ENVIRONMENTAL ASSESSMENT

WEAPONS ENGINEERING TRITIUM FACILITY

Building 205, Technical Area 16

LOS ALAMOS NATIONAL LABORATORY

Los Alamos, New Mexico

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Summary in Main Files
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EXECUTIVE SUMMARY

The Weapons Engineering Tritium Facility (WETF) was planned by the U.S. Department of Energy (DOE) to retain at Los Alamos National Laboratory the capability of repackaging small quantities of tritium to exacting specifications. Small quantities of tritium are required for energy research and development activities and for research on nuclear weapons test devices carried out as part of the Laboratory mission. The WETF is an improved design proposed to replace an aging Los Alamos facility where tritium has been repackaged for many years. Tritium repackaging at the older facility was suspended in October 1990. Operations at the older facility will remain suspended pending completion of the National Environmental Policy Act (NEPA) process and a decision on whether to operate the new facility or to continue tritium repackaging at the older facility. This Environmental Assessment evaluates the environmental consequences to be expected from operating the new facility, for which construction was completed in 1984, compared with those from continuing to operate the old facility. The document was prepared for compliance with NEPA.

In operation, the WETF will incorporate state-of-the-art systems for containing tritium in glove boxes and capturing any tritium released into the glove box exhaust system and the laboratory atmosphere. The expected result is a decrease in doses to workers and a decrease in annual tritium emissions related to packaging operations from about 7 000 curies (from current operations at the aging facility) to less than 400 curies (from the proposed operations at the WETF). The proposed action would reduce the total quantity of tritium emitted annually from the Laboratory by 60%. In addition, the tritium captured during operations at the WETF could be reclaimed and recycled, reducing the demand for new tritium production.

Liquid discharges from the WETF would contain about 0.0001 curie of tritium per year. This is less than 1% of the tritium found in effluents from the present facility. Effluent streams from the WETF, like those from the existing facility, would be surface discharges and would not enter the aquifer from which municipal water supplies are drawn. That aquifer is isolated from surface discharges by thick tuff and volcanic sediment deposits.

Less than 6 cubic meters (200 cubic feet) of low-level radioactive waste per year would be disposed of on site. Solid radioactive waste of greater activity would be stored on site until the tritium decays sufficiently that the waste becomes nonradioactive trash or until demand and technology make tritium waste reclamation cost-effective. Quantities are not expected to exceed 2 cubic meters (72 cubic feet) per year. The quantity of solid radioactive waste generated at the WETF would be approximately the same as that generated at the present facility.

The risk to the public from normal tritium-packaging operations would be significantly less from the WETF than from the present facility. Even if an accident should occur, any tritium releases caused by such an abnormal event would be smaller from the WETF because of the tritium-capture systems, which would reduce the doses to the public.

Decisions on the decontamination and decommissioning of the facility to be replaced and on any ultimate reuse of the facility will be assessed at a later date. As a part of the decision-making process, a NEPA review will be conducted.

The proposed action will thus reduce the adverse environmental impacts caused by tritium repackaging by substantially reducing the amount of tritium that escapes to the environment.

WEAPONS ENGINEERING TRITIUM FACILITY
Los Alamos National Laboratory

1.0 STATEMENT OF PURPOSE AND NEED

1.1 Present and Future Mission of the Los Alamos Tritium Facility

Tritium* is used in fusion research performed at Los Alamos National Laboratory (LANL or the Laboratory) and in weapons test devices assembled at the Laboratory and tested at the Nevada Test Site. Small quantities are prepared and packaged to meet the precise requirements of experiments and to reduce the amount of tritium that could be released by potential uncontrolled emissions from test facilities.

The present and future mission of the Laboratory tritium-packaging facility is to

- repackage tritium, which is obtained from the U.S. Department of Energy (DOE) supplier, into smaller quantities and at specified higher pressures;
- analyze gaseous tritium for purity;
- remove contaminants, especially helium-3, from tritium gas; and
- prepare and package mixtures of tritium with other gases.

1.2 Purpose and Need for a New Tritium Facility

Tritium, supplied in small quantities and highly purified for research projects, is crucial in the operation of ongoing DOE programs at the Laboratory and the Nevada Test Site. These programs support the nation's energy and weapons defense research efforts.

Construction on the new facility in this project began in October 1982 and was completed in February 1984. The proposal is that this facility begin operation and replace the aged tritium-packaging facility now located in Building 86 at Technical Area 33 (TA-33). Tritium repackaging at the older facility was suspended in October, 1990. Operations at the older facility will remain suspended pending completion of the National Environmental Policy Act (NEPA) process and a decision on whether to operate the new facility or to continue operating the older facility. The old facility has no containment or recovery capacity for either gaseous or aqueous tritium wastes, which means that tritium escapes to the environment. Also, because the old facility is remote from all analytical and user groups, tritium packages must be transported over public roads. Operating in a new facility, built to modern containment and recovery standards and located adjacent to the program support facilities, will enhance the safety of the public and of Laboratory employees, will aid in protection of the environment, and will ensure an adequate supply of packaged gas for research projects. Work proposed to be performed at the new facility includes preparing, analyzing, and packaging suitable mixtures of deuterium, tritium, and other gases for experiments.

The assessment of effects presented in this Environmental Assessment (EA) is based on conservative assumptions that tend to maximize the estimates of environmental impacts. Thus, actual environmental consequences are expected to be less than those presented here. Also, because the proposed

*Tritium is a radioactive (unstable) isotope of hydrogen having an atomic weight of 3, a half-life of 12.26 years, and specific activity of 10 000 Ci/g; tritium decays to ^{3}He by emitting a 0.018-MeV beta particle.

action is to replace an existing facility, the continued operation of which represents the no-action alternative, the proposed action is expected to result in an overall improvement in impact when compared to operating the older facility.

1.3 History of Planning for the New Tritium Facility

The need for a new facility for packaging tritium has been recognized since 1974. All through the planning process, consideration has been given to improvements in facility design and to studies of alternative sites, consistent with the National Environmental Policy Act (NEPA) philosophy. From 1979 to the present, siting considerations and determinations of maximum inventory and design emission levels have evolved substantially. Environmental impact documentation has been prepared several times during this evolutionary process, as shown in Table 1-1.

The first document, an EA for a new tritium-packaging operation, was prepared in April 1979. The plan proposed the addition of 280 m^2 (3 000 ft^2) of space to an existing building at TA-41, where some of the packaged tritium would be used. The addition was sized to provide for a maximum inventory of 24 g of tritium and an annual emission rate of 100 Ci. The EA was reviewed and approved by the Laboratory Environmental Review Committee (LERC) in 1979.

A new tritium facility to supplement or replace the existing facility at TA-33 was described in the sitewide Environmental Impact Statement (EIS) of 1979 (DOE 1979). The description of the facility, proposed site location, and design capacity were identical with those specified in the April 1979 EA.

In March 1981, a Health, Safety, and Environmental Remark (HSER) was prepared for a new tritium facility addition at TA-41. The plans in this document called for the size of the proposed facility to be increased to 370 m^2 (4 000 ft^2). This facility also was designed for 100 Ci/year of routine tritium emissions, but the maximum inventory amount was not stated. Environmental information provided in this document was accepted by the DOE Albuquerque Operations Office (DOE/AL) on August 17, 1981, and a statement was issued by that office that no EIS or EA would be required for the project.

TABLE 1-1. Environmental Impact Documentation for Evolving New Tritium Facility, 1979–1990

Document	Date Prepared	Proposed Site	Design Emission (Ci/yr)	Maximum Inventory (g)	Status
Environmental Assessment (EA)	04/79	TA-41	100	24	Indeterminate
Sitewide Environmental Impact Statement (EIS)	12/79	TA-41	100	Not stated	Published December 1979
Health, Safety, and Environmental Remark (HSER)	03/81	TA-41	100	Not stated	Approved August 17, 1981
Action Description memorandum (ADM)[a]	09/81	TA-16	100	Not stated (100 g implicit)	Indeterminate
ADM (rev.)	03/87	TA-16	400	250	See Note

[a]This document was a revision of the HSER.

NOTE: As a result of this revised ADM, the DOE Albuquerque Operations Office (DOE/AL) requested additional information on October 21, 1987. On February 5, 1988, they requested a decision on the level of NEPA documentation required, and in June 1989, DOE Headquarters requested an EA.

The site selected for this new facility was subsequently recognized as having significant disadvantages, including its location in the bottom of Los Alamos Canyon, which is next to the developed public area of Los Alamos. The following limitations were identified for the selected site:

- the facility would be in close proximity to townsite business and residential areas, beginning at the canyon rim;
- the location is in a rockfall zone;
- possible adverse impact could result to a wetland area in the canyon bottom;
- the constricted area in the canyon bottom would limit proper facility construction and future expansion;
- the location is 7 miles from the radiographic facilities at TA-16, which would require packages to be transported over public roads for analysis; and
- management in the Design Engineering (WX) Division was considering consolidating all their operations at TA-16.

The TA-41 location is an alternative that was considered but dismissed. The location is not acceptable for further construction because of impact on floodplains and wetlands, the proximity to the Los Alamos townsite, and the hazard from falling rocks.

Because of the disadvantages of the TA-41 site, the HSER was revised and resubmitted in September 1981. The document described a facility essentially identical to the one addressed in the HSER document, but the proposed site was changed to TA-16, which is on a mesa top remote from the settled areas of Los Alamos County. TA-16 is located within S Site, the area set aside for high-explosives testing and machining, and thus is a secure area. The advantage to being in a secure area is that management has more efficient control over procedures designed to minimize risk to the public and to provide maximum security against theft or diversion of radioactive materials. The design emissions rate specified in the ADM for this tritium facility was again set at 100 Ci/year. The maximum inventory amount was not stated, but 100 g is implicit from subsequent documentation.

Construction on this facility began in October 1982. The facility was accepted as complete in February 1984. Process equipment was designed and installed in the interval from 1984 to 1987 (LANL 1989b). In March 1987, the proposal was revised to provide for an expected increase in the amount of maximum inventory from 100 to 250 g. This EA has been prepared to assess the environmental impacts of operating the new tritium-packaging facility, Building 205 at TA-16, now called the Weapons Engineering Tritium Facility (WETF).

