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

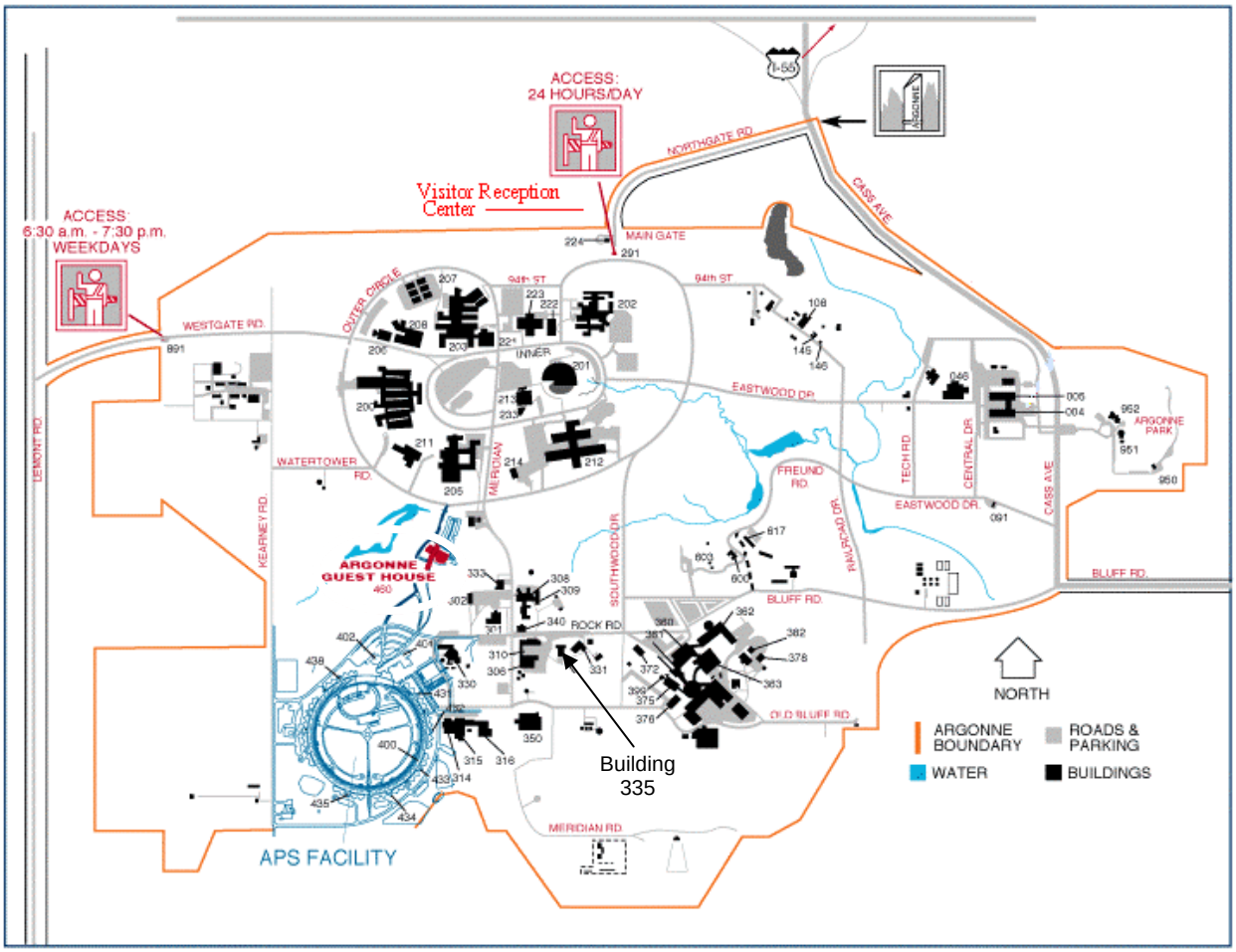
Figure 1-1. Juggernaut Reactor, inside Building 335

