

DOE/EA-1159

FINAL

ENVIRONMENTAL ASSESSMENT

DECONTAMINATION AND DISASSEMBLY OF THE

BIOLOGICAL IRRADIATION FACILITY

AT ARGONNE NATIONAL LABORATORY - EAST

ARGONNE, ILLINOIS

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ACRONYMS

ALARA	As Low As Reasonably Achievable
ANL-E	Argonne National Laboratory - East
ASA	Auditable Safety Analysis
AQCR	Air Quality Control Region
CCE	Contamination Control Envelope
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
Ci	Curie
CODE	Committed Organ Dose Equivalent
D&D	Decontamination & Decommissioning
DOE	U.S. Department of Energy
EA	Environmental Assessment
EBWR	Experimental Boiling Water Reactor
EENF	Environmental Evaluation Notification Form
EMO	Environmental Management Operations
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FFCA	Federal Facilities Compliance Act
ft	Feet
HEPA	High Efficiency Particulate (filter)
HVAC	Heating, Ventilation and Air Conditioning
IAC	Illinois Administrative Code
IEPA	Illinois Environmental Protection Agency
kg	kilograms
lbs	pounds
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
mrem	Millirem
MW	Megawatt
PCB	Polychlorinated Biphenyl

ACRONYMS (continued)

RCRA	Resource Conservation and Recovery Act
TCLP	Toxicity Characteristics Leaching Procedure
TEDE	Total Dose Equivalent
TRU	Transuranic
WMO	Waste Management Operations
yr	Year

1.0 BACKGROUND

1.1 Facility History

The Biological Irradiation Facility (JANUS) was used to produce short-lived isotopes, by neutron absorption, needed in the research program of the Division of Biology and Medicine.

The facility was in operation from August, 1961 to March, 1992, to test the effects of neutron exposure in animals. The reactor was defueled and the fuel shipped off-site in 1993. All liquid systems were drained. These operations were conducted as part of the routine operations of the facility. The reactor had also been defueled/refueled in 1983.

1.2 Facility Description

JANUS is located in Building 202 (Figure 1-2). JANUS was housed within a brick building with thick concrete walls. This building encompasses the entire facility, with the exception of the cooling unit and stack which are located outdoors. The wing that contains the JANUS facility is 48' by 60' and occupies two floors, the one housing the reactor being below ground.

JANUS is a highly enriched uranium, light water-moderated and cooled assembly. The core consisted of nineteen elements of fuel jacketed in aluminum, located within a 4-foot diameter aluminum tank. The tank around the core is in turn surrounded by a graphite region. (Figure 1-3, 1-4 and 1-5).

JANUS was specifically designed as a facility to perform irradiations necessary for the research program of the Division of Biology and Medicine. The two irradiation faces supplied neutrons of essentially the same energy spectrum but of widely different intensity. This difference allowed relatively short, acute exposures on the high-dose side and prolonged chronic exposures on the low-dose side.

There is a high-level and a low-level dose room. The neutron flux in the high-level dose room was intense enough to provide acute irradiations for the animals under study. The neutron levels in the low level dose room are thought to have caused some activation to the materials in them although the intensity was significantly lower.

High-Level Side

Acute studies required the use of the high-level face, and most of these were carried out with the highest dose rates obtainable (100-150 rad/min) at full power. These experiments were set up with shutters in place while the reactor was on. The duration of exposures on the high-level side did not usually exceed an hour.

Low-Level Side

The low-level side was intended to be used for chronic exposures. Although this side was not ever used for experimentation, neutron activation is possible as dose rate measurements were recorded in the room during the early part of the reactor's life. Concrete filled shutters stopped the radiation from either the high-level or low-level dose rooms when necessary. A lead wall beyond the shutter area prevented gamma rays from reaching the radiation area.

Adjacent to each of the dose rooms is a preparation room where specimens were prepared and cared for. These rooms contained instrumentation to indicate total dosage and dose rates being received by the specimens. The shutters and converter plates were controlled from the preparation rooms.

The reactor was operated from the control room which is located on the ground floor of the building.

Also on the ground floor is an area above the reactor in which maintenance and refueling procedures took place. Large plugs in the floor of the maintenance/refueling area allow for access to the reactor from above.

The equipment for both a primary and secondary circulation system and for a helium system was located in the equipment room situated between the preparation rooms. An air-cooled radiator to cool the secondary system water is outside the building.

A building ventilation system provided proper control of humidity, temperature, and ventilation in the irradiation cells and the control room. The filters and blowers in this system served to remove particulate matter from the building atmosphere. A 75 foot exhaust stack served to dilute and disperse the air that was vented.

1.3 Current Status

JANUS is no longer in use but remains contaminated with low level radioactive material and contains activated components following many years of operation. The reactor room and high dose room are considered activated. The primary water system is considered contaminated. The facility is in safe storage with on-going surveillance and maintenance activities taking place. A radiological characterization (Ref. 21) of JANUS was conducted in February and March, 1996.

Key points of the characterization findings are as follows:

- Total isotopic inventory is estimated at less than 28 millicuries, resulting in a Facility Classification of "Other Industrial Facilities."
- Approximately 99% of the total activity is in the graphite around the reactor tank.
- Except for one small spot of fixed contamination on the floor in the low dose room, no fixed or removable contamination was found on any wall, ceiling, floor, light fixture, or ductwork in the facility.
- Predominant nuclides detected were Co^{60} , Eu^{152} and Eu^{154} .
- Low levels of alpha contamination were found in only three locations: the glovebox, the rabbit tube, and the small spot on the floor of the low dose room (100 dpm/100 cm², fixed).