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES TO THE PROPOSED ACTION

2.1 Proposed Action

The proposed action is to perform the tritium-packaging operations in a new, expanded facility at TA-16, called the WETF. The WETF, which incorporates state-of-the-art subsystems for containment and collection of tritium gas and liquids, is in a 740-m^2 (8 000-ft^2) two-level building and is capable of handling a maximum of 250 g of tritium at one time. The building is located in an area designated for nonexplosives at TA-16, which is a remote explosives site approximately 5 km (3 mi) southwest of the Los Alamos townsite. The location of TA-16 with respect to the Laboratory, Los Alamos County, Bandelier National Monument, and New Mexico is shown in Figs. 2-1 and 2-2. An artist's conception

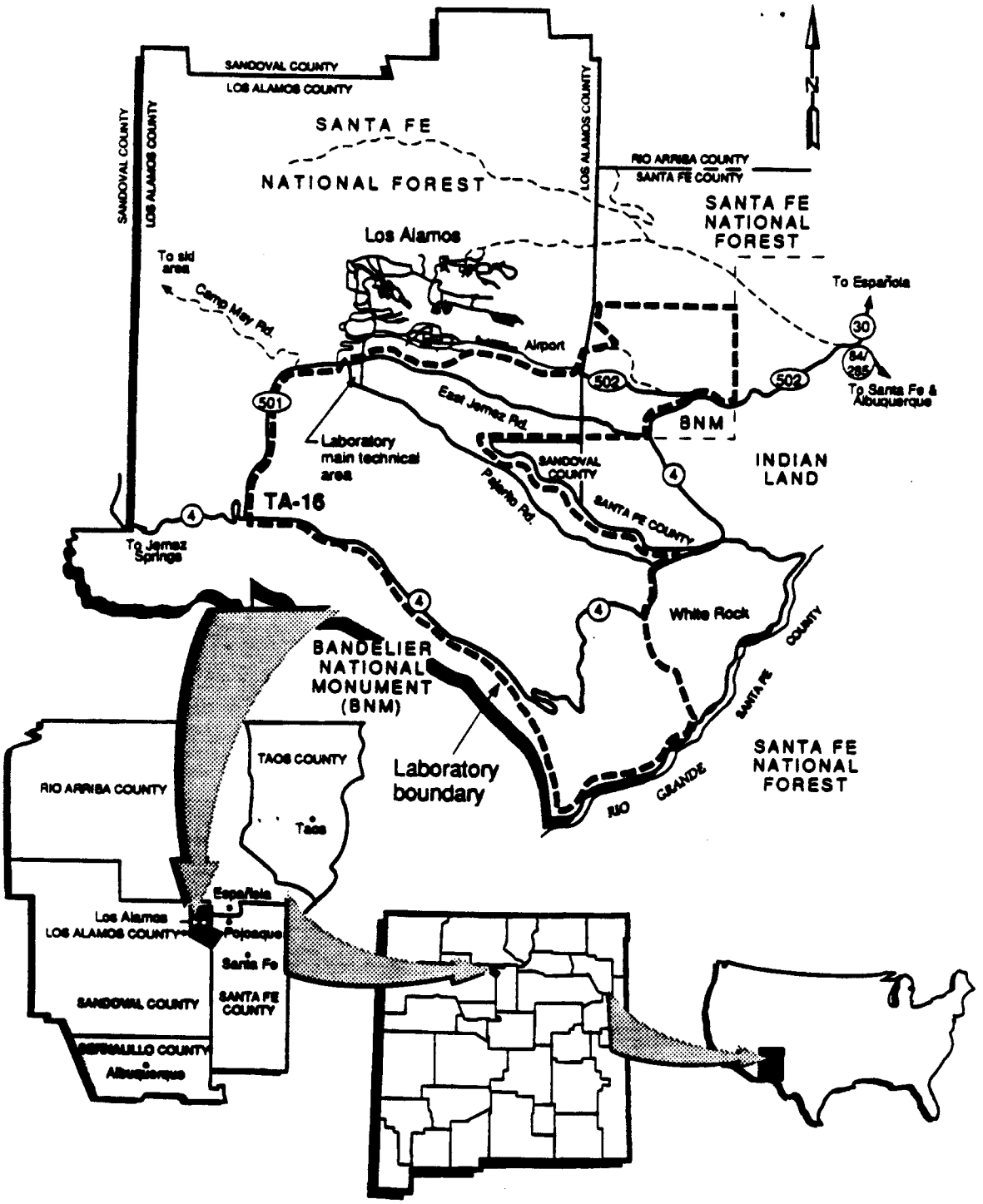

FIG. 2-1. Location of Los Alamos National Laboratory.

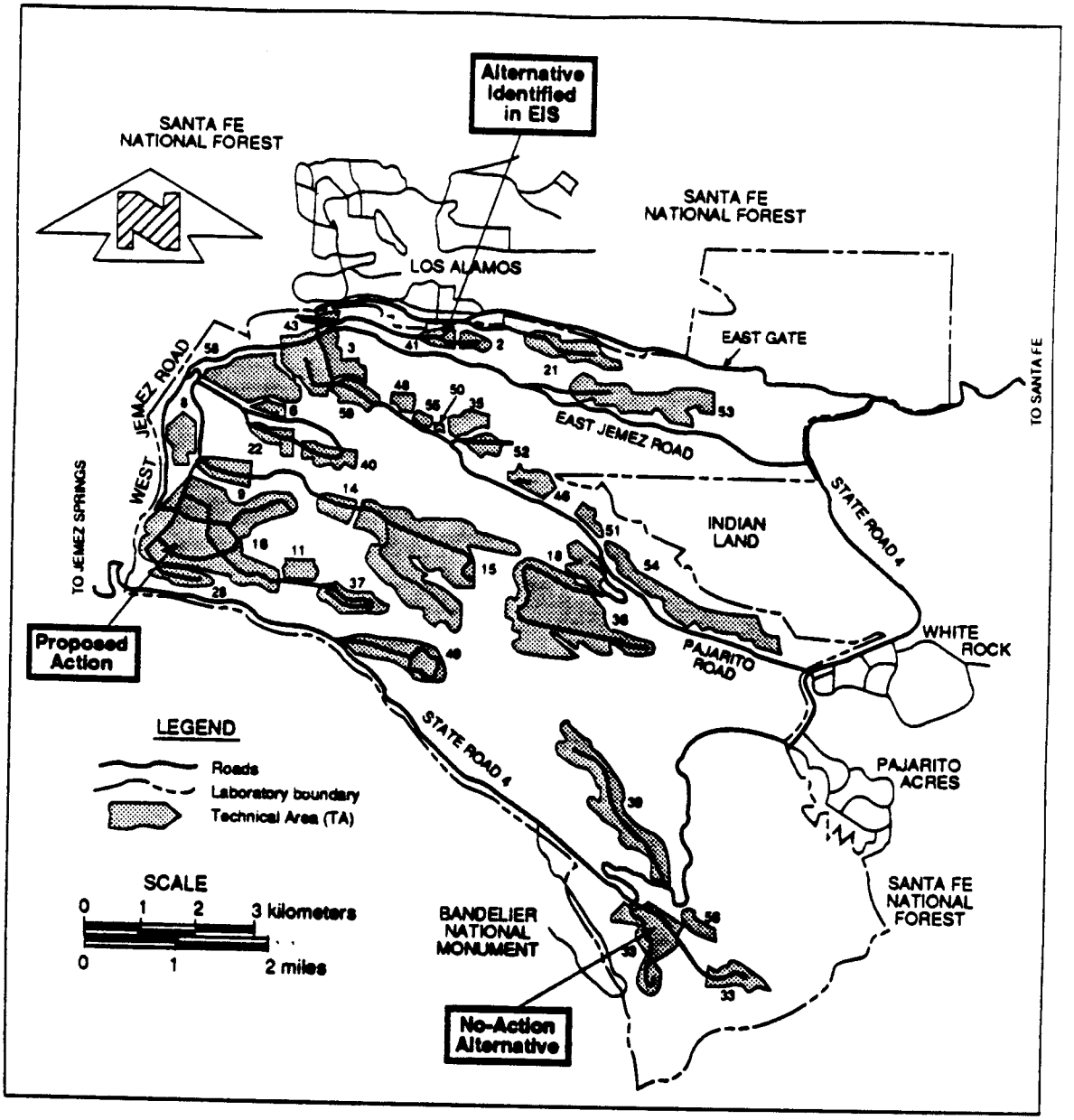

FIG. 2-2. Location of Laboratory technical areas and Los Alamos populated areas.

of the WETF is shown in Fig. 2-3. Tritium coming into the Laboratory will continue to be stored in the vault at TA-41 before being transferred to the WETF at TA-16. Packaged tritium from the WETF, in some cases, will be returned to the vault at TA-41 before being shipped off site. This storage in the TA-41 vault will be a continuation of current practice.

The WETF is sited approximately 15 m (50 ft) southwest of a non-high-explosives Materials Testing Facility in the southwest section of TA-16. This entire area is behind security barriers. The WETF and its subsystems are described fully in the FSAR (Final Safety Analysis Report, LANL 1989b).