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

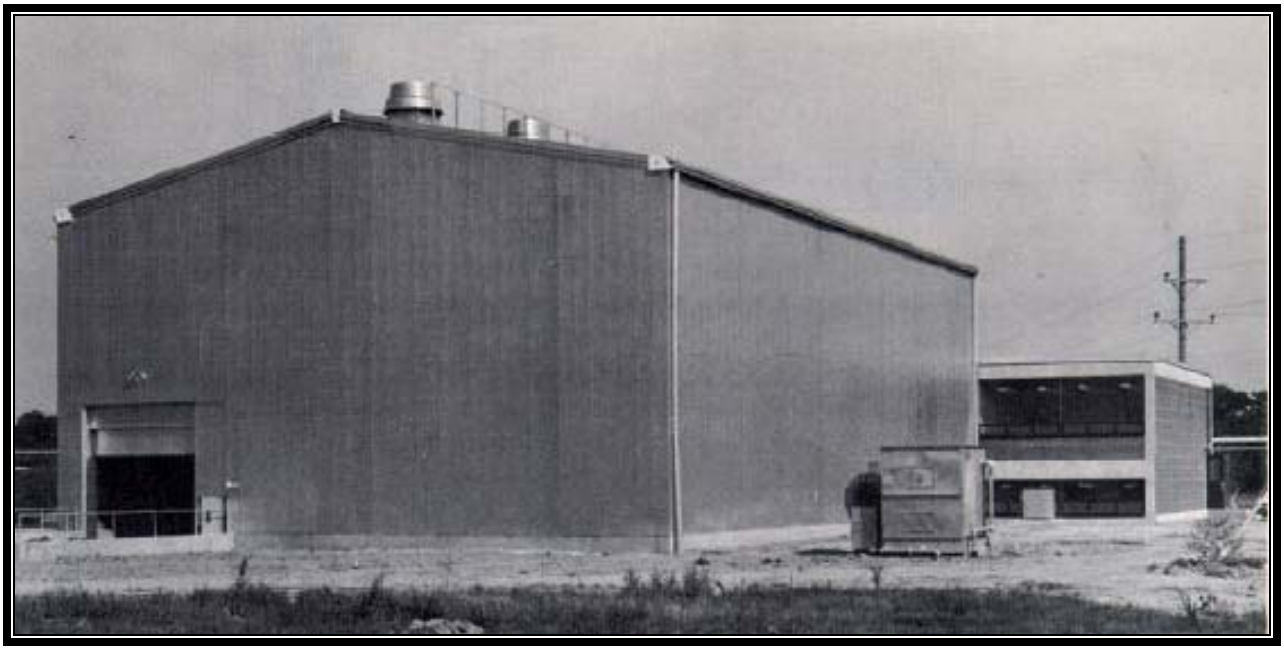


Figure 1-4. Building 335, rear view showing reactor building and cooling tower

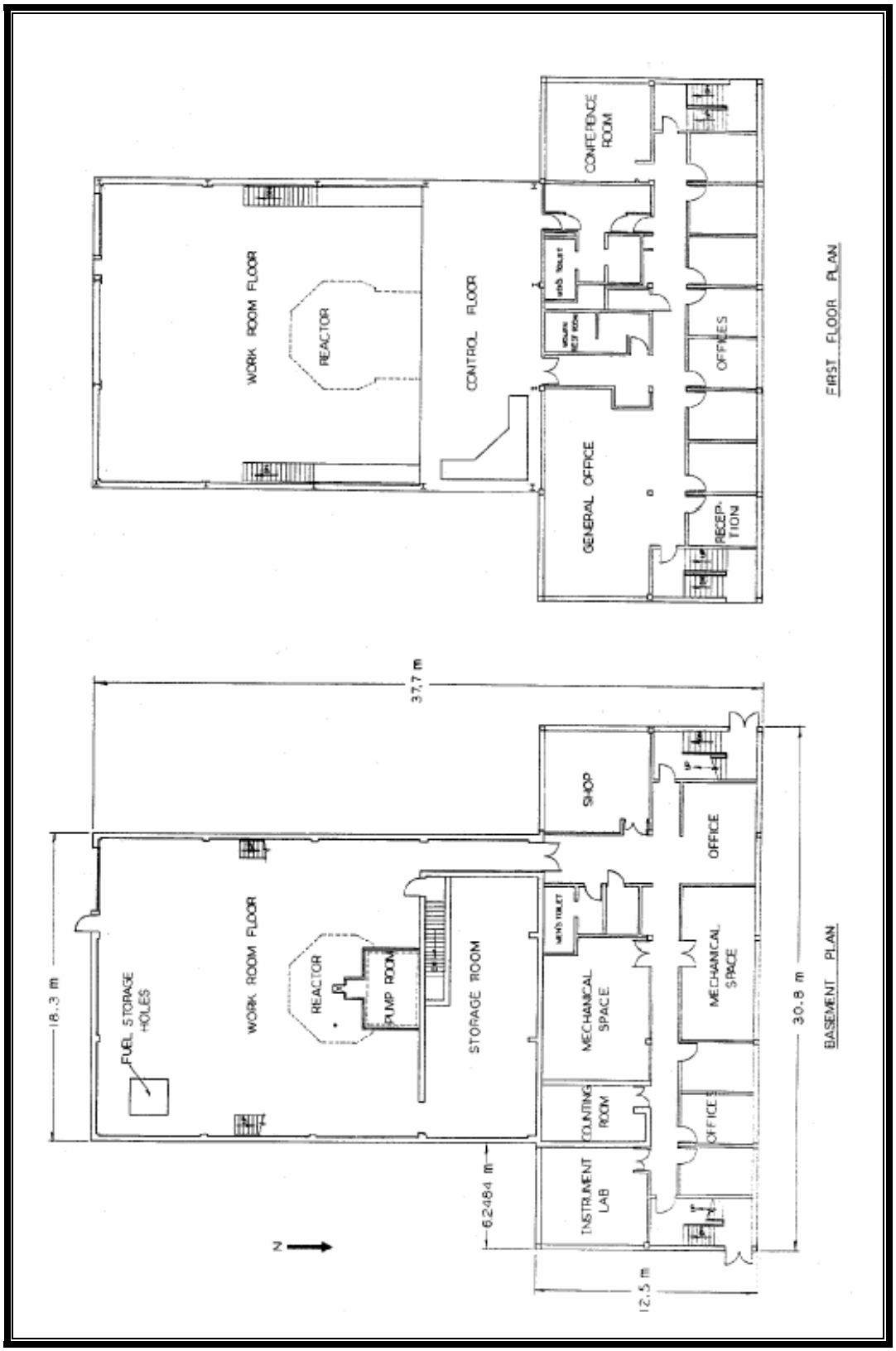


Figure 1-5. Building 335, floor plan

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.