOE expects that excavation would encounter groundwater, resulting in the extraction of up to 76,000 liters (20,000 gallons) of radioactively contaminated groundwater. Radioactive liquid wastes, potentially including groundwater, would be treated onsite by evaporation and stabilization. Approximately 1,500 liters (400 gallons) of sludge would be generated. The sludge would be disposed of as either CH-LLW or mixed LLW, depending on its composition, and in accordance with applicable regulations and DOE policies and procedures.

Asbestos. Approximately 6 cubic meters (220 cubic feet) of asbestos insulation would be removed from piping and ventilation ductwork and the floors. Testing for asbestos would be performed before beginning decommissioning procedures. Asbestos found would be labeled and removed prior to starting any decommissioning work in those areas. Asbestos abatement would be conducted in accordance with applicable site procedures. This waste would be disposed of at an industrial landfill located within 160 kilometers (100 miles) of ANL-E.

Polychlorinated Biphenyls (PCBs). Approximately two 208-liter (55-gallon) drums of PCBs from light ballasts and capacitors would also be generated. Depending on the presence of radioactive constituents, this waste would be packaged and transported in accordance with applicable regulations and DOE policies and procedures. It would be treated and disposed of either at Envirocare or at Perma-Fix/Materials & Energy Corporation.

Solid Wastes. Approximately 46 cubic meters (60 cubic yards) of nonradioactive and nonhazardous debris waste would be generated. This would be disposed of at a local landfill within 100 miles of ANL-E.

Table 3-2 lists the waste volumes estimated and the sites to which the waste would be shipped for disposal.

Table 3-2. Estimated Waste Volumes

Waste Type	Volume	Planned Destination	Notes
LLW – debris (CH)	140 m^3(5,000 ft^3)	Hanford, NTS, or Envirocare	Includes concrete, miscellaneous materials, and equipment
LLW – debris (RH)	7 m^3 (250 ft^3)	Hanford or NTS	Parts of reactor and core assembly
LLW – soil (CH)	550 m^3 (19,500 ft^3)	Hanford, NTS, or Envirocare	Based on past experience, contaminated soil is not likely to be found
Aqueous radioactive liquid waste	380 L (100 gal) – residual in facility piping	Hanford or NTS (if LLW) or Envirocare (if mixed LLW)	N/A
	1,500 L (400 gal) – sludge from groundwater contaminated during soil excavation (if needed)	Hanford or NTS (if LLW) or Envirocare (if mixed LLW)	Estimate of 20,000 gallons of groundwater, treated by onsite evaporation and stabilization, resulting in 400 gallons of sludge
Mixed LLW	6 m^3 (200 ft^3)	Envirocare	Includes lead shielding and pieces, lead-based paint
Contaminated oil	114 L (30 gal)	Envirocare or Perma-Fix/Materials & Energy Corporation	N/A
Asbestos	6 m^3 (220 ft^3)	Special waste landfill within 100 miles of ANL-E	Floor tiles from control room, cooling tower piping; hazardous waste
PCBs	Two 208-L (55-gal) drums	Envirocare or Perma-Fix/Materials & Energy Corporation	Light ballasts, capacitors; could be hazardous or mixed waste
Solid waste	46 m^3 (60 yd^3)	Local landfill within 100 miles of ANL-E	Nonradioactive and nonhazardous debris

N/A: not applicable

3.2 No Action Alternative

Under the no action alternative, the Juggernaut Reactor Facility would not be decontaminated and the existing equipment would not be removed. The facility would be maintained in its present safe shutdown condition. Surveillance and monitoring activities would continue to ensure adequate containment of radioactive contamination, provide physical safety and security controls, and allow for personnel access. The facility would remain unavailable for other beneficial uses.

4.0 Affected Environment

This section briefly describes the existing conditions at the ANL-E site. Decontamination and decommissioning activities would occur within Building 335 or immediately outside of the building in previously disturbed areas. For this reason, no direct, indirect, or cumulative impacts would be expected to current land use, biological resources (including sensitive, threatened, or endangered species or their critical habitat), cultural or archeological resources, visual resources, ambient noise levels, wetlands, or floodplains. The primary sources for information in this section are the *Argonne National Laboratory-East Site Environmental Report for Calendar Year 2002* (ANL 2003c) and the *Environmental Evaluation Notification Form for the Decontamination and Decommissioning of the Juggernaut Reactor in Building 335 at Argonne National Laboratory -East (ANL-E)* (ANL 2003d).

4.1 Site Description

ANL-E occupies the central 607 hectares (1,500 acres) of a 1,514-hectare (3,740-acre) tract in southern DuPage County, Illinois (see Figure 4-1). ANL-E is completely surrounded by the 907-hectare (2,240-acre) Waterfall Glen Forest Preserve, which is used as a public recreational area, nature preserve, and demonstration forest. The ANL-E site is approximately 43 kilometers (27 miles) southwest of downtown Chicago and 39 kilometers (24 miles) west of Lake Michigan. The terrain of ANL-E is gently rolling, partially wooded, former prairie and farmland. The grounds contain a number of small ponds and streams.