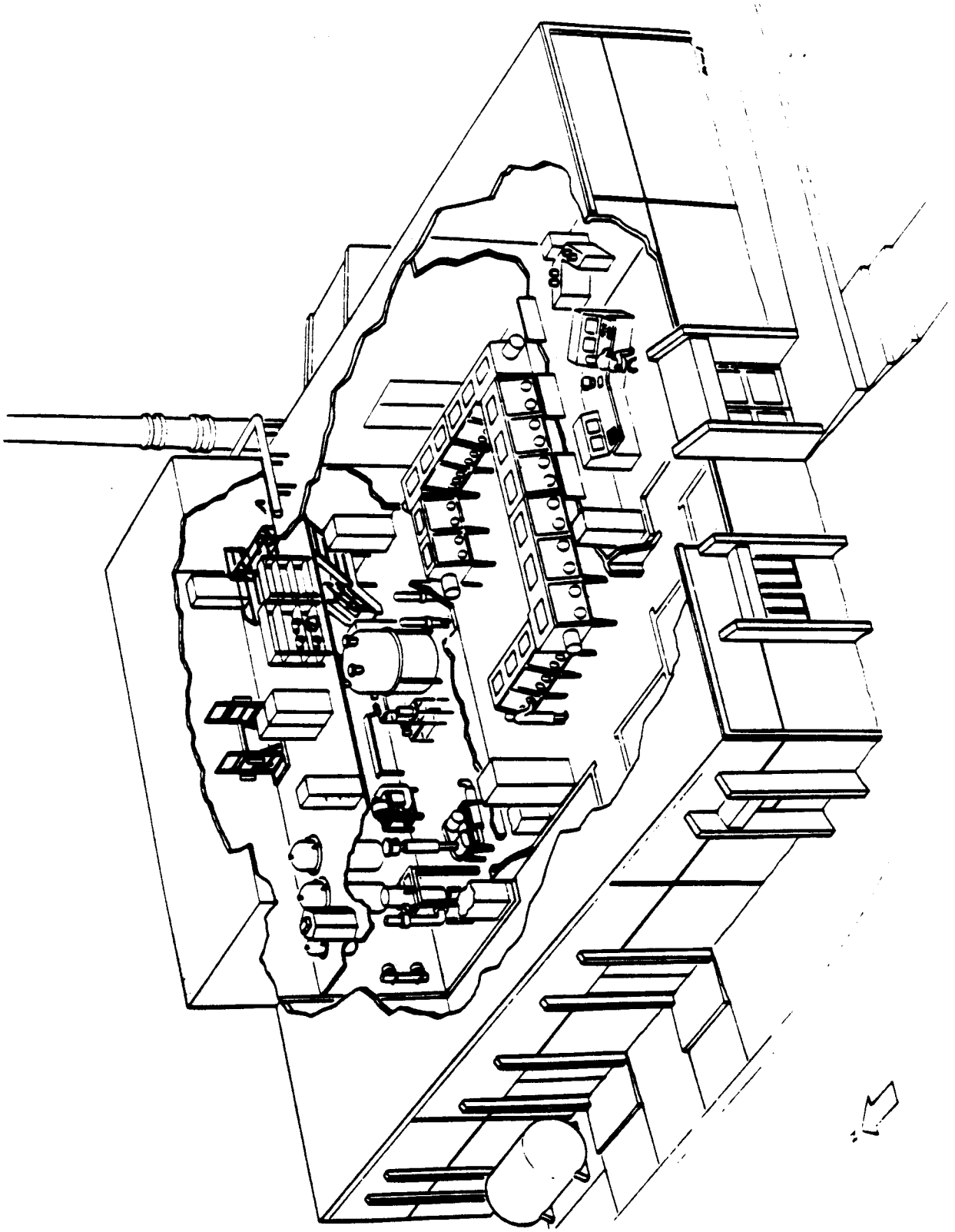

FIG. 2-3. Artist's conception of the WETF.

At some future time, DOE may consider relocation of other facilities at the Laboratory that address weapons components. The location of the WETF at TA-16 does not preclude any options for future locations of these facilities. Any proposed future relocation of facilities related in any way to the WETF will be evaluated in accordance with the NEPA process before any decisions are made.

The most significant advances in the WETF design are the provisions for subsystems to contain and capture leaked tritium gas and tritiated waste water. Briefly stated, the design is for a three-level gas-containment system. The first level and primary containment for gases consists of containers that will be handled within glove boxes. The second level of containment is provided by the glove boxes themselves. A nonoxidizing atmosphere of dry nitrogen flows through the glove boxes and is exhausted to the Tritium Waste Treatment Subsystem, where any tritium or deuterium escaping from primary containment is catalytically oxidized to tritiated water vapor. The tritiated water vapor is then captured on molecular sieve material before the atmosphere is exhausted to the environment. The third level of containment is the building. Experience with similar tritium-capture technology indicates that although the capture system is not 100% effective, emissions from the WETF would be <50 Ci/year, much less than the conservatively stated design level of 400 Ci/year and significantly less than the 7 000 Ci/year from the older facility.

In addition to the Tritium Waste Treatment Subsystem for handling tritium, the facility also has an alarm system, to alert the operator when a leak occurs, and an Emergency Tritium Cleanup Subsystem that can be activated manually or automatically. Three options are provided for responding to tritium leaks in the facility:

1. Even without an alarm sounding, the operator always has the option to manually seal off the laboratory atmosphere from its normal flow to the stack and to redirect the atmosphere exhaust into the Emergency Tritium Cleanup Subsystem.
2. When sufficient tritium has leaked into the room atmosphere to raise air concentrations above 0.05 mCi/m^3, the room air-monitor system sets off an alarm. The operator then has discretion as to whether to seal off the exhaust to the stack and redirect the air through the Emergency Tritium Cleanup Subsystem or to continue allowing the room atmosphere, which now contains some tritium, to be exhausted to the stack.
3. When the room air-monitor system senses a tritium concentration of 0.5 mCi/m^3, the alarm is activated again and the atmosphere exhaust path to the stack is automatically sealed. The exhaust flow is automatically redirected through the Emergency Tritium Cleanup Subsystem.

Molecular sieve material from the Emergency Tritium Cleanup Subsystem could be stored at the Laboratory or sent off site to be recycled, depending on tritium supply and the economics of recovery. The tritium captured from releases in the glove box atmosphere will be sent off site to be recycled. The subsystems used to capture tritium from the glove box atmosphere and to clean up any tritium leaked into the room atmosphere are described more fully in the facility FSAR (LANL 1989b).

The planned maximum inventory for the WETF at any one time is 250 g of tritium. However, all normal operations are planned so that only 24 g or less will be in process in the glove box line at any time. A special work permit and special procedures are required for operations requiring more than 24 g. This situation is expected to occur rarely, no more often than once per year (LANL 1989b).

Tritiated industrial waste water, other than that described above, will be collected and processed as a part of the Laboratory's liquid waste management operation. Floors in laboratory rooms in the new facility will be wet mopped weekly during operation to reduce tritium contamination. The mop

water will be collected in a tank and periodically transferred to the Liquid Radioactive Waste Treatment Plant at TA-50. Before they are discharged to the environment, effluents from this facility will be monitored to assure compliance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit.

There will be no hazardous or radioactive air emissions from the WETF, other than tritium. The only other emissions will be air and nitrogen gas, a normal component of air (78%).

Tritium-packaging operations will be moved from Building 86 at TA-33 into the WETF over a period of 1 to 2 years. At the end of that time, a decision on decontamination and decommissioning (D&D) and reuse of Building 86 will be made. The extent of D&D operations will determine the amount and types of waste that will be generated. A NEPA review of the environmental impacts of D&D, renovation, and any new proposed operations expected to be performed in that building will be conducted as part of the decision-making process for that project. No decisions will be made on D&D, renovation, or reuse of the building before the NEPA review process has been completed.

The WETF operation will comply with all relevant health, safety, and environmental criteria and regulations.

2.2 The No-Action Alternative

The no-action alternative is to retain all tritium-packaging operations in Building 86 at TA-33 (for location, see Fig. 2-2).

In October, 1990, DOE suspended tritium-packaging operations at this facility. Operations at the older facility will remain suspended pending completion of the NEPA process and a decision on whether to operate the new facility (the proposed action) or to continue operating the older facility (the no-action alternative). The Laboratory has long operated this facility, which was built before present-day containment methods were developed and which is located at some distance from user groups. The facility has minimal provision for containing leaked tritium gas; glove box and laboratory atmospheres are exhausted directly to the environment. A molecular sieve column collects tritium from piping-line cleanup operations only. When the column capacity is reached, or if the exchange rate is overwhelmed, excess tritium is emitted through the stack.

Atmospheric emissions of tritium from TA-33 have been routinely monitored. Over the years, a number of accidental tritium releases have been reported from this facility (LANL 1980–1989a). Past accidental releases resulted from such things as a faulty shipping-container closure, operator error, and leaking experimental apparatus. In addition to accidental releases, some releases were a consequence of experiments being carried out in a facility that has virtually no tritium-capture capability. Emissions from normal operations and accidental releases together have averaged almost 7 000 Ci/year during the past 10 years.

Effluents from TA-33 are also monitored. Waste mop water, contaminated with low levels of tritium, is discharged to a tile field at TA-33. Discharges are measured at about 2.5 to 3 Ci/year. No off-site migration of tritium has been detected in wells that have been monitored (LANL 1989a).

The TA-33 facility has less capacity to store tritium than does the WETF. The maximum inventory of the existing facility is 100 g of tritium, whereas the maximum inventory of the WETF will be 250 g. As is specified for the WETF, the old facility does not process more than 24 g of tritium at a time under standard operating conditions.

Transportation safety will be little affected by continuing tritium-packaging operations at TA-33. As shown in Fig. 2-2, TA-33 is remote from analysis facilities and user groups at TA-16 and from

facilities where research on tritium test devices is done at TA-41. At present, large packages of tritium (>10 g) are received from the Savannah River Plant, a DOE facility in Georgia. These packages are stored in a vault at the TA-41 facility before being transported about 19 km (12 mi) to TA-33 for repackaging. Packages sent to and from TA-16 for radiographic analysis add another 32 km (20 mi), round trip, which will not be required under the proposed action. About 50 trips per year are made between TA-33 and TA-41, where the tritium packages are assembled into test-device components, a 38-km (24-mi) round trip. In addition, about 10 to 20 trips per year are made to transport tritium packages to other Laboratory user groups at TA-16 and other sites. All these trips are made over public highways.

2.3 Alternatives Considered but Dismissed

2.3.1 Addition to the TA-41 Facility

As stated in Sec. 1.3, the original proposal for a new tritium facility was that it be an addition to the facility at TA-41, which is located in the bottom of Los Alamos Canyon in very close proximity to the Los Alamos townsite and residential areas. TA-41 is closer to the townsite than either TA-33 or TA-16 (Fig. 2-2). Potential doses to the public, therefore, would be much greater from TA-41 than from TA-33 or TA-16. Construction would have a negative impact on floodplains and wetlands on the canyon floor, and rocks falling from the canyon walls would also pose a hazard. In addition, the canyon location would mean a restricted building area, which would preclude options for locating related facilities in the same area. Earlier in the NEPA process, the TA-41 site was recognized as unacceptable and a superior site (TA-16) was identified, in part because it is a large site, remote from populated areas. Further consideration of the TA-41 site was discontinued late in 1981.

2.3.2 Renovation of Building 86 at TA-33

Building 86 at TA-33 could be renovated to incorporate the state-of-the-art tritium containment and capture technology. However, the site is closer to populated areas in White Rock than is TA-16. Even with improved technology, the population exposures to radioactive emissions would be greater from a facility at TA-33 than from one at TA-16. Further, tritium-packaging operations would have to be suspended during the renovation period, which would adversely affect the schedules for experiments that depend on packaged tritium. Finally, retrofitting an older facility is considered to be more difficult and is frequently more costly than new construction. This alternative was not pursued.