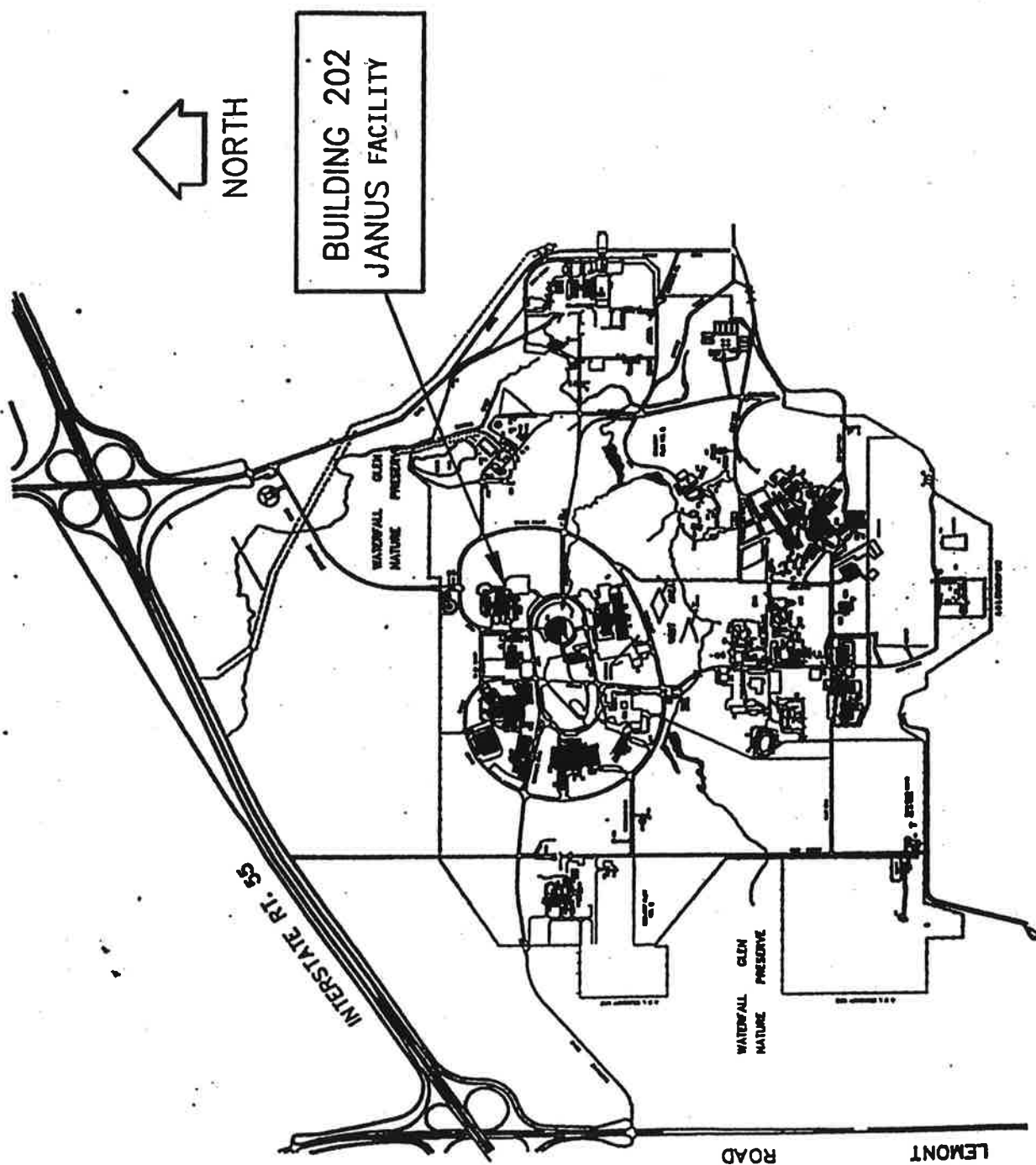


Figure 1-1. Location of the JANUS Facility on the ANL-E Site