ANL-E is in a region that is subject to tornadoes. Tornadoes have been observed in the area almost every month of the year, but are more active during April to June.

Land use in the area surrounding ANL-E includes residential, commercial, and industrial properties. No resident population lives within 1.6 kilometers (1 mile) of the center of the project site. Approximately 4,000 people work at ANL-E.

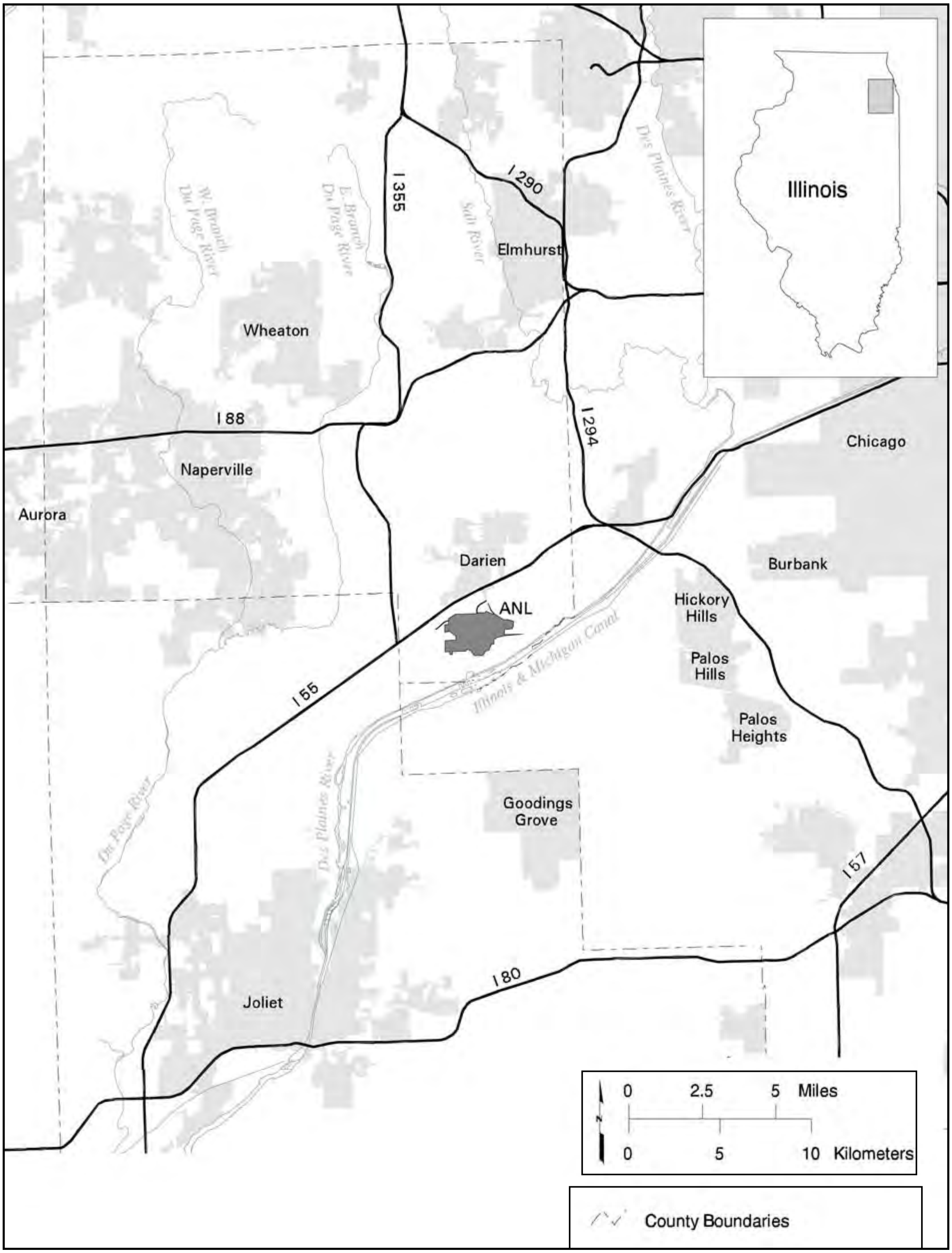


Figure 4-1. Location of Argonne National Laboratory – East

No state- or Federal-listed threatened or endangered species are known to reside at the Juggernaut Reactor Facility site. No historic properties would be affected by the proposed action (see Appendix A).

4.2 Air Quality

Routine continuous monitoring of the permitted emission sources at ANL-E has indicated that the amount of radioactive material released to the atmosphere from these sources is extremely small, resulting in a very small incremental radiation dosage to the neighboring population. The calculated potential maximum individual offsite dose to a member of the general public from ANL-E operations for 2002 was 0.039 mrem (air pathway), well below the DOE radiation protection standard of 100 mrem per year for all pathways set forth in DOE Order 5400.5. For comparison, the average American living in the United States is typically exposed to 360 mrem annually from natural and other sources of radiation.