2.3.3 Relocation of the Tritium-Packaging Capability to Another DOE Site

The capability to repackage tritium could be developed at another DOE site. However, this alternative would greatly increase the transportation required because packaged tritium would have to be shipped from the Savanna River Plant production site to the repackaging site and then to Los Alamos. Additional transportation between the repackaging site and Los Alamos might also be necessary, depending on tritium requirements at Los Alamos. Transportation between Los Alamos and the Nevada Test Site would not be changed. This alternative was not pursued.

3.0 THE ENVIRONMENT

3.1 Laboratory Setting

Los Alamos National Laboratory is located on 111 km^2 (43 mi^2) of land in Los Alamos County in north-central New Mexico, approximately 100 km (60 mi) north-northeast of Albuquerque, 40 km

(25 mi) northwest of Santa Fe, and 30 km (20 mi) southwest of Española (Fig. 2-1). The Laboratory is on the Pajarito Plateau, a series of mesas and canyons, at an elevation about 2 200 m (7 200 ft) above sea level. The San Ildefonso Pueblo borders the Laboratory to the east; Bandelier National Monument, to the southwest.

A detailed description of the Laboratory environs is presented in the Laboratory EIS (DOE 1979).

3.1.1 Geology and Hydrology

The geologic and hydrologic characteristics of the Laboratory area are discussed in the annual environmental surveillance report for 1988 (LANL 1989a) and the Laboratory EIS (DOE 1979).

Water occurs at the Laboratory as on-site surface waters, shallow ground water, and the main aquifer underlying the site. The on-site surface and shallow ground waters are not a source of municipal, industrial, or agricultural supply. The shallow ground waters occur as perched zones that do not extend beyond the site boundary. These surface and perched waters are tapped only by monitoring wells; no off-site surface flow and no connections with the underlying aquifer have been found. The main aquifer, which is 180 to 360 m (600 to 1200 ft) deep and isolated from the surface by an impermeable layer of dry tuff and volcanic sediments 110 to 190 m (350 to 620 ft) thick, is tapped by wells as the source of municipal drinking water for Los Alamos. Recharge of this aquifer comes from the Jemez Mountains west of the Laboratory site.

3.1.2 Seismology

The Laboratory is located on the western edge of the Rio Grande Rift. Only one earthquake of magnitude 5.5 is known to have occurred in the vicinity of Los Alamos within the last 150 years. Los Alamos lies on the boundary between Zones 1 and 2 of the Uniform Building Code; Laboratory facility designs are based on the more restrictive Zone 2 criteria. Evaluation of the earthquake risk at Los Alamos is based on the results of a study of seismic hazard for DOE sites (Coats 1984). The design basis earthquake (DBE) has a force* of 0.38 g and a predicted return period of 5 000 years.

3.1.3 Climatology and Meteorology

The climatological and meteorological characteristics for the Laboratory area are discussed in the 1988 Laboratory environmental surveillance report (LANL 1989a). Briefly, Los Alamos has a semiarid, temperate mountain climate. Average annual precipitation is about 45 cm (18 in.).

3.1.4 Population Distribution

To evaluate the impacts of emissions from the new tritium facility, the potential effects on individuals as well as population groups have been investigated. The nearer an individual lives to an emission source, the greater the individual's exposure to the emission. As the size of the population increases, the population's collective exposure also increases. Thus, it is advantageous to locate a facility far from individual members of the public and from population centers.

The FSAR (LANL 1989b) describes effects on individuals who work in the WETF. In this EA, additional analysis is provided to address these effects on an individual who works in the same TA. Calculations of maximum effects on a member of the public who could be exposed are based on that person being located on the public highway that follows the site boundary. Exposures to individuals in Los Alamos townsite, White Rock, Royal Crest Trailer Park, and the Frijoles Campground of

*See the glossary at the end of the report for an explanation of units (for example, g).

Bandelier National Monument (Fig. 2-2), which are occupied year around, are also evaluated. The distances between these locations and tritium facilities at TA-16 and TA-33 are summarized in Table 3-1.

For this EA, exposures are also evaluated for off-site populations. Population calculations are based on projections made from the 1980 census data (U.S. Census 1987): Los Alamos townsite (10 200), White Rock (9 200), and the area within 80 km (50 mi) of the Laboratory (203 000). The TA-16 site for the WETF is closer to the Los Alamos townsite than to White Rock; TA-33 is closer to White Rock than to Los Alamos. Projections for population growth within 80 km (50 mi) of the Laboratory indicate a population of 276 000 by the year 2010. This estimate is used for calculations of long-term effects.

3.2 Site for the Proposed Action

The TA-16 site (Fig. 2-2) is a level, partially wooded area supporting a ponderosa pine community with an understory of mixed grasses, forbs, and shrubs. The animal population consists primarily of birds (passerines), field rodents, and large browsers, such as deer and elk.

Soils at the site are primarily Tocal and Frijoles, very fine sandy loams. The Frijoles series consists of deep (45–152 cm [18–60 in.] to bedrock), well-drained soils on nearly level to moderately sloping mesa tops. The Tocal series includes very shallow to shallow (about 36 cm [14 in.] to bedrock), well-drained soils on gently to moderately sloping mesa tops. These soils have slow to medium (Frijoles) or slow (Tocal) run-off and a moderate erosion hazard.

The area is a mesa top and contains no floodplains or wetlands. Thus, no floodplains or wetlands are threatened at the WETF location.

More than 900 archaeological and historic sites have been identified on Laboratory land. Before any construction began on the WETF, the Laboratory archaeologist surveyed the prospective site and determined that no historical site or archaeological ruin would be impacted (Steen 1981).

The Laboratory has been surveyed for the presence of threatened and endangered species, as documented in the site-wide EIS (DOE 1979). At that time, none were present. Subsequently, surveys have been conducted using the current threatened and endangered species lists for the United States and for New Mexico (F&WS 1988, 1989). Possible sites for proposed projects are routinely surveyed for the presence of these species during site selection; none have been found at the Laboratory to date.

TABLE 3-1. Distances Between Tritium Facilities and Population Locations, Used To Estimate Possible Human Exposure

	Distance (m)					
Tritium Facility Location	**Laboratory Site[a]**	**Site Boundary[b]**	**Frijoles Campground**	**White Rock[c]**	**Los Alamos[c]**	**Royal Crest Trailer Park**
TA-16 (proposed action)	150	427	750	12 000	5 500	5 800
TA-33 (no-action alternative)	175	200	1 300	4 000	12 400	10 800

[a]Location of potentially exposed individual who works at the same Laboratory TA but not in the same building.

[b]Location of potentially exposed member of the public on the highway at the Laboratory site boundary (see Fig. 2-2).

[c]Largest nearby population centers.

The WETF is located in a previously developed site. The area immediately around the facility was surveyed for the presence of threatened or endangered species by a Laboratory biologist as part of the site selection process. None of the possible federal or state threatened or endangered species were found.

3.3 Environmental Quality and Monitoring Program

3.3.1 Routine Air, Water, and Foodstuffs Monitoring

The Laboratory supports an ongoing environmental surveillance program, as required by DOE orders (DOE 1981 and 1988a). This surveillance program maintains routine monitoring for radiation, radioactive materials, and hazardous chemicals at the Laboratory and in the surrounding region. Samples of air particulates, gases, waters, soils, sediments, and foodstuffs are collected for analysis from monitoring stations within the Laboratory boundary, in nearby residential and community areas, and in surrounding areas up to 80 km (50 mi) from the Laboratory. The samples are used to document compliance with appropriate standards set by DOE and the U.S. Environmental Protection Agency (EPA) (DOE 1985, EPA 1989a and 1989b). These standards protect public health and safety by limiting people's exposure to airborne and waterborne toxic and radioactive materials. Measurements are also made to detect natural cosmic and terrestrial radiation, called background radiation, and external radiation from Laboratory operations. The monitoring program is explained in detail in the annual reports prepared by the Laboratory Environmental Protection Group (HSE-8) in the Health, Safety, and Environment Division (for example, see "Environmental Surveillance at Los Alamos During 1988," LANL 1989a).

A systematic monitoring program to assess the effects of Laboratory operations on the natural on-site flora and fauna is presently being developed. A preoperational environmental survey has been made at the location of the proposed action, TA-16, in compliance with DOE guidelines (DOE 1988a) to provide base line information about tritium in plant material.

3.3.2 Estimated Radiation Doses and Risks from Routine Laboratory Operations During 1988

The possible impact on members of the public from liquid discharges containing radioactive material has been assessed by monitoring on- and off-site waters, as described in detail in the annual environmental surveillance report (LANL 1989a). Shallow ground waters in the on-site alluvium and perched water areas are routinely monitored; some radionuclide migration into these waters has been detected. Effluent radionuclides have been detected off site only in Los Alamos Canyon where, at the site boundary, the concentrations are <1% of the guideline set for off-site discharges by DOE (DOE 1986, 1989). Water from the municipal supply wells shows no effects from Laboratory operations; the concentrations of tritium, cesium, and plutonium are at, or below, the limits of detection. There is no effect on members of the public from liquid discharges originating at the Laboratory.

Produce, garden soil, fish, honey, and honeybees have been routinely sampled from on- and off-site locations to monitor for the presence of radioactive materials (LANL 1989a). The data indicate that Laboratory operations do not result in significant doses to members of the public from eating local plant products or fish.

The impact on members of the public from environmental releases of radioactive material to air is evaluated using the monitoring information collected. Impact is measured by the incremental radiation dose, above natural background, that an individual could receive as a result of Laboratory operations. The effective dose equivalent is the hypothetical whole-body dose that carries the same risk of

cancer or genetic disorder as a given dose to several target organs. The effective dose equivalent concept allows direct comparison to be made of exposures from isotopes and exposure pathways that target different organs. For convenience, the term dose is used for the 50-year effective dose equivalent, calculated using the DOE dose-conversion factors (DOE 1986). The components of this dose are received by the individual internally through inhalation, skin absorption, and ingestion, and externally through exposure to radiation from the ground and from the release cloud.

The dose that populations who live close to the Laboratory could receive as a result of Laboratory operations is estimated each year. The method by which the calculations are made is summarized in the 1988 environmental surveillance report (LANL 1989a). The annual effective dose equivalents from routine Laboratory operations in 1988, for average members of the public, are summarized in Table 3-2.