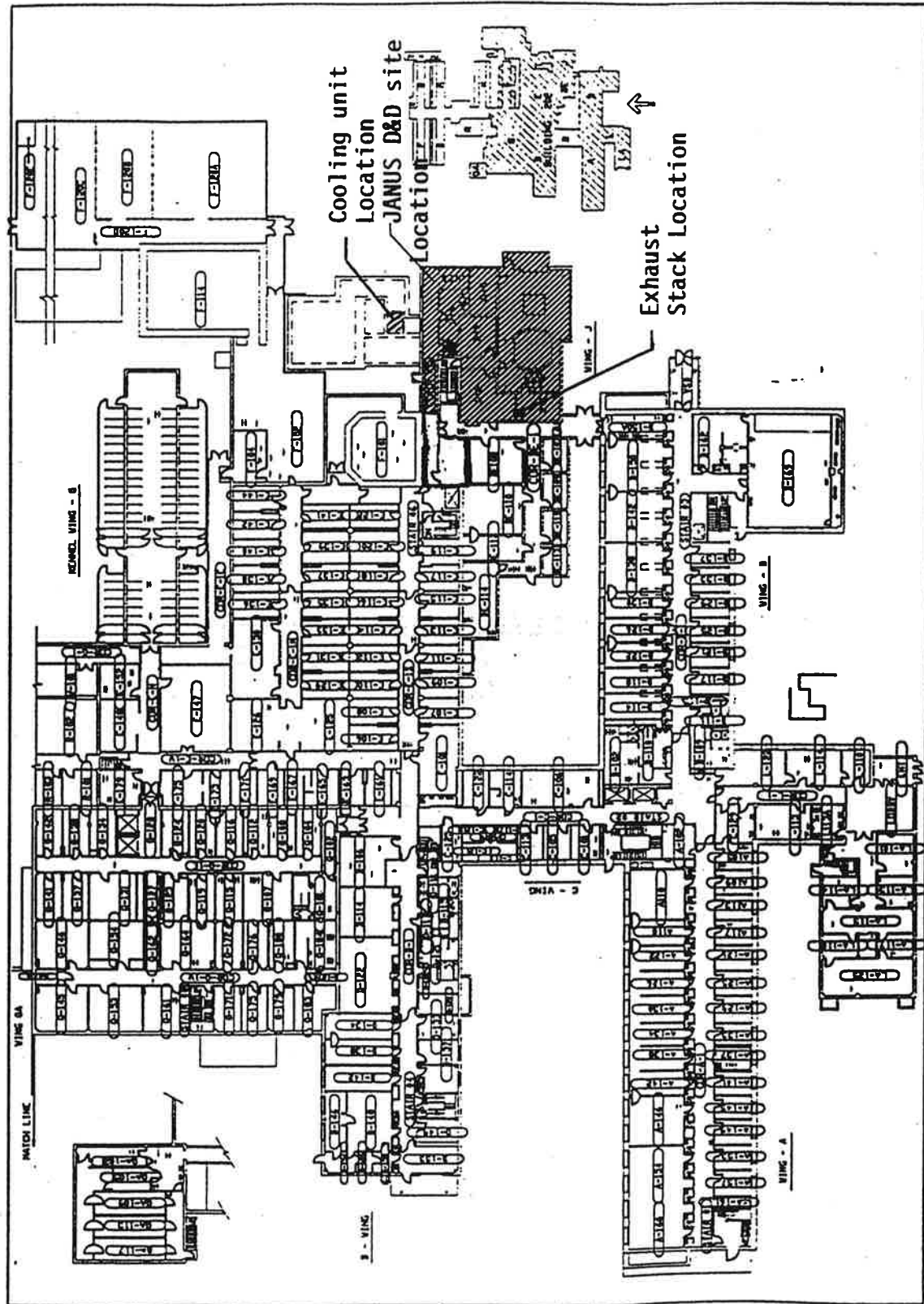


Figure 1-2. Location of JANUS Facility in Building 202 (Shaded Areas)

