CHAPTER 2

PROPOSED ACTION AND ALTERNATIVES

The WIPP facility, in addition to serving its primary mission as a TRU waste disposal site, needs to perform a variety of actinide chemistry experiments to (1) support WIPP's recertification efforts, (2) address scientific questions important to WIPP, (3) improve TRU waste characterization techniques, and (4) improve DOE's understanding of how the waste interacts with the natural environment in order to better understand waste isolation performance. In the past, WIPP-related actinide chemistry experiments have taken place at DOE laboratory facilities at other DOE sites such as LANL. However, due to reductions in travel budgets and additional security requirements being imposed on DOE weapons laboratories, DOE believes it would be better able to maintain the budget, schedule, and quality of experiments conducted in support of the WIPP program if they were performed in Carlsbad.

DOE is preparing this document to inform decision makers about the potential environmental impacts of the actinide chemistry experiments associated with the Proposed Action, one alternative laboratory location, and a no action alternative, each of which are described in more detail in this chapter. Under the Proposed Action, DOE would construct and operate the ACRSL facility adjacent to the CEMRC in Carlsbad. An alternative is to construct and operate a new actinide chemistry laboratory on the WIPP site. The No Action Alternative is to continue experimental activities in actinide chemistry at existing laboratory facilities at LANL.

The descriptions of the design, construction, and operation of the proposed ACRSL facility were obtained from the proposal submitted by the CEMRC (2000). The descriptions of the actinide chemistry research program and range of potential experiments that may be conducted in the ACRSL were obtained from WIPP project personnel (Mercer 2002).

2.1 PROPOSED ACTION (NEW ACTINIDE LABORATORY AT CEMRC)

Under the Proposed Action, DOE would construct and operate an ACRSL facility in Carlsbad to support actinide chemistry experiments for WIPP. The ACRSL would be located adjacent to the existing laboratory operated by the CEMRC (see Figure 1-2), which would manage the proposed new facility. The new laboratory could either be a mobile laboratory facility, a newly constructed permanent laboratory facility, or a combination of these two facilities (currently, it appears that DOE would begin actinide experiments in the mobile facility and use the newly constructed permanent laboratory building for additional experiments when funding for the new building became available). If DOE decides to use the mobile facility, it would be permanently sited at the CEMRC and the facility would be equipped to meet all air quality, safety, and security requirements in the same manner as the rest of the ACRSL facilities. The new permanent laboratory would be a freestanding building, but it would be located close enough to the CEMRC to be connected by a walkway. Thus, the new building would look like another wing of the CEMRC (Figure 1-2). DOE would make the actinide chemistry laboratory available to third-party users to perform work in support of the WIPP mission.

The proposed ACRSL facility would be approximately 725 square meters (7,800 square feet). The parameters of the conceptual design of the proposed facility are provided in Table 2-1. The design assumes that the infrastructure already present at the CEMRC is not replicated in the ACRSL facility. The proposed ACRSL facility would use existing CEMRC infrastructure such as meeting rooms, administrative offices, reception area, parking, land, access road, fiber optic line, utilities, and sewer. The proposed ACRSL would also have the support of the CEMRC administrative personnel (for example, director, fiscal specialist, buyer, and computer technicians). In addition, the ACRSL would not provide

permanent office space for facility users; instead, cubicle space would be provided for non-resident technical work outside the laboratories.

Table 2-1. ACRSL Facility Conceptual Design

Description	Area in square meters (square feet)
Functional Net Space	
High-level radiochemistry	84 (900)
Wet chemistry	56 (600)
Sample preparation	84 (900)
Instrumentation	84 (900)
Waste management	46 (500)
Miscellaneous (e.g., cubicle space, reception, etc.)	139 (1,500)
Subtotal	**493 (5,300)**
Building gross space (e.g., corridors, walls, mechanical, etc.)	232 (2,500)
Building Gross Area	**725 (7,800)**

Source: CEMRC 2000

The CEMRC would be funded by DOE to construct and maintain the facility, and DOE would purchase the movable equipment; however, it would be a multi-user facility. Most of the staff at the facility would consist of personnel on long-term assignments from LANL, Sandia National Laboratories, and Westinghouse TRU Solutions LLC. Most of this staff would probably reside permanently in Carlsbad. Some of the staff could consist of personnel on short-term assignments from other DOE laboratories; other federal agencies; American universities or companies; or foreign governments, universities, or companies. These individuals would probably not reside permanently in Carlsbad. The total long- and short-term staff would comprise between 15 and 25 people. Efforts would begin in fiscal year (FY) 2002, with construction likely beginning in FY2003. The existing facilities at Carlsbad would be used to the maximum extent possible. The program would collaborate with the CEMRC by setting up new capabilities at the CEMRC in FY2002 and by supporting some of the existing capabilities and personnel.