Exposure to radiation increases an individual's chance of developing cancer. This increased chance is best evaluated by applying data to populations rather than individuals because populations include individuals who have different levels of sensitivity. Radiation-protection advisory groups have estimated the chance of developing cancer by using data on populations who have received high radiation doses and then projecting their estimates to populations who receive low doses. A prediction of the biological effects of low–linear energy transfer (low-LET) ionizing radiation (BEIR III methodology, NAS/NRC 1980) is that 167 to 501 additional cancers will develop in a population that collectively receives 1 000 000 person-rem of low-LET radiation. The increased chance of an average individual developing cancer because of Laboratory operations is also shown in Table 3-2. The maximum increased individual dose from normal Laboratory operations in 1988 was 6.2 mrem. This was at East Gate and was due, principally, to short-lived airborne emissions from the Los Alamos Meson Physics Facility at TA-53 (LANL 1989a). The methodology for calculating dose and chance of cancer mortality is presented in the Laboratory environmental surveillance report (LANL 1989a).

A revised prediction model relating health effects to low radiation doses (BEIR V) was published in January 1990 (NAS/NRC 1990). Because DOE health physicists are still evaluating the changes in assumptions and calculation methodology, they have not yet directed that the new model be used in making health-effect calculations. A preliminary estimate is that health effects predicted in this EA

TABLE 3-2. Individual Added Dose and Cancer Incidence Attributable to Laboratory Operations

Exposure Source	Added Effective Dose Equivalent[a] (mrem)	Added Chance of Individual Cancer[b]
All Laboratory Operations		
Los Alamos	1.2×10^{-1}	2×10^{-5} to 6×10^{-5}
White Rock	7.0×10^{-2}	1×10^{-5} to 4×10^{-5}
Background		
Los Alamos	3.4×10^{2}	6×10^{-2} to 2×10^{-1}
White Rock	3.3×10^{2}	6×10^{-2} to 2×10^{-1}

[a]Annual dose (LANL 1989a).

[b]Calculated using BEIR III factors (NAS/NRC 1980), as described in the Laboratory 1988 environmental surveillance report (LANL 1989a).

might be doubled using BEIR V methodology. Because of the very low health-effect values associated with operating the tritium facility, however, this would not cause a significant change in conclusions.

3.3.3 Estimating Doses from Tritium Emissions

Normal Operations. Tritium releases from normal operations cause human exposure, calculated as a 50-year effective dose commitment, mainly through the inhalation pathway but also to body surface through immersion in the release cloud. Thus, the whole-body effective dose equivalent from tritium exposure is the same as the total-body dose. The skin-absorption pathway is significant only for tritiated water vapor and is a minor exposure pathway. The ingestion pathway, for an individual eating foodstuffs contaminated with tritiated water exchanged from air, also is a minor pathway. The computer code AIRDOS-EPA (Moore 1979) and dose-conversion factors, based on procedures and factors developed by the International Commission on Radiation Protection (ICRP 1979–1982) and published by DOE (DOE 1986), were used to estimate doses resulting from routine airborne emissions from the tritium facilities at TA-16 and TA-33. Use of the AIRDOS-EPA code is discussed in the environmental surveillance report (LANL 1989a).

Released tritium may exist as gas or as tritiated water vapor. Under natural conditions, oxidation of tritium gas to water is a very slow process (Brown 1990). The rate of oxidation of tritium to water in soil is <1%/hour; the rate in air is much less. The measure of potential biological damage, the dose-conversion factor, is four orders of magnitude (10 000 times) greater for tritiated water than for tritium gas (ICRP 1979–1982). The 400 Ci/year of releases from normal operations at the WETF are conservatively assumed to be 5% tritiated water and 95% tritium gas.

During the years of operation at the TA-33 facility, tritium that is released during normal operations has diffused into pumps and onto exposed surfaces and slowly has become oxidized. This facility does not have a catalytic oxidation and capture system for tritium released during normal operations. The tritium in pump oil and on exposed surfaces is continually being released as tritiated water through exchange with water vapor in the air, even when no tritium operations are being carried out. In contrast, the accidental releases occur over too short a time scale for significant oxidation to take place (Brown 1990). These facts are consistent with assuming the accidental emission is tritium gas. Annual releases, which average 7 000 Ci/year, have included normal operational releases and many accidental releases (LANL 1980–1989a). On the basis of past experience with the magnitude of these releases, 2 000 Ci/year (29%) are assumed to be normal operational releases in the form of tritiated water; the remaining 5 000 Ci/year (71%) are accidental releases assumed to be tritium gas.

The dose calculations from normal operations assess inhalation, skin absorption, and ingestion pathways. The ingestion pathway is included for off-site individuals because tritiated water exchanges readily with water in plant material, such as local garden produce.

Abnormal Events. A series of abnormal events that cause tritium releases to the environment has been postulated in the WETF FSAR (LANL 1989b). Four of these abnormal events have been selected as a way to compare the risks posed by the two alternatives being considered. The events selected represent two high-probability, low-consequence events, one event caused by a natural phenomenon (earthquake), and one low-probability, high-consequence event. In estimating the doses from abnormal-event releases, the escaped tritium is assumed to be released too rapidly for significant oxidation to tritiated water to occur (Brown 1990), resulting in a release ratio of 99% tritium gas and 1% tritiated water. Dose calculations for the on-site individual and all off-site population groups assess only the surface exposure and inhalation pathways. As with calculations of accidental releases

related to nuclear power plants, calculations of dose by the ingestion pathway are not included because contaminated foodstuffs could be collected and impounded as radioactive waste if necessary.

The tritium release from abnormal events was modeled using a center-line Gaussian plume-dispersion equation (Slade 1968). The dose-conversion factors were taken from DOE recommendations (DOE 1986).

3.3.4 Exposed Individuals and Populations

Doses were calculated for several potentially exposed individuals and population groups, as discussed in the 1988 environmental surveillance report (LANL 1989a). Doses to individuals are in units of millirem; those to populations are in person-rem. Doses from normal operations to individuals working in the building are calculated using monitoring data for individuals at TA-33 and making extrapolations to establish doses to individuals in the WETF, taking into consideration the superior worker protection afforded by glove boxes, which should reduce the dose to 1% to 10% of that received by workers at TA-33. The on-site individual is defined as someone who works at the TA where the release occurs and who is in an adjacent facility, in accordance with DOE guidance (DOE 1988b). This individual is assumed to be at the point of maximum concentration of the release plume. (Accident-related doses to individuals working in the building where the release occurs are addressed in the facility FSAR [LANL 1989b]). The site-boundary individual (member of the public on public or privately owned land) happens to be at the closest Laboratory site boundary (the highway, Fig. 2-3) when an abnormal release occurs. The maximum individual dose (MID) is calculated for individuals residing off site in White Rock, Los Alamos townsite, Frijoles Campground, and Royal Crest Trailer Park, but nearest to the emitting facility. The population doses are calculated for the populations living in White Rock, Los Alamos, and within 80 km (50 mi) of the Laboratory.

4.0 ENVIRONMENTAL IMPACTS FROM THE PROPOSED ACTION AND THE NO-ACTION ALTERNATIVE

4.1 Impacts from Normal Operations — Proposed Action

The proposed action is to perform tritium-packaging operations at the WETF.

4.1.1 Airborne Emissions

Emissions from the WETF will be air, nitrogen from the glove boxes, and a small amount of tritium. A small amount of the tritium (5%) is assumed to be tritiated water vapor.

Radioactive Emissions. The methodology for calculating dose equivalent from airborne emissions is presented in the Laboratory environmental surveillance report (LANL 1989a). Briefly, the emission is assumed to be from the facility stack. Emissions will occur throughout the year and will be directed by prevailing winds at the time of the release. A 50-year whole-body effective dose equivalent from annual emissions was estimated for each target group.

The WETF is designed with subsystems to prevent or minimize tritium emissions to the environment. However, as small amounts of tritium will be lost to the environment through routine maintenance and handling, minor leaks, and permeation, a conservative estimate for normal operational releases of 400 Ci/year was established as the design goal for the WETF, as documented in the FSAR (LANL 1989b). Actual emissions are expected to be <50 Ci/year, much less than the design goal.

The estimated tritium emissions of 400 Ci/year are a marked improvement over the tritium emissions that have occurred at the Laboratory during past years. The reported average annual tritium emissions during the past 10 years and the improvement expected by moving all tritium-packaging operations from the TA-33 facility to the WETF at TA-16 are shown in Table 4-1.

The estimated 400-Ci/year release rate was used to calculate human exposures from WETF emissions. The effective dose equivalents to an off-site individual and to members of the public from annual tritium releases resulting from normal operations are shown in Tables 4-2 and 4-3. An individual who works in the WETF might receive an effective dose equivalent of 5 to 200 mrem/year. An individual who works at Building 460, about 350 m (1150 ft) northeast of the WETF, might receive a dose of 0.004 mrem/year. In comparison, the doses to workers who have been performing tritium-packaging operations at TA-33 have been 500 to 2000 mrem/year. Workers in an adjacent facility, Building 114, have had doses of 0.2 mrem/year. It is estimated that moving operations to the WETF would reduce worker doses by a factor of 10 or more.

The doses received by all individuals and populations are extremely small compared with those from natural background and from Laboratory normal operations. The largest dose that will be received per year by a member of the public (at Royal Crest Trailer Park) from normal WETF operation is 2.1×10^{-4} mrem. This dose is several orders of magnitude less than EPA's protective standard for airborne radionuclides (EPA 1989b) and DOE's Radiation Protection Standard (DOE 1989). The population dose is slightly higher in Los Alamos than in White Rock, but in both cases doses are very small.

Hazardous Emissions. There will be no significant emissions of nonradioactive hazardous materials.

4.1.2 Liquid Wastes

Radioactive Wastes. Radioactive liquid waste will consist mainly of low-level (less than 100-μCi/m^3) contaminated mop water, produced at a rate of about 20 liters/week (5 gal./week), or about 1 040 liters/year (275 gal./year), and totaling 0.1 mCi of tritiated water per year (LANL 1989a). This industrial waste water will be discharged to a vaulted, 5 700-liter underground storage tank at the WETF (Fig. 1-3). The tank level will be monitored, visually or by computer. When the tank is sufficiently full, the contents will be transported by the Laboratory's Waste Management Group (HSE-7) to the Liquid Radioactive Waste Treatment Plant at TA-50. The incremental quantity of tritium expected from WETF is not significant. Over the past 5 years, an average of 70 Ci/year of tritiated water has been processed (LANL 1985–1989a). The tritiated liquid waste from TA-33, about 2 to 3 Ci/year, is discharged to a tile field at TA-33. Thus, for liquid waste management, the proposed action is a significant improvement over the no-action alternative.