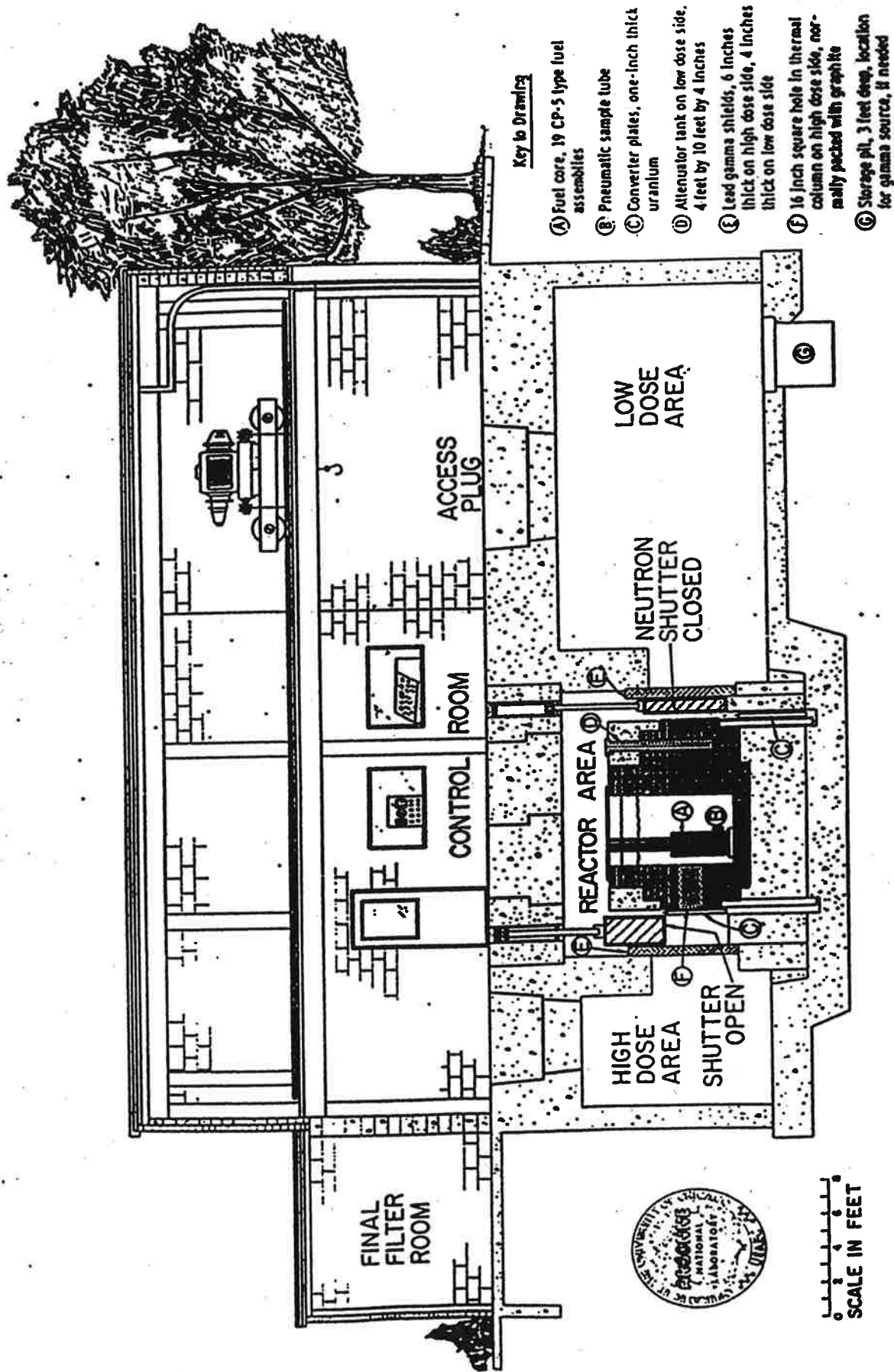


Figure 1-3. Elevation Cross Section of the JANUS Facility

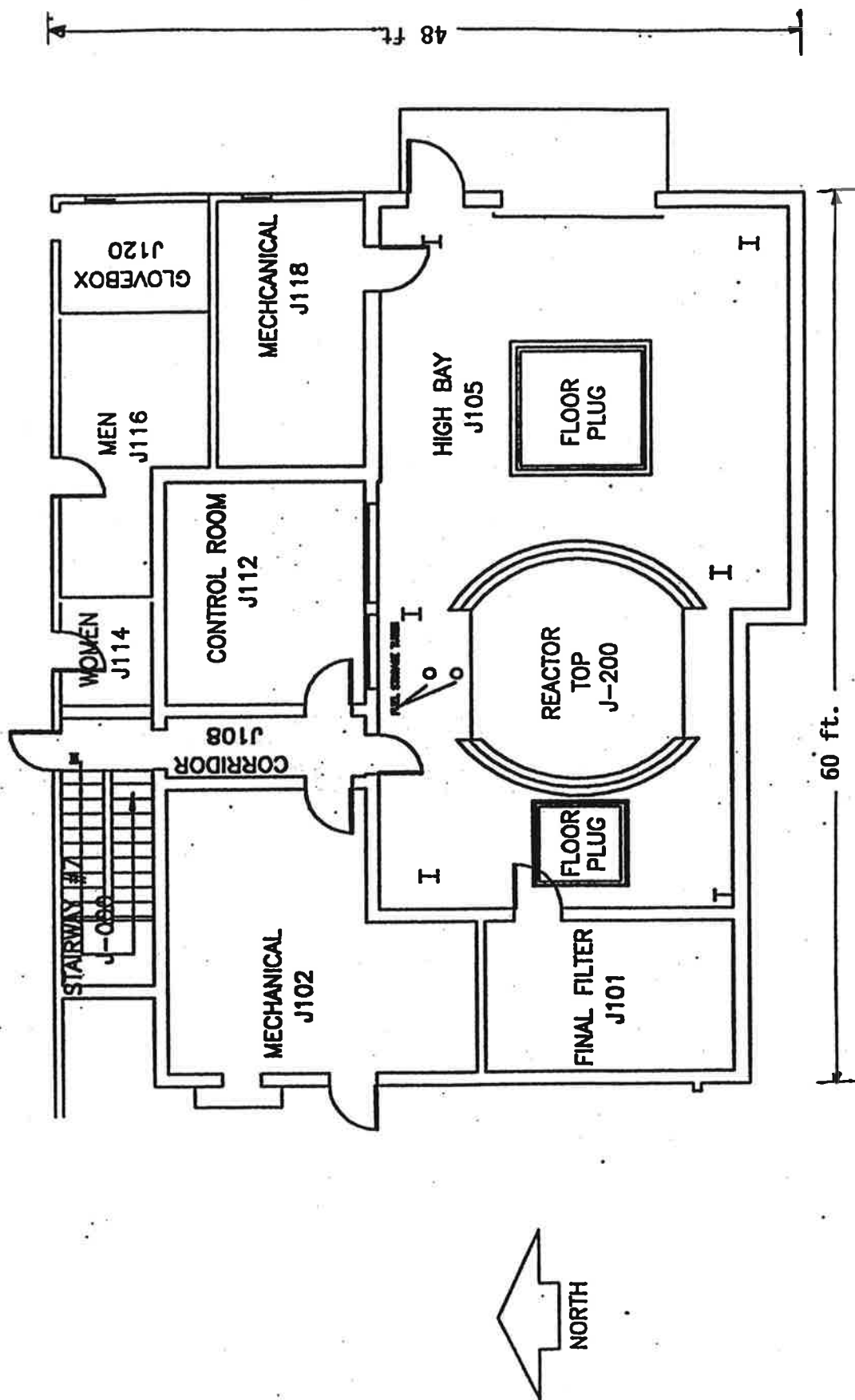


Figure 1-4. JANUS Facility Main Floor with Room Numbers

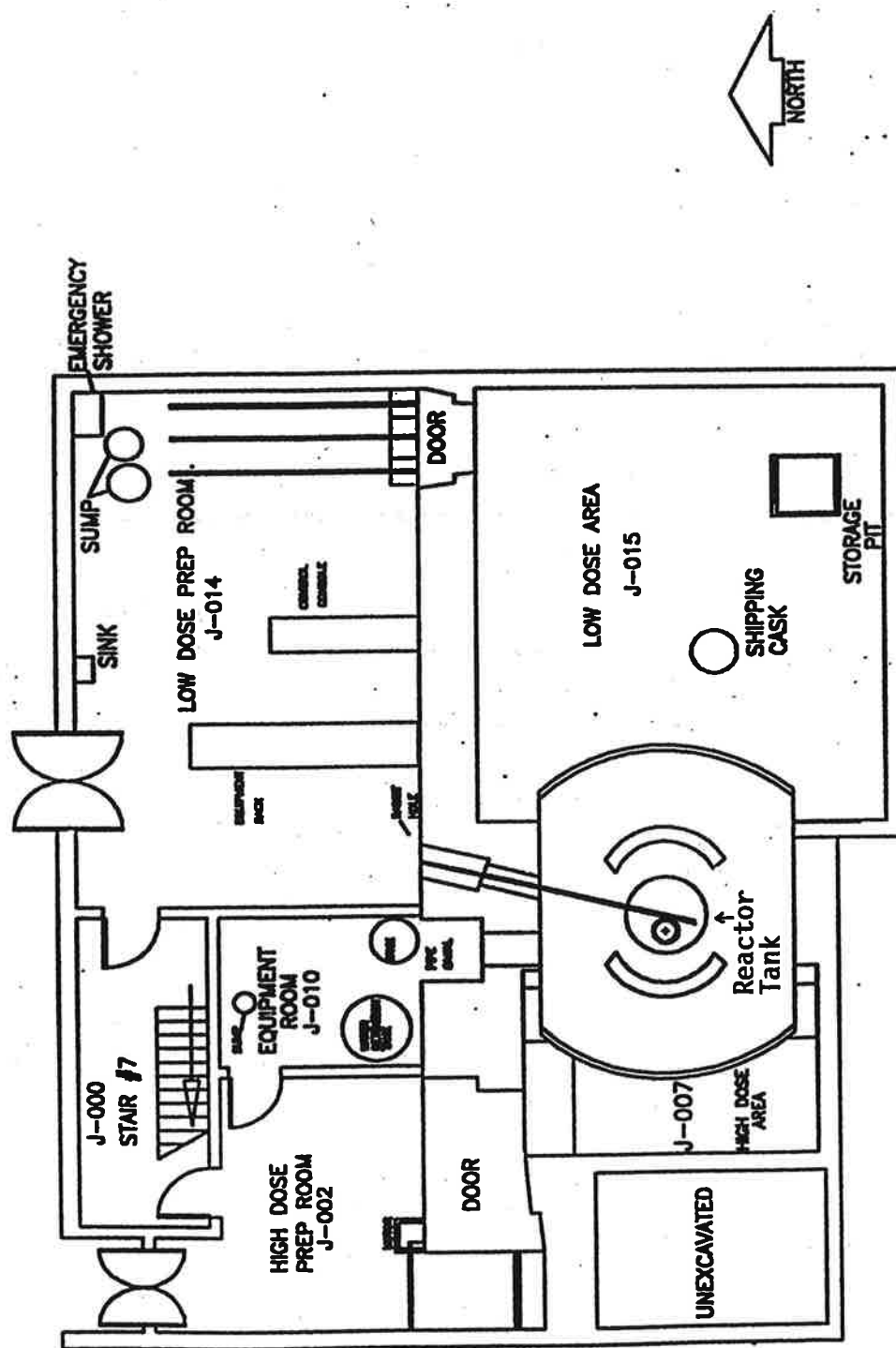


Figure 1-5. JANUS Facility Service Floor with Room Number

2.0 PURPOSE & NEED

The purpose of this project is to accomplish, in part, the DOE/EM 40 program mission which is to protect human health and the environment from risks posed by inactive and surplus DOE facilities and contaminated areas, by remediating sites and facilities in the most cost efficient and responsible manner possible in order to provide for future beneficial use.

This project is needed to assure the protection of the health and safety of the public, DOE and contractor employees, and the environment, consistent with DOE Order 5820.2A, Radioactive Waste Management. Residual radioactivity from neutron activation is present in the reactor vessel, reactor structural components and shielding structures. Process systems and components that are contaminated would also be decontaminated and disassembled since these materials are in close proximity to nearby occupied areas.

3.0 DESCRIPTION OF PROPOSED ACTION & NO ACTION ALTERNATIVE

3.1 The Proposed Action

The proposed action is the decontamination and disassembly of JANUS, which includes activities such as disassembly, size reduction, packaging, and disposal. The majority of the work would be performed indoors of Building 202. The removal of the cooling unit and the exhaust stack are the only planned outdoor demolition work.

The proposed activities are broken down into phases of work, as listed in Table 3-1. These phases are organized around major components of the facility, and may be performed in a different order. For example, Phases VIII and IX may be performed after Phase I. Figures 1-4 and 1-5 denote the locations where the following activities would take place.