2.1.1 Range of Potential Experiments

The activities that would be performed in the proposed ACRSL can be generally described as directed research and development in actinide chemistry involving tracer levels of radioactive materials. The activities may involve reactions in the solid state and in aqueous and non-aqueous liquid media (varying with programmatic requirements). No production or process lines or routine waste treatment operations would be carried out in the facility. This would be a multi-user facility in which long- and short-term projects would be carried out as defined in the associated hazard control plans. Categorization of experimental activities according to their levels of radioactive materials would help mitigate most hazards.

The maximum amount of radioactive material housed at the combined CEMRC and proposed ACRSL would not exceed 2 curies (the site-wide limit). Because of the diverse hazards and operations in the proposed ACRSL, special physical and administrative access controls would be in place. For example, physical controls would include double high-efficiency particulate air (HEPA) filters at a minimum on all exhaust airflows. An additional local HEPA filter in the exhaust would be provided for glove boxes or high-activity fume hoods, so the airflow would be treated by triple-HEPA filtration before discharge to the environment. There would be no radioactive releases to the sanitary sewer. As part of the administrative controls, facility-specific training would be required for workers who would need

unescorted access to the facility to perform any of the operations covered by the active hazard control plans. Activities would include the handling of alpha-emitting actinide elements (for example, uranium-233, neptunium-237, plutonium-239, plutonium-238, plutonium-242, americium-241, americium-243, and curium-248), and beta-emitting elements (for example, cesium-137, strontium-89, strontium-90, technetium-99, technetium-95, sodium-22, europium-152, cerium-141, and cerium-144). Experiments could include solubility and speciation studies, electrochemistry, and calorimetry at ambient and elevated temperature and pressure conditions. Experiments would be carried out in various types of containers (for example, beakers, flasks, vessels), both open and closed, made of various materials (for example, titanium, glass, and Teflon). All experiments involving samples of TRU elements would be handled using appropriate containment in solid and solution forms. All experiments involving solid TRU samples would be performed in HEPA-filtered glove boxes.

The proposed ACRSL would focus on special nuclear material (specifically, plutonium-238, plutonium-239, plutonium-240, plutonium-241, plutonium-242, neptunium-237, curium-248, curium-244, americium-241, and americium-243, in quantities that would never be sufficient to form critical mass); source material (for example, uranium and thorium series); and by-product material (for example, technetium-99, yttrium-90, strontium-90, and cesium-137). All of the research activities would be permitted under the existing broad-scope license possessed by the CEMRC. The CEMRC's license has recently been amended to allow for the total radioactivity on site to be 2 curies. At these quantities, an emergency plan for responding to the release of radioactive material and an evaluation of demonstrating offsite doses would not be required under the State of New Mexico Radiation Protection Regulations. However, the CEMRC license does limit the size of a single source to 30 microcuries for special nuclear material, 2 millicuries for source material, and 2 millicuries for byproduct material. If the ACRSL were constructed, it is likely that the single source limit would have to be increased. The total site limit at the CEMRC would not be increased beyond 2 curies. In addition, a decommissioning plan to determine financial assurance requirements may be necessary.