Treated liquid effluents containing low levels of radioactivity are discharged from the TA-50 liquid waste treatment plant and one sewage-treatment lagoon in compliance with an EPA National Pollutant Discharge Elimination System (NPDES) permit. Compliance with permit specifications is monitored by the EPA and the New Mexico Environmental Improvement Division (NMEID). Tritium discharges over the past 5 years are presented in Table 4-4 (LANL 1989a). The liquid waste discharge flows into Mortandad Canyon and not into the aquifer from which drinking water for the Laboratory and Los Alamos is drawn, as discussed above (LANL 1989a). No increase in human dose will be associated with the effluents from WETF.

Nonradioactive Wastes. Very small quantities (in liters) of alcohol, trichloroethane, and acetone will be kept for cleaning purposes. Used solvents will be collected separately and turned over to the

TABLE 4-1. Average Annual Tritium Emissions from Normal Operations

Average Annual Emissions	Tritium Emissions (Ci)			
	Laboratory Other Sources	No-Action Alternative TA-33	Proposed Action WETF TA-16	Laboratory Total
1979–1988[a]	3 200	7 000	0	10 200
1990–2020 (estimated)[b]	3 200	0	400	3 600
Decrease in emissions expected by implementing proposed action				<6 600>

[a]Data are from the Laboratory annual environmental surveillance reports 1979–1988 (LANL 1981–1989a).
[b]Estimate assumes Laboratory emissions from other sources remain constant and that the WETF completely replaces Building 86 at TA-33.

TABLE 4-2. Individual Dose from Each Year of Normal Operations — Proposed Action

Source	Effective Dose Equivalent (mrem)			
	Frijoles Campground	White Rock	Los Alamos	Royal Crest Trailer Park
WETF normal operations	8.0×10^{-5}	5.3×10^{-5}	1.5×10^{-4}	2.1×10^{-4}
Laboratory normal operations[a]	Not available[b]	7.0×10^{-2}	1.2×10^{-1}	Not available[b]
Radiation Protection Standards				
70-year dose commitment[c]	1.0×10^{1}	1.0×10^{1}	1.0×10^{1}	1.0×10^{1}
50-year dose commitment[d]	1.0×10^{2}	1.0×10^{2}	1.0×10^{2}	1.0×10^{2}
Background[a]	3.4×10^{2}	3.4×10^{2}	3.3×10^{2}	3.3×10^{2}

[a]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).
[b]Data are not available because dose was not calculated separately for this site.
[c]U.S. Environmental Protection Agency regulation (EPA 1989).
[d]U.S. Department of Energy memorandum (DOE 1986).

TABLE 4-3. Population[a] Dose from Each Year of Normal Operations — Proposed Action

Source	Effective Dose Equivalent (person-rem)		
	White Rock	Los Alamos	Area Within 80-km (50-mi) Radius of the Laboratory
WETF normal operations	4.9×10^{-4}	1.5×10^{-3}	3.7×10^{-3}
Laboratory normal operations[b]	6.4×10^{-1}	1.2×10^{0}	2.2×10^{0}
Background[b]	3.0×10^{6}	4.1×10^{6}	6.5×10^{4}

[a]Population of White Rock is assumed to be 9 200; Los Alamos, 10 200; and area within 80-km (50-mi) radius of the Laboratory, 203 000.
[b]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).

TABLE 4-4. Tritium Effluents from Liquid Radioactive Waste Treatment Plant at TA-50 Resulting from Normal Operations

	Tritium Releases (Ci)
Laboratory total operations[a]	
1984	4.7×10^1
1985	7.7×10^1
1986	9.0×10^1
1987	1.1×10^2
1988	2.6×10^1
Average	7.0×10^1
Projected annual discharges, 1990–2020	
WETF	1.0×10^{-4}
Laboratory total operations	7.0×10^1

[a]Data are from the Laboratory annual environmental surveillance reports, 1984–1988 (LANL 1985–1989a).

Laboratory Waste Management Group (HSE-7) for disposal in accordance with the Resource Conservation and Recovery Act (RCRA) and Laboratory procedures.

Sanitary waste will be discharged into the domestic sewer and will consist of the discharge from two rest rooms accommodating an average of fewer than 10 people during working hours. The sanitary waste treatment facility that now serves TA-16 is of adequate capacity to accommodate the small increment of sanitary flow associated with this project and therefore will continue to operate within the limits of its NPDES permit.

4.1.3 Solid Wastes

Radioactive Wastes. Expected radioactive solid wastes at the WETF will consist of tritium-contaminated material such as the molecular sieve material from the Emergency Tritium Cleanup Subsystem (used only in case of an accidental release into the building), some used equipment, and occasional small amounts of debris, such as clothing, gloves, and tissue from cleanups. The tritiated molecular sieve material from the Tritium Waste Treatment Subsystem will be sent off site for tritium recovery and the molecular sieve container will be returned. Other materials will be buried or stored, depending on the level of activity.

Tritiated water from the Tritium Waste Treatment Subsystem will be adsorbed on molecular sieve columns housed in ALM-1 shipping containers. These containers are approved for shipping tritium and are used by DOE to return molecular sieve material to Mound Laboratory for recovery of tritium. The containers were designed at Mound Laboratory.

Low-level waste, such as gloves, tubing, and valves, will be collected in a marked dumpster and transferred to the low-level-waste burial pit at TA-54. This facility is operated in accordance with relevant DOE orders. About 3 to 6 m^3 (100 to 200 ft^3) of low-level waste will be generated per year.

Radioactive waste with activity greater than that of low-level waste will be placed in double-containment drums and transported to the waste management area at TA-54, where the drums will be stored in shafts drilled 18 m (60 ft) deep into volcanic tuff. Because the half-life of tritium is short, 12.26 years, the material will eventually become nonradioactive waste. Long-term decisions about managing this waste have not yet been made. The waste will consist of contaminated plumbing, metal containers, and other equipment, and will be packaged in 30-gal. drums and overpacked in 55-gal. drums with tritium-absorbent material between the drum walls. Contaminated vacuum pumps will be surrounded by an absorbent to hold any tritium-contaminated oil.

A single column of molecular sieve material from the Emergency Tritium Cleanup Subsystem can hold about 5 000 Ci of tritium. In the event of a major spill within the facility, the contaminated sieve material will be placed in a 30-gal. drum, overpacked with a 55-gal. drum. Asphalt or other tritium absorbent will be placed between the drum walls. The drum will be placed in the same TA-54 storage shafts, pending a management decision on long-term storage or recovery. Alternatively, the tritium could be recovered, as discussed for the Tritium Waste Treatment Subsystem, depending on tritium supply and the economics of recovery.

The amount of solid waste to be stored will depend on the number and severity of tritium spills and the rate at which contaminated equipment needs to be replaced. Equipment to be used in the WETF glove box lines will be selected for reliability and with consideration of the restricted contamination storage area. About 5 to 10 drums of waste per year (1 to 2 m^3 [36 to 72 ft^3]) may be generated, comparable with the amount generated by the TA-33 operation.

In summary, no major quantities of tritiated waste will be sent to burial sites unless a major tritium leak occurs.

Nonradioactive Waste. Nonradioactive solid waste will consist of paper, rubber gloves, rags, packing material, office supplies, lunch discards (such as plastic containers), and garbage (estimated to be less than 200 ft^3/year). This waste will be disposed of as sanitary landfill material in the Los Alamos municipal landfill.

4.1.4 Transportation

Transportation of radioactive materials at the Laboratory is addressed in the sitewide EIS (DOE 1979). Radioactive materials have been transported in accordance with U.S. Department of Transportation (DOT) regulations. Packages used at the Laboratory to transport radioactive material are designed to limit exposure to radiation under normal conditions and to limit the probability of an accidental release. Tritium packaged at the Laboratory has had no detectable external radiation 3 ft from the container.

Relocating tritium operations to TA-16 will slightly decrease the transportation of tritium on public highways. The large shipments of tritium from Savannah River will be stored in the vault at TA-41 and will then be transported to the WETF, a distance of 20 km (12 mi). At present, with the no-action alternative, these shipments are stored in the vault at TA-41 before being moved to TA-33, a distance of 20 km (12 mi). Package verification will be done at TA-16, requiring no transportation on public roads. Transportation requirements to ship packaged tritium back to the vault at TA-41, to other users throughout the Laboratory, and to the Nevada Test Site will remain the same. Shipping procedures for radioactive material will continue to follow DOE orders and the Laboratory Transportation Manual.

4.1.5 Consequences from Normal Operations — Proposed Action

The consequences of normal operations are represented by estimates of the number of cancers caused in individuals and populations exposed to radioactive emissions. The doses calculated to be received by individuals and populations are converted (using a value in the BEIR III methodology) to estimates of chance of cancer. The report estimates that 167 to 501 cancers per 1 000 000 person-rem of radiation will be received in 1 year (NAS/NRC 1980). The doses from WETF operations will produce <1 added cancer in any of the populations exposed, as shown in Tables 4-5 and 4-6.

4.2 Impacts from Normal Operations — No-Action Alternative

The no-action alternative is continued operation of the tritium-packaging facility in Building 86 at TA-33. Tritium packaging at this facility was recently suspended. Operations at this facility will remain suspended pending completion of the NEPA process and a decision on whether or not to operate the WETF (the proposed action).

4.2.1 Airborne Emissions

Emissions from the tritium-packaging operations in Building 86 at TA-33 are air, tritium, and tritiated water vapor. The tritiated water vapor is assumed to be 29% of the total tritium released.

Radioactive Emissions. The tritium facility at TA-33 has always had significant releases of tritium. The tritium releases from that facility and from the Laboratory as a whole for the last 10 years are summarized in Table 4-7. The TA-33 facility has contributed more than half of the annual Laboratory tritium emissions. Over the past 10 years, emissions from Building 86 at TA-33 have averaged nearly 7 000 Ci/year, whereas design emissions from the WETF are less than 400 Ci/year.