TABLE 3-1 PROPOSED ACTIVITIES

PHASE OF WORK	TYPES OF ACTIVITY DURING PHASE
I Preparation of Work Site	Conduct radiological survey. Test for asbestos. Remove activated racks for holding mouse cages. Disconnect electrical components.
II Fuel Storage Tubes (See Fig. 1-4)	Decontaminate inner surfaces of fuel storage tubes and seal them for disposal.
III Low Dose Area (See Fig. 1-5)	Remove fuel transfer cask, miscellaneous equipment, and lead bricks (from gamma shield and storage pits) to main floor.
IV Low Dose Prep Room (see Fig. 1-5)	Decontaminate (if necessary) and remove sink, sump and drain leading to the retention tank. Remove control console.
V High Dose Area (see Fig. 1-5)	Remove and dispose (as appropriate) of shutter drives and aluminum mount of the high dose side. Remove contents of the high dose room (e.g. steel I-beams, aluminum grating, an 8-inch layer of borobauxite concrete, 4 inches of lead, two air receiving tanks, three air cylinders, converter and attenuator plate cables and pulleys) through the hatch between the Main Floor and the High Dose Room. Remove 56 lead sheets (approximately 4 feet high by 8 inches wide by 1 inch thick), lead ceiling tiles, plugs and screws, and lead from walls and floor. Remove the lead wall between the High Dose Room and Attenuator Cavity and lead ledge from east side of room. Remove the borated hard board behind the lead covering the walls and floor.
VI Equipment Room (See Fig. 1-4 and 1-5)	Erect contamination controls (i.e., a catch containment beneath primary components to capture any residual water within the piping) prior to removal of the primary cooling water system. Remove the remaining components of the secondary water system (2 pumps and the two heat exchangers) as well as the remaining components of the reactor helium system. Remove the cooling unit. Remove and dispose of (as appropriate) the remaining components of the controls for the skimmer and level control. Seal the pipe canal inside the room before the contamination controls are removed.
VII	Remove the shielding blocks from the Main Floor above the reactor.

PHASE OF WORK	TYPES OF ACTIVITY DURING PHASE
Biological Irradiation Facility (See Fig. 1-4)	Install a Contamination Control Envelope (CCE), with proper HEPA filtered ventilation, at the top of the reactor prior to removal of the reactor components, shielding, and graphite. Remove the reactor tank and other components with a crane. Survey the CCE interior surfaces and decontaminate, if necessary, prior to dismantlement.
VIII Main Floor (See Fig. 1-4)	Remove the glovebox in Room J-120, the HEPA filter unit in adjacent room, and exhaust ductwork.
IX Control Room (See Fig. 1-4)	Remove the instrumentation within the control room on the main floor.
X Exhaust System	Remove and dispose of (as appropriate) contaminated ventilation ductwork, filters, fan, and 75 foot tall exhaust stack located on the roof of Building 202.
XI Miscellaneous Removal	Remove the sanitary tank from hallway, the 75 kVA transformer located beneath the stairs, and approximately 60 borax-filled, ten foot long downspouts from the exhaust pit area.
XII Final Survey	Perform a final radiological survey to confirm the remaining structure does not exceed the unrestricted release criteria.
XIII Post Final Survey Activities	Fill the Main Floor fuel storage tubes and Low Dose Room storage pit with concrete. Patch all openings resulting from removal of ductwork and piping.
XIV Site Closeout	Demobilize site, and prepare the radiological survey report and Project Closeout Data Package.

No hazardous materials would be introduced into the project area. Cleaning supplies, paint and decontamination solutions and other non-hazardous materials 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 JANUS (Ref. 21) was completed in March, 1996. Based on sample analysis the following waste volume estimates are provided.

Approximately 8.5 cubic meters (300 cubic feet) of asbestos insulation would be removed from piping and ventilation ductwork. 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 the ES&H Manual (Ref. 10), Chapter 4-4.

Hazardous waste in the form of lead paint dust would be accumulated during this project. Approximately 0.3 cubic meters (10 cubic feet) is expected to require packaging and shipment to a permitted RCRA storage facility in accordance with applicable regulations and DOE policies and procedures.

Approximately 45.3 cubic meters (1600 cubic feet) of contact handled low level waste would be generated, packaged and shipped to a DOE low level radioactive waste disposal site in accordance with DOE policies and procedures.

Approximately 0.4 cubic meters (15 cubic feet) of mixed waste (predominately activated lead) would be generated during this project. This material would be treated and/or disposed of in accordance with the proposed Federal Facilities Compliance Act Site Treatment Plan for Argonne-East. Current plans are to have ANL Waste Management Operations treat the lead by macro-encapsulation on-site. Permits are currently being revised to include this process. The remaining non-activated lead shielding (approximately 7.9 cubic meters, 280 cubic feet) would be reused at ANL-E (See Section 5.6).

3.2 No Action Alternative And Impacts

Under the no action alternative the Biological Irradiation Facility would not be decontaminated and the existing equipment would not be removed. The facility would be maintained as at present in a safe lay up condition. Surveillance and monitoring activities would continue to ensure adequate containment of radioactive contamination, provide physical safety and security controls and to preserve the facility to allow for personnel access.

This alternative would preclude the use of this space for other activities and continue the Department's liability for the facility and would not allow the Laboratory to accomplish the EM 40 program mission. The reuse of lead shielding would also be precluded. This alternative would result in the continued radiation exposure to surveillance and maintenance personnel and the continued risk of release of material due to accidents or natural hazards.