DOE is proposing to conduct several experimental studies of issues relevant to WIPP operations and EPA recertification in the proposed ACRSL. These studies would help DOE address specific scientific and technical issues related to waste characterization, repository performance, and enhanced operations of the repository. Planned and potential experiments to support WIPP operations and recertification include, but are not necessarily limited to: (1) the effects of WIPP-relevant materials (such as reductants) and potential radiolysis by-products (for example, hypochlorite and peroxide) on the oxidation states and speciation of plutonium, americium, uranium, thorium, and neptunium; (2) the effects of organic ligands on the mobility of plutonium and other actinide elements in WIPP-relevant brines; (3) the demobilization of actinides by borehole fill materials; and (4) the efficacy of oxidation state analogs for predicting the behavior of the actinides. These studies would require the use of the radioactive isotopes of plutonium, americium, uranium, thorium, and neptunium, and perhaps cesium and strontium. Specific issues that may be addressed include (not necessarily in order of priority):

1. The occurrence of plutonium(V) and plutonium(VI) in some of the Actinide Source-Term Waste Test Program experiments;

2. The effects of alpha radiolysis of WIPP-relevant brines on the oxidation states of plutonium, uranium, and neptunium;

3. Reduction of oxidized actinides such as plutonium(V) and plutonium(VI) to plutonium(III) and plutonium(IV), respectively, by steel, other iron-base metals, and perhaps aluminum;

4. Effects of reactions between WIPP brines and various waste forms on brine chemistry, especially Eh and pH;

5. An integrated thermodynamic and kinetic redox model for plutonium under expected WIPP conditions;

6. Co-precipitation and sorption of plutonium, americium, uranium, thorium, and neptunium by magnesium oxide and other relevant materials such as cements;

7. The extent to which colloids could increase the solubilities of plutonium, americium, uranium, thorium, and neptunium by forming complexes with these elements in WIPP brines; and

8. The extent to which organics could increase the solubilities of plutonium, americium, uranium, thorium, and neptunium.

The types of experiments that could be performed in the proposed ACRSL facility are expected to fall within five major categories of research. Appendix A contains specific examples of the types of experiments within each of the five major research categories that could be conducted at the ACRSL.

DOE could also conduct two other categories of study: (1) experimental studies of issues relevant to the characterization of TRU waste, and (2) studies for possible funding by other DOE projects, other federal agencies, private American companies, or even foreign governments or companies. These studies could require the use of radioactive elements other than those listed previously.

Experiments conducted in the proposed ACRSL are expected to initially involve only simulated contact-handled (CH)-TRU or remote-handed (RH)-TRU waste rather than actual CH-TRU or RH-TRU waste. Researchers would specify which radioisotopes would be required and the quantities of each radioisotope required. Solubility experiments require dissolved radioactive element concentrations that are high enough to stabilize radioactive element-bearing solids and enough of these solids for post-test characterization by methods such as X-ray diffraction analysis. Currently, it is anticipated that solubility (or similar) experiments would require glove boxes with atmospheres at a pressure slightly lower than ambient for containment of these radioactive elements, but they would not require shielded hot cells with remote-controlled (robotic) apparatus.

2.1.2 Facility Coordination and Management

The CEMRC would acquire all permits and licenses necessary to construct and operate the facility. Under the Proposed Action, the CEMRC would establish an ACRSL user group with members from DOE, CEMRC, LANL, and Sandia National Laboratories. The ACRSL user group would select a design team, which would likely consist of laboratory consultants, health physics consultants (for glove box design and monitoring requirements), architects, mechanical and electrical engineers, and equipment planners. As indicated in Chapter 1, the current CEMRC license, as amended, would allow the quantities of radioactive materials required for the proposed scientific activities for the proposed ACRSL facility.

The CEMRC would provide overall project management for construction of the ACRSL facility. Once constructed, the CEMRC would be responsible for managing owner occupancy activities (for example, testing of building systems and equipment). During construction, the CEMRC would arrange for major fixed and movable building-related equipment (such as glove boxes and fume hoods), minor movable equipment (telephones, radiation monitors, etc.), and furnishings (bench stools, cubicles, etc.). However, specification, procurement, and maintenance of scientific instrumentation would be the responsibility of the ACRSL facility users. The proposed ACRSL building would be constructed to accommodate a wide variety of scientific equipment and instrumentation.

2.1.3 Facility Operations

The proposed ACRSL facility, once constructed, would be owned by New Mexico State University and operated by the CEMRC under contract to DOE. The CEMRC would operate the facility as a multi-user research laboratory, providing basic usage coordination, physical plant operation, and environmental, safety, and health compliance management (including radioactive materials licensing). Long- and short-term research projects to support the operation of WIPP would be performed by research entities (such as LANL and Sandia National Laboratories) identified by the Carlsbad Field Office (CBFO), and the CEMRC would facilitate such projects through the operations contract. The ACRSL would be administered as an integrated program of the CEMRC to avoid duplication of administrative costs and to capitalize on opportunities for collaborative efforts.