Particulates in the air are also monitored at ANL-E perimeter and offsite sampling stations for total alpha activity, total beta activity, strontium-90, isotopic thorium, isotopic uranium, and plutonium-239. No statistically significant difference was identified between samples collected at the ANL-E perimeter and samples collected offsite.

4.3 Environmental Justice

Executive Order No. 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations, directs Federal agencies to identify any disproportionately high and adverse human health or environmental effects of their actions on minority or low-income populations. To identify such impacts, it is first necessary to identify the minority or low-income populations that could be affected by the proposed action or no action alternative.

Approximately 8.7 million people live within an 80-kilometer (50-mile) radius of ANL-E, and approximately 183,000 people live within 8 kilometers (5 miles) of ANL-E (DOE 2003). On the basis of 2000 census data, 51 percent of the population within 80 kilometers (50 miles) and 24.5 percent of the population within 8 kilometers (5 miles) of the site consists of minorities, as compared with the state averages of 32.2 percent for Illinois, 14.2 percent for Indiana, and a national average of 30.9 percent (DOE 2003). With respect to low-income populations, 11.5 percent of the population within 50 miles (80 kilometers) and 10.9 percent of the population within 5 miles (8 kilometers) of the site are comprised of low-income populations, as compared with the state averages of 10.7 percent for Illinois, 9.5 percent for Indiana, and a national average of 12.4 percent (U.S. Census Bureau 2003).

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 x 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.

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Appendix A:

Illinois State Historic Preservation Officer Concurrence Letter

Illinois Historic Preservation Agency

1 Old State Capitol Plaza • Springfield, Illinois 62701-1507 • Teletypewriter Only (217) 524-7128
Voice (217) 782-4836

ARGONNE AREA OFFICE
JAN 0 9 2004
RECEIVED

DuPage County
Argonne
Proposed Decontamination and Decommissioning of Juggernaut Reactor
Building 335
IHPA Log #048120103

January 2, 2004

Robert Wunderlich
Department of Energy
Argonne Group
9800 South Cass Avenue
Argonne, IL 60439

Dear Mr. Wunderlich:

We have reviewed the documentation submitted for the referenced project(s) in accordance with 36 CFR Part 800.4. Based upon the information provided, no historic properties are affected. We, therefore, have no objection to the undertaking proceeding as planned.

Please retain this letter in your files as evidence of compliance with section 106 of the National Historic Preservation Act of 1966, as amended. This clearance remains in effect for two years from date of issuance. It does not pertain to any discovery during construction, nor is it a clearance for purposes of the Illinois Human Skeletal Remains Protection Act (20 ILCS 3440).

If you have any further questions, please contact Cody Wright, Cultural Resources Manager, Illinois Historic Preservation Agency, 1 Old State Capitol Plaza, Springfield, IL 62701, 217/785-3977.

Sincerely,

Anne E. Haaker

Anne E. Haaker
Deputy State Historic
Preservation Officer
AEH

Appendix B:

Illinois Emergency Management Agency Comment Letter

IEMA
Illinois Emergency Management Agency
Division of Nuclear Safety

Rod R. Blagojevich, Governor
William C. Burke, Director

January 7, 2004

Mr. Peter R. Siebach
NEPA Compliance Officer
Safety and Technical Services
Department of Energy
9800 South Cass Avenue
Argonne, Illinois 60439

Dear Mr. Siebach:

The Governor's Office has asked the Illinois Emergency Management Agency, Division of Nuclear Safety (IEMA/DNS), to review and comment on the Environmental Assessment (EA) for Decontamination and Decommissioning of the Juggernaut Reactor at Argonne National Laboratory-East (ANL-E). For reference, IEMA/DNS was known as IDNS before July 1, 2003.

The State of Illinois agrees with the overall conclusion of the report, that the proposed action is needed to ensure protection of the health and safety of the public and the environment. We do not believe that the No Action Alternative is an acceptable option.

The State has two minor comments about the elements of the proposed action. First, the summary of the characterization data does not describe the radiological condition of the concrete and soil at the base of the fuel storage holes in the basement. We suggest that this area be examined carefully for contamination. Second, we note that the proposed action is projected to generate a considerable amount of mixed low-level waste. We suggest that the generation of this waste be coordinated with the appropriate Argonne Group staff to assure that this material is properly reflected in the Proposed Site Treatment Plan for ANL-E.

Thank you for the opportunity to comment on this EA. I hope these comments are still useful at this late date, but as your transmittal letter suggested, the close of a comment period on December 26 was somewhat problematic.

Sincerely,

Gary N. Wright

Gary N. Wright
Assistant Director

cc: Julie Curry, Deputy CoS, Labor and Economy
Office of the Governor

Kristen Richards
Office of the Governor

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