4.0 THE AFFECTED ENVIRONMENT

4.1 Site Description

ANL-E occupies 1,700 acres in southern DuPage County, Illinois and is shown on Figure 1-1 (Ref. 4). ANL-E is completely surrounded by the 2,040 acre Waterfall Glen Forest Preserve, which is used as a public recreational area, nature preserve, and demonstration forest. The ANL-E site is approximately 27 miles southwest of downtown Chicago and 24 miles west of Lake Michigan. The JANUS facility is located in a wing of Building 202 (Fig. 1-2).

The surrounding area is varied in land use and includes residential, commercial and industrial properties (Refs. 1, 2). No resident population live within 1 mile of the center of the project site. Approximately 6,200 ANL-E, DOE and contractor employees, and no-pay appointees work at ANL-E (Ref. 4).

ANL-E is a region subject to tornadoes. Tornadoes have been observed in the area almost every month of the year, but are more active during April to June, and between 3:00 P.M. and 7:00 P.M. (Ref. 13). For the 30 year period 1954-1983, 89 tornadoes were recorded in the 1^0 square ($9,275 \text{ km}^2$) of latitude and longitude containing ANL-E, an average of approximately 3 per year. The expected frequency of a tornado striking any given location ("point strike") in Illinois is 1.57×10^3 which is equivalent to return period of once every 637 years. Expected dimensions of this tornado would be $19.26 \times 0.17 \text{ km}$, with an area of 7.56 km^3 (Ref. 14).

No state listed threatened or endangered species are known to reside at the JANUS facility site. Also there are no cultural resource sites within the proposed project area.

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 off-site dose to a member of the general public for 1994

was 0.015 mrem which, excluding radon -220, is 0.15% of the 10 mrem per year EPA standard (Ref. 4).

Air monitoring was also conducted at ANL-E perimeter and off-site sampling stations for total alpha activity, total beta activity, strontium-90, isotopic thorium, isotopic uranium, and plutonium-239 (Ref. 4). No statistically significant difference was identified between samples collected at the ANL-E perimeter and samples collected off-site.

5.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED ACTION

5.1 Environmental Impacts Of Decontamination And Disassembly

5.1.1 Sensitive Resources

Since the proposed activity would be conducted predominately indoors, there would be no environmental impact on the sensitive resources such as wetlands, floodplains, endangered species and cultural resources.

5.1.2 Waste Disposal Capacity

5.1.2.1 Sanitary and Laboratory Wastewater

The proposed action would involve less than twenty outside contractor personnel for about 5 months. They would represent a 0.13% increase in waste water handling requirements, well within the excess handling capacity of the laboratory system.

Small amounts of laboratory wastewater used during the project will be collected and sampled to determine if it meets laboratory wastewater discharge requirements or if it must be sent to Waste Management Operations (WMO) in Building 306 for processing. In either case, ANL-E has adequate waste handling capacity to manage the wastewater.

5.1.2.2 Conventional Wastes

The proposed action would generate approximately 59.4 cubic meters (2100 cubic feet) of non-contaminated waste materials such as concrete, metals and glass from structures and equipment. These materials would be disposed of by the contractor by offering certain materials to the scrap market for recycling, with the remaining conventional wastes to be disposed of at a municipal or commercial landfill which would have adequate capacity to accept the waste. Therefore, no disposal impact for this waste would be anticipated.

5.1.2.3 Hazardous Wastes

The proposed action would generate approximately 0.3 cubic meters (10 cubic feet) of lead based paint removed from shield block surfaces. This hazardous waste would be disposed through a contract vendor in accordance with applicable ANL-E Waste Management Operations procedures and state RCRA requirements. A contract vendor that would have adequate capacity to dispose of this waste would be selected.

5.1.2.4 Mixed Waste

The proposed action would generate approximately 0.4 cubic meters (15 cubic feet) of mixed waste predominately in the form of activated lead. This material would be treated and disposed of in accordance with the Federal Facilities Compliance Act Site Treatment Plan for ANL-E. ANL Waste Management Operations would treat the lead by macro-encapsulation on-site and ship the treated lead to a commercial facility (i.e. Envirocare) for disposal. Permits are being revised to reflect this. After treatment and packaging the final disposal volume is estimated to be 3.4 cubic meters (20 cubic feet). This is well within the disposal capacity of the disposal site. Alternatively, the activated lead would be shipped to Envirocare where it would be treated and disposed.

5.1.2.5 Radioactive Waste

Approximately 45.3 cubic meters (1600 cubic feet) of low level radioactive waste would be generated by this project in the form of activated concrete and metal and contaminated paper, cloth and plastic. The major isotopes are Co^{60} , Eu^{152} and Eu^{154} . This material would be packaged and shipped to the DOE low level radioactive waste disposal site in Hanford, WA in accordance with Waste Management Operations procedures and DOE policies and procedures. This disposal site has adequate capacity to receive this waste. After packaging for shipment, this waste is estimated to require 65.1 cubic meters (2300 cubic feet) of disposal space.

5.1.2.6 Asbestos

The proposed action would generate approximately 8.5 cubic meters (300 cubic feet) of asbestos waste. Testing for asbestos was completed during the characterization of the facility. The asbestos would be removed by an asbestos abatement contractor or WMO in accordance with applicable procedures for safe removal, handling, packaging, shipping, and final disposal. The disposal capacity for this waste would be adequate for either abatement contractor or WMO.

5.1.3 Air Quality Impacts

This project would not result in the release of any criteria pollutants.