The 7 000-Ci average tritium release per year was used to calculate the human doses expected from continued operation of the TA-33 facility. The annual effective dose equivalents from normal tritium releases to off-site individuals are shown in Table 4-8; those for exposed populations are shown in Table 4-9. The average annual dose to a worker in the TA-33 facility has been about 0.5 to 2 rem/year. The dose to an on-site individual who works in Building 114, 100 to 150 m (270 to 490 ft) northwest of Building 86, is 0.2 mrem/year. This dose is two orders of magnitude greater than that expected for the WETF because operations at TA-33 are not carried out in glove boxes. The doses to the population in White Rock resulting from TA-33 operation are about 25% of the total dose from Laboratory operations. However, the doses to individuals and populations are several orders of magnitude less than the EPA standard for airborne radionuclides (EPA 1989b) and the DOE Radiation Protection Standard (DOE 1989b). For the same receptor individual or population, doses are at least 10 times as great from continued TA-33 operation as those expected from operating at the WETF.

Hazardous Emissions. There are no significant emissions of nonradioactive hazardous materials from Building 86 at TA-33.

4.2.2 Liquid Wastes

Radioactive Wastes. As with the WETF, the radioactive liquid waste produced in Building 86 at TA-33 consists mainly of contaminated mop water. Because of the poorer tritium-containment design at TA-33, both the tritium concentration and the mop-water volume are greater than at the WETF. About 5 200 liters/year (1 400 gal./year) of industrial waste water with a tritium concentration of up to 250 μCi/liter are produced. About 2 to 3 Ci of tritium per year are discharged to a septic tank and tile field at TA-33. Past environmental contamination will be addressed under the Laboratory

TABLE 4-5. Individual Added Dose and Increased Incidence of Cancer Attributable to Each Year of Normal Operations — Proposed Action

	Dose (mrem)	No. of Cancers
WETF		
Frijoles Campground	8.0×10^{-5}	1×10^{-11} to 4×10^{-11}
White Rock	5.3×10^{-5}	9×10^{-12} to 3×10^{-11}
Los Alamos	1.5×10^{-4}	3×10^{-11} to 8×10^{-11}
Royal Crest Trailer Park	2.1×10^{-4}	6×10^{-11} to 1×10^{-10}
Laboratory [a]		
Frijoles Campground	Not available[b]	
White Rock	7.0×10^{-2}	1×10^{-8} to 4×10^{-8}
Los Alamos	1.2×10^{-1}	2×10^{-8} to 6×10^{-8}
Royal Crest Trailer Park	Not available[b]	
Background [a]		
Frijoles Campground	3.3×10^{2}	6×10^{-5} to 2×10^{-4}
White Rock	3.3×10^{2}	6×10^{-5} to 2×10^{-4}
Los Alamos	3.4×10^{2}	6×10^{-5} to 2×10^{-4}
Royal Crest Trailer Park	3.4×10^{2}	6×10^{-5} to 2×10^{-4}

[a]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).
[b]Data are not available because dose was not calculated separately for this site.

TABLE 4-6. Population[a] Added Dose and Increased Incidence of Cancer Attributable to Each Year of Normal Operations — Proposed Action

	Dose (person-rem)	No. of Cancers
WETF		
White Rock	4.9×10^{-4}	8×10^{-8} to 2×10^{-7}
Los Alamos	1.5×10^{-3}	3×10^{-7} to 8×10^{-7}
Area within 80-km (50-mi) radius of the Laboratory	3.7×10^{-3}	6×10^{-7} to 2×10^{-6}
Laboratory [b]		
White Rock	6.4×10^{-1}	1×10^{-4} to 3×10^{-4}
Los Alamos	1.5×10^{0}	3×10^{-4} to 8×10^{-4}
Area within 80-km (50-mi) radius of the Laboratory	2.2×10^{0}	4×10^{-4} to 1×10^{-3}
Background [b]		
White Rock	3.0×10^{3}	6×10^{-2} to 2×10^{-1}
Los Alamos	4.1×10^{3}	7×10^{-1} to 2×10^{0}
Area within 80-km (50-mi) radius of the Laboratory	6.5×10^{4}	1×10^{1} to 3×10^{1}

[a]Population of White Rock is assumed to be 9 200; Los Alamos, 10 200; and area within 80-km (50-mi) radius of the Laboratory, 203 000.
[b]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).

TABLE 4-7. Airborne Tritium Emissions from TA-33 and from all Laboratory Operations, 1979–1988[a]

Year	Tritium Emissions (Ci) TA-33	Laboratory Total	TA-33 (% of total)
1979	10 470	15 044	70
1980	6 965	7 520	93
1981	6 085	7 224	84
1982	13 600	15 837	86
1983	4 410	7 891	56
1984	7 110	14 869	48
1985	4 870	8 638	56
1986	6 660	10 700	62
1987	1 000	3 180	31
1988	7 960	11 000	72
Average	6 913	10 190	68

[a]Data are from the Laboratory annual environmental surveillance reports, 1979–1988 (LANL 1980–1989a).

TABLE 4-8. Individual Dose from Each Year of Normal Operations — No-Action Alternative

Source	Effective Dose Equivalent (mrem) Frijoles Campground	White Rock	Los Alamos	Royal Crest Trailer Park
TA-33 normal operations	1.4×10^{-2}	1.7×10^{-2}	1.5×10^{-3}	1.8×10^{-3}
Laboratory normal operations[a]	Not available[b]	7.0×10^{-2}	1.2×10^{-1}	Not available[b]
Radiation Protection Standards				
70-year dose commitment[c]	1.0×10^{1}	1.0×10^{1}	1.0×10^{1}	1.0×10^{1}
50-year dose commitment[d]	1.0×10^{2}	1.0×10^{2}	1.0×10^{2}	1.0×10^{2}
Background[a]	3.3×10^{2}	3.3×10^{2}	3.4×10^{2}	3.4×10^{2}

[a]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).
[b]Data are not available because dose was not calculated separately for this site.
[c]U.S. Environmental Protection Agency regulation (EPA 1989).
[d]U.S. Department of Energy memorandum (DOE 1986).

TABLE 4-9. Population[a] Dose Resulting from Each Year of Normal Operations — No-Action Alternative

Source	Effective Dose Equivalent (person-rem)		
	White Rock	Los Alamos	Area Within 80-km (50-mi) Radius of the Laboratory
TA-33 normal operations	1.6×10^{-1}	1.5×10^{-2}	5.6×10^{-1}
Laboratory normal operations[b]	6.4×10^{-1}	1.2×10^{0}	2.2×10^{0}
Background[b]	3.0×10^{6}	4.1×10^{6}	6.5×10^{4}

[a]Population of White Rock is assumed to be 9 200; Los Alamos, 10 200; and area within 80-km (50-mi) radius of the Laboratory, 203 000.

[b]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).

Environmental Restoration Program. No tritium contamination from this discharge has been detected at the site boundary (LANL 1989a). This discharge is 200 to 300 times the expected discharge from the WETF.

Nonradioactive Wastes. The use and disposal of nonradioactive liquids is equivalent to that described above for the WETF. Sanitary wastes from Building 86 are discharged to the septic tank and tile field.

4.2.3 Solid Wastes

Radioactive Wastes. In Building 86 at TA-33, there is no subsystem for capturing leaked tritium from glove box or laboratory atmospheres before the air is discharged from the stack. During piping cleanup, the atmosphere passes through a molecular sieve. When the molecular sieve material has reached capacity, it is placed in double-containment drums for storage. The major quantity of high-level radioactive solid waste is 0.6 to 1.2 m^3 (4.4 to 8.8 ft^3) per year of clothing, gloves, and tissue from cleanup activity and from used pumps containing residues of tritiated oil. This material is placed in 30-gal. drums, overpacked with 55-gal. drums with asphalt between the drum walls, and sealed. The sealed drums are sent to the TA-54 radioactive waste management site where they are placed in shafts drilled in the tuff. The drums are retrievable, as discussed above. Approximately 5 to 10 drums per year are generated.

Low-level waste consists of tubing, valves, and other possibly contaminated equipment, generated at a rate of 3 to 6 m^3 (100 to 200 ft^3) per year. This material is collected in a specially marked dumpster and transported to TA-54 for burial in the Laboratory's low-level waste pit.

Nonradioactive Wastes. The nonradioactive solid waste produced in Building 86 at TA-33 is similar in nature and volume to that projected for the WETF—somewhat less than 5.5 m^3 (200 ft^3) per year. This is disposed of as sanitary landfill material in the Los Alamos municipal landfill.

4.2.4 Transportation

For the no-action alternative, large shipments of tritium received from the DOE Savannah River Plant would continue to be stored in the vault at TA-41 and then transported 20 km (12 mi) over

public roads to TA-33 for packaging. Package verification is performed at TA-16, a 32-km (20-mi) round trip. About 50 one-way trips per year of 20 km (12 mi) are made to deliver packaged tritium from TA-33 to TA-41 for assembly into test devices, which are then sent to the Nevada Test Site. About 20 trips per year made from TA-33 to other Laboratory sites will not be significantly affected by the location of the tritium-packaging facility. Transportation of packaged tritium to other areas at the Laboratory and the Nevada Test Site follows DOE and the Laboratory Transportation Manual procedures for radioactive material.

4.2.5 Consequences from Normal Operations — No-Action Alternative

The continued operation of the TA-33 facility to package tritium will result in emissions of about 7 000 Ci of tritium per year. The doses and increased incidence of cancer in exposed individuals and target populations are shown in Tables 4-10 and 4-11. The increase in cancers is <1 for all exposed individuals and populations.

4.3 Cumulative and Long-Term Effects of the Proposed Action Compared with the No-Action Alternative

The major result of implementing the proposed action (when compared to operating the older facility) will be an annual average decrease in tritium emissions of more than 6 000 Ci. Much of the tritium will be captured and made available for reprocessing instead of being exhausted to the environment, as it is under the no-action alternative. Assuming that the WETF has a life cycle of 30 years, the potential exists to recycle up to 190 000 Ci of tritium, a substantial improvement over the no-action alternative.

Cumulative effects of implementing the proposed action are that total tritium lost as airborne and liquid waste from the Laboratory would be reduced substantially (compared to cumulative effects associated with operating the older TA-33 facility). As shown in Table 4-1, tritium-gas emissions from the Laboratory are expected to be reduced from an average of 10 200 Ci/year to not more than 3 600 Ci/year, a decrease of more than 60% (Table 4-12). The proposed action represents a significant improvement in air quality.

The proposed action also represents a significant improvement in the quality of water discharged to the environment. Less tritium would be released as liquid effluent under the proposed action because of the improved confinement system, as shown in Table 4-12. With the no-action alternative, discharges are about 2.5 Ci/year, whereas the discharges from the WETF are projected to be only 0.1 Ci/year. In addition, the discharge from TA-33 goes to a tile field, whereas the discharge from the WETF will be processed through the Laboratory Liquid Radioactive Waste Treatment Plant. The discharges from this facility are controlled by the NPDES permit and are regularly monitored. The 5-year average tritium release from the liquid waste treatment facility is 70 Ci (LANL 1985–1989a); thus, the addition of 0.1 Ci per year from WETF represents no significant addition to the amount of tritium discharged.

The proposed action (when compared to operating the older TA-33 facility) would decrease the dose to the individual who receives the greatest dose from Laboratory normal operations. This individual, who resides at East Gate, receives an annual dose of 6.2 mrem, mostly from short-lived air activation products produced from the linear particle accelerator across the canyon (LANL 1989a). That individual's dose from the proposed action is calculated to be 7.5×10^{-5} mrem/year, whereas the dose from the no-action alternative is 4.0×10^{-3} mrem/year. The dose would be decreased by implementing the proposed action, but not significantly.

TABLE 4-10. Individual Added Dose and Increased Incidence of Cancer Attributable to Each Year of Normal Operations — No-Action Alternative

	Dose (mrem)	No. of Cancers
TA-33		
Frijoles Campground	1.4×10^{-2}	2×10^{-9} to 7×10^{-9}
White Rock	1.7×10^{-2}	3×10^{-9} to 9×10^{-9}
Los Alamos	1.5×10^{-3}	3×10^{-10} to 8×10^{-10}
Royal Crest Trailer Park	1.8×10^{-3}	3×10^{-10} to 9×10^{-10}
Laboratory[a]		
Frijoles Campground	Not available[b]	
White Rock	7.0×10^{-2}	1×10^{-8} to 4×10^{-8}
Los Alamos	1.2×10^{-1}	2×10^{-8} to 6×10^{-8}
Royal Crest Trailer Park	Not available[b]	
Background[a]		
Frijoles Campground	3.3×10^{2}	6×10^{-5} to 2×10^{-4}
White Rock	3.3×10^{2}	6×10^{-5} to 2×10^{-4}
Los Alamos	3.4×10^{2}	6×10^{-5} to 2×10^{-4}
Royal Crest Trailer Park	3.4×10^{2}	6×10^{-5} to 2×10^{-4}

[a]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).
[b]Data are not available because dose was not calculated separately for this site.

TABLE 4-11. Population[a] Added Dose and Increased Incidence of Cancer Attributable to Each Year of Normal Operations — No-Action Alternative

	Dose (person-rem)	No. of Cancers
TA-33		
White Rock	1.7×10^{-1}	3×10^{-5} to 9×10^{-5}
Los Alamos	1.5×10^{-2}	3×10^{-6} to 8×10^{-6}
Area within 80-km (50-mi) radius of the Laboratory	5.6×10^{-1}	9×10^{-5} to 3×10^{-4}
Laboratory[b]		
White Rock	6.4×10^{-1}	1×10^{-4} to 3×10^{-4}
Los Alamos	1.5×10^{0}	3×10^{-4} to 8×10^{-4}
Area within 80-km (50-mi) radius of the Laboratory	2.2×10^{0}	4×10^{-4} to 1×10^{-3}
Background[b]		
White Rock	3.0×10^{3}	6×10^{-2} to 2×10^{-1}
Los Alamos	4.1×10^{3}	7×10^{-1} to 2×10^{0}
Area within 80-km (50-mi) radius of the Laboratory	6.5×10^{4}	1×10^{1} to 3×10^{1}

[a]Population of White Rock is assumed to be 9 200; Los Alamos, 10 200; and area within 80-km (50-mi) radius of the Laboratory, 203 000.
[b]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).

The long-term effect of implementing the proposed (compared to operating the older TA-33 facility) action is that the decreased annual tritium emissions, as shown in Table 4-12, will reduce the radiation doses to members of the public living in the vicinity of the Laboratory. Assuming a facility lifetime of 30 years and constant production rates, the decreases in doses and expected incidence of cancer are shown in Table 4-13. Implementing the proposed action will decrease the long-term doses to exposed individuals and populations attributable to tritium-packaging operations by one or more orders of magnitude. The expected incidence of cancer is also decreased, but because all numbers are <1, no effect will be detected. The incidence of cancers caused by background radiation would obscure any effect related to implementing the proposed action.

The expected decrease in tritium effluent, although environmentally desirable, will have no effect on reducing human doses because the effluent does not enter the Los Alamos potable aquifer.

TABLE 4-12. Projected Tritium Releases to the Environment During Normal Operations

	Air Emissions (Ci)			Liquid Effluents (Ci)		
	TA-33	WETF	Decrease[a] with WETF	TA-33	WETF	Decrease[a] with WETF
1 year	7 000	400	<6 600>	2.5	0.1	<2.4>
30 years	210 000	12 000	<198 000>	75.0	3.0	<72.0>

[a]Decrease in tritium (in curies) released to the environment from implementing the proposed action.

TABLE 4-13. Individual and Population Doses and Increased Incidence of Cancer Attributable to Normal Operations for 30 Years — Proposed Action and No-Action Alternative

	Proposed Action, WETF at TA-16		No-Action Alternative, TA-33	
	Dose	No. of Cancers	Dose	No. of Cancers
Dose to an Individual (mrem)				
Frijoles Campground	2.4×10^{-3}	4×10^{-10} to 1×10^{-9}	4.2×10^{-1}	7×10^{-8} to 2×10^{-7}
White Rock	1.6×10^{-3}	3×10^{-10} to 8×10^{-10}	5.1×10^{-1}	9×10^{-8} to 3×10^{-7}
Los Alamos	4.5×10^{-3}	8×10^{-10} to 2×10^{-9}	4.5×10^{-2}	8×10^{-9} to 2×10^{-8}
Royal Crest Trailer Park	6.3×10^{-3}	2×10^{-10} to 3×10^{-9}	5.4×10^{-2}	9×10^{-9} to 3×10^{-8}
Background (per year)	3.3×10^{2}	6×10^{-5} to 2×10^{-4}	3.3×10^{2}	6×10^{-5} to 2×10^{-4}
Dose to Population[a] (person-rem)				
White Rock	1.5×10^{-2}	2×10^{-6} to 6×10^{-6}	5.1×10^{0}	9×10^{-4} to 3×10^{-3}
Los Alamos	4.5×10^{-2}	8×10^{-6} to 2×10^{-5}	4.5×10^{-1}	8×10^{-5} to 2×10^{-4}
Area within 80-km (50-mi) radius of the Laboratory	1.1×10^{-1}	2×10^{-5} to 6×10^{-5}	1.7×10^{1}	3×10^{-3} to 9×10^{-3}

[a]Population of White Rock is assumed to be 9 200 in year 2020 (constant); Los Alamos, 10 200 (constant); and area within 80-km (50-mi) radius of the Laboratory, 312 500.

The overall long-term and cumulative effects of implementing the proposed action will result in an improvement in environmental quality because of significantly decreased releases of tritium to the environment, when compared to continued operation of the older, TA-33 facility.

5.0 ENVIRONMENTAL EFFECTS AND RISKS FROM ABNORMAL EVENTS

5.1 Potential Abnormal Events

Some general abnormal events, or accidents, that could cause tritium to be released to the environment were selected as a basis for comparing operating risks from the proposed action and the no-action alternative. These events were selected using the FSAR prepared for the WETF (LANL 1989b), which documents the failure modes and effects analysis, the probability of accidents, and the development of the source term (original tritium leakages) for the tritium release. Source term, release, and probability information from that FSAR has been used in this analysis. The probabilities and source terms are assumed to be the same for the two facilities. However, because the TA-33 facility has no emergency cleanup system, the entire source term is released to the environment, whereas at the WETF the source term would be reduced before being released to the environment because it would pass through the tritium capture and cleanup system. Thus, for the same abnormal event, tritium emissions to the environment would be smaller from the WETF than from TA-33.

Additional abnormal events were identified but dismissed as not being credible. Events with a probability $<10^{-6}$ per year are not considered credible (NRC 1988, DOE 1987, Elder 1986). The possibility of a fire as an event was discarded during preparation of the WETF FSAR as not being credible because there is no ignition source within the building and flammable materials are limited. The facility is heated with steam rather than natural gas, and all equipment is grounded to prevent sparking. The probability of an aircraft crash on the Special Nuclear Materials Research and Development (SNM R&D) Laboratory also has been assessed as incredible, about 10^{-7} per year (Fuentes 1988). The roof area of that facility is about 10 times as large as that of the WETF, making the WETF less likely to be hit.

Four abnormal events are considered in this assessment. Two are identified in the draft FSAR as high-probability, low-consequence events, one is due to a natural phenomenon (earthquake), and the last is a low-probability, high-consequence event, also discussed in the FSAR (LANL 1989b). In each case, the same abnormal event is analyzed for the WETF and for Building 86 at TA-33. For the fourth abnormal event, the parallel is not complete. A failure of the gas chromatograph mass-flow controller is postulated to occur, causing the entire 100 g of tritium, the maximum at risk during processing, to be released in either facility. At TA-16, the release is directed to a tritium waste treatment (holding) tank, but overpressure causes the tank seal to fail, releasing the entire quantity of tritium. The facility at TA-33 does not have such a tank.

Realistic, but conservative, assumptions are used in analyzing the abnormal events. Conservative assumptions tend to overestimate the consequences and probabilities. The calculations of consequences and probabilities thus will bound all events not separately analyzed. Conservative assumptions include the following:

- a realistic maximum inventory is at risk;
- the probability of the tritium being released is identical with the probability of the occurrence of the abnormal event that would initiate the release;
- for the three abnormal events taken from the FSAR, the greatest probability of occurrence assigned to that event in the FSAR is used;

- the probabilities assigned to abnormal events and releases at the WETF are also used for the older Building 86 at TA-33;
- adverse meteorological conditions will prevail; and
- the release is 99% tritium gas and 1% tritiated water.

The abnormal events that were analyzed are described below. Table 5-1 lists the abnormal events considered, the probabilities of event occurrence, and the quantity of tritium that could be released in the facility (source term) and to the environment (release) for the proposed action (WETF) and the no-action alternative (