A major responsibility of the CEMRC would be to provide a safe working environment for all users. To ensure a safe working environment, all activities performed in the proposed ACRSL facility would be conducted in accordance with the requirements of the CEMRC's Radioactive Materials License, Radiation Control Manual, and Chemical Hygiene Plan, under direct supervision of the Radiation Safety Officer and Chemical Hygiene Officer. These requirements would apply to any user present or experiment being conducted at the ACRSL. The CEMRC would provide all safety-related infrastructure support (for example, training and orientation, contamination surveys, fume hood audits, chemical and waste inventory tracking). The CEMRC would also manage the proposed ACRSL facility's chemical and radioactive material and waste inventories to ensure compliance with the CEMRC's Radioactive Materials License, Radiation Control Manual, Chemical Hygiene Plan, and other applicable state and federal regulations. The proposed ACRSL and CEMRC would continue to be regulated and audited by the New Mexico Environment Department, Radiation Protection Bureau in accordance with the CEMRC's Type A Specific License of Broad Scope for radioactive materials.

The CEMRC would be responsible for the management and disposal of industrial, hazardous and low-level, Class A, radioactive waste generated from experiments conducted in the proposed ACRSL. No user would generate mixed waste without prior approval by the CEMRC Radiation Safety Officer and Chemical Hygiene Officer, who would require the user to provide a plan for expedient disposal or removal from the proposed ACRSL. User organizations would be responsible for the disposal of any mixed waste or radioactive waste (other than Class A) that is generated from experiments conducted at the ACRSL. These wastes would be removed from the proposed ACRSL by the responsible organization within 1 year of generation (or less if required by applicable regulations). None of these wastes would be discharged to the Carlsbad sewer system.

Sanitary and solid waste disposal for the proposed ACRSL facility would be handled through existing CEMRC connections and subscriptions with the City of Carlsbad. Sanitary waste would be disposed of through the existing sewer connection for the CEMRC. Non-hazardous solid waste would be included with the existing CEMRC subscription to the City of Carlsbad for solid waste disposal.

2.2 ALTERNATIVE FOR NEW ACTINIDE LABORATORY AT WIPP

Under this alternative, DOE would design, construct, and operate a new actinide chemistry laboratory at WIPP. The most likely location for this new laboratory would be in the northeast corner of the WIPP site inside the fence (Figure 2-1). Although the design of the laboratory would be similar to the design of the ACRSL facility for the Proposed Action, the new laboratory at WIPP would be a larger building. The new building would include meeting rooms, administrative offices, and a reception area, and would require connections for utilities and sewer. A new actinide chemistry laboratory at WIPP would also require new hires for administrative support (for example, director, fiscal specialist, buyer, and computer technicians).

2.3 NO ACTION ALTERNATIVE FOR EXISTING ACTINIDE LABORATORY AT LANL

Under the No Action Alternative, DOE would continue experimental activities in actinide chemistry at the existing laboratory facilities at LANL. Currently, these experiments are conducted primarily in Technical Area (TA) 48 (shaded area in Figure 2-2), with most of the experiments in the Radiochemistry Laboratory (TA-48-1, shaded area in Figure 2-3). The Radiochemistry Laboratory is designed as an actinide chemistry and metallurgy building with full capabilities for performing special nuclear material analytical chemistry and materials science (DOE 1999). Previously, critical WIPP-related research activities were performed at many separate laboratories around the country. Now, with the exception of the LANL location, WIPP has ended those experiments at other sites. This alternative would not allow DOE to meet its goal of enhancing the efficiency and cost-effectiveness of the actinide chemistry program or of eliminating the difficulties associated with the security requirements at laboratories that primarily perform weapons-related work.

2.4 ALTERNATIVES CONSIDERED BUT NOT ANALYZED

Two alternatives to the Proposed Action were considered but not analyzed. One possible alternative would be to build a new actinide chemistry laboratory in a different area of the country. However, this alternative was not analyzed because it would not meet DOE's objective to consolidate experiments near WIPP. Another possible alternative would be to discontinue all WIPP-related actinide chemistry experiments. This alternative was not analyzed because it would not meet DOE's need to perform a variety of actinide chemistry experiments to (1) support WIPP's recertification efforts, (2) address scientific questions important to WIPP, (3) improve TRU waste characterization techniques, and (4) improve DOE's understanding of how the waste interacts with the natural environment in order to better understand waste isolation performance.

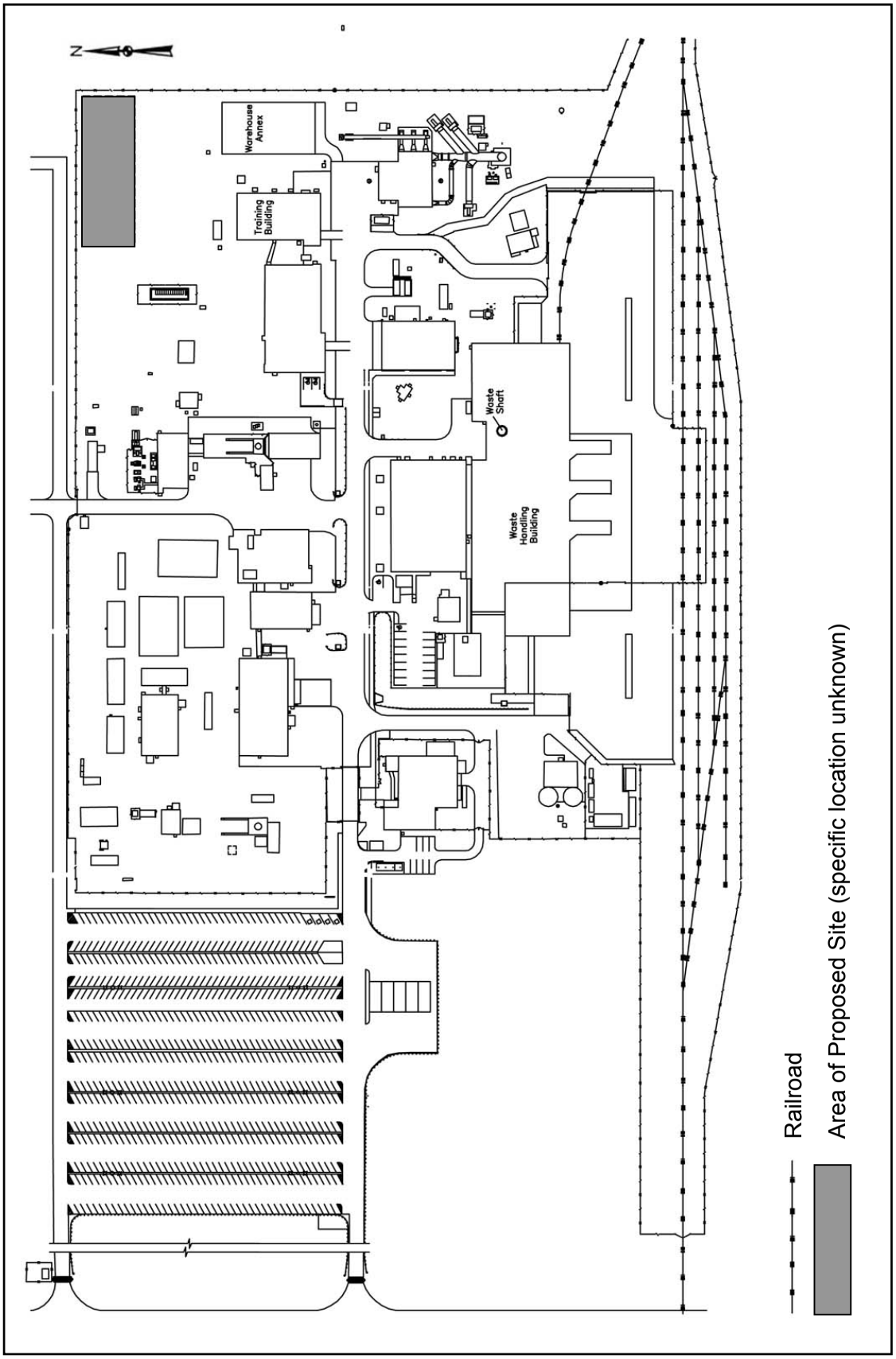
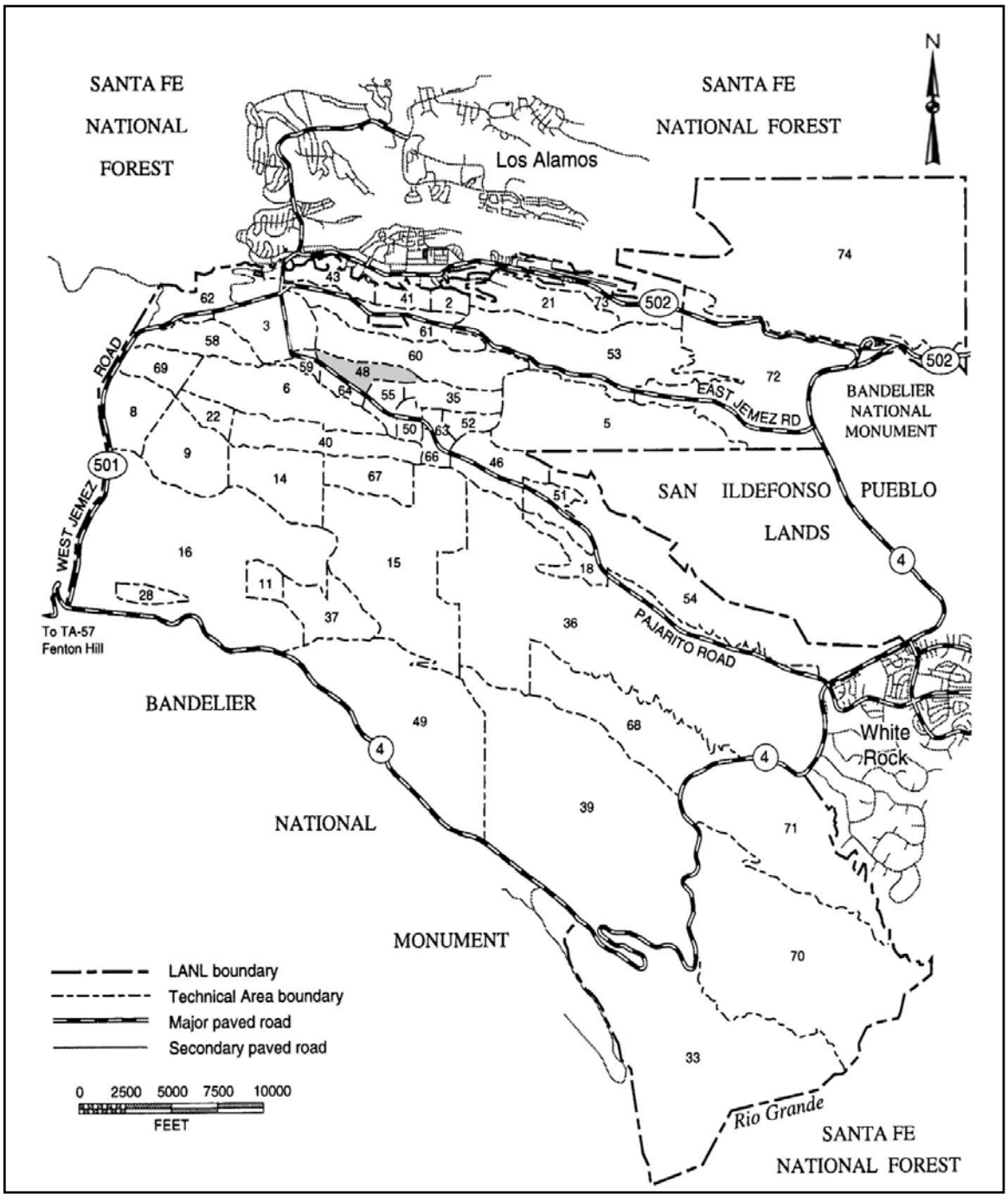
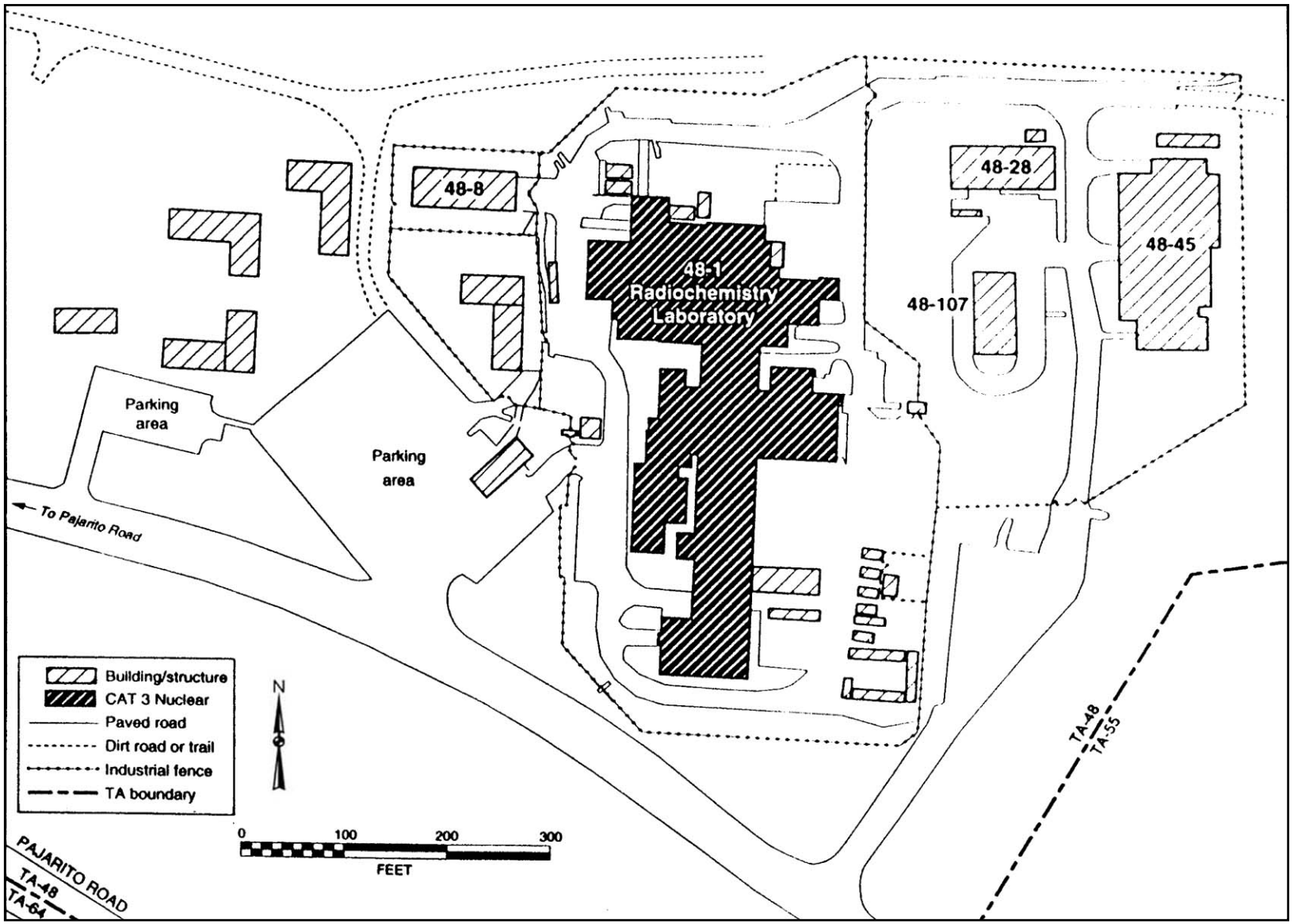


Figure 2-1. Potential Location of the New Actinide Chemistry Laboratory on the WIPP Site



Source: DOE 1999

Figure 2-2. Location of TA-48 at LANL



Source: DOE 1999

Figure 2-3. Location of the Radiochemistry Laboratory (TA-48-1) at LANL

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