5.1.3.1 Hazardous Emissions

Due to the small quantities of hazardous materials, the potential for hazardous emissions to the atmosphere is extremely small, and limited to minor and probably negligible amounts of dust containing lead or asbestos from materials described in Section 5.1.2.3 and 5.1.2.6.

5.1.3.2 Radioactive Emissions

The potential for radioactive emissions to the atmosphere is extremely small, and limited to minor and probably negligible amounts of dust containing radionuclides from materials described in Section 5.1.2.4 and 5.1.2.5.

These emissions would contain Co^{60} , Eu^{152} and Eu^{154} . Over 98% of all the radioactivity at the facility is in the graphite blocks around the reactor. These blocks would be removed by hand and placed in containers for disposal. Very little radioactive material is available to become airborne.

5.1.4 Noise Impacts

Noise would be associated with the operation of machinery and equipment such as jack hammers, concrete saws and scrabblers, portable HEPA filters and fork lift trucks. Receptors of such noise would be limited to persons who work in or near Building 202. Noise impact to persons beyond the site and its buffer zone (Waterfall Glen Nature Preserve) would not be noticed because of the distances. The wearing of plug type personal protective equipment would be required for workers in areas posted as hearing protection required.

5.1.5 Socioeconomic Impacts/Environmental Justice

Total proposed action costs would be less than \$5 million. These expenditures would take place over two years and represents approximately 1% of ANL-E's annual operational expenditure. 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. Temporary relocation of contractor personnel may be necessary for the duration of the project.

There would be no social impacts such as those related to relocation of residents or impacts on lifestyle and living conditions. The proposed action does not have a disproportionate effect on minority or low income populations and would in general have negligible effects on the surrounding community.

5.1.6 Radiological Impacts

The only radiological effect on non-project workers in building 202 or on the ANL-E site or members of the public would be from radiological emissions (section 5.1.3.2). Personnel exposures are expected to average 300 mrem per worker (Table5-1). Protective clothing, personnel monitoring devices and area radiation monitors with alarm capability would be used in conjunction with the project ALARA Program to keep personnel exposures reasonable.

Worker exposures to radiation under normal operations would be 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 5 rem per year. Based on an occupational risk factor of 4×10^{-4} fatal

cancers per person-rem, workers engaged in this proposed project would incur a 2.4×10^{-3} risk of harmful health effects.

TABLE 5-1 RADIOLOGICAL EXPOSURE TO WORKERS

Activities Involving Radiation Exposure	Number of Workers	Duration (Hours)	Area Dose Rate	Total Exposure (mrem)
High Dose Room - Remove lead ceiling	2	34	3 μ R/hr	0.2
- Remove Lead Walls & Floor	2	66	3 μ R/hr	0.4
Remove Reactor Systems	3	56	1 mR/hr	168
Remove Reactor Tank	3	22	3 mR/hr	198
Remove Graphite Blocks	3	83	10 mR/hr	2490
			Project Total	2856.6

5.2 Environmental Impacts Of Transportation

Approximately 3 truckloads of clean waste, 4 truckloads of LLW and 1 truckload of mixed waste would leave the site for shipment of material to disposal sites throughout the five month duration of the project. This compares to the present off-site shipment of LLW of approximately 75 shipments per year.

The trucking firm used by ANL-E to transport LLW experienced an accident rate of 0.44 accidents per million miles in 1995. They experienced one fatality in the last three years. Average annual mileage is approximately 50 million miles, therefore the fatality rate would be

foregoing impact analyses take into consideration on-going ANL-E actions (Ref. 15). 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 (Ref. 2) are not anticipated to be within the vicinity of Building 202 during the duration of the project activities. The principal cumulative effect at issue is that the proposed action would reduce the environment, health and safety impacts, consequently it will have a positive effect at the ANL-E site. The specific future use is not known. Additional NEPA review would be preformed for any proposed re-use.

5.5 Compliance With Regulations

The proposed actions would comply with applicable federal, state and local laws. The applicable environmental laws and regulations are summarized below.

- Operating air permits for Building 202 (Clean Air Act).
- Asbestos removal and disposal at Building 202 (Clean Air Act and State Asbestos Abatement Law).
- Modification to existing RCRA Part B permit application for additional hazardous and mixed waste storage and treatment capacities and for closure of certain hazardous and mixed waste storage areas (Resource Conservation and Recovery Act).
- DOE Orders governing radioactive waste storage and decontamination/decommissioning of certain structures.
- DOT regulations.

5.6 Pollution Prevention

The proposed action would enhance ANL-E's waste minimization and pollution prevention practices. Efforts would be made during the disassembly process to recycle approximately 90,900 kg (200,000 lbs) of lead brick and lead ceiling tile to the ANL-E Lead Bank for future use on-site.

Efforts would also be made to recycle steel building materials and metal equipment that is not activated or contaminated.

6.0 RELATIONSHIP OF THE PROPOSED ACTION TO OTHER ACTIONS
AND ACTIONS BEING CONSIDERED UNDER OTHER NEPA REVIEWS

The proposed action is related to the Proposed Upgrade of Waste Storage Facilities Project which includes the treatment of mixed wastes (DOE-EA 1073).

7.0 REFERENCES

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- (2) Argonne National Laboratory - East (ANL-E), 1993. FY 94 Laboratory Integrated Facilities Plan. Document No. JOSTD-106-G-T006.
- (3) Argonne National Laboratory-East (ANL-E), Five Year Plan for Environmental Restoration and Waste Management Program.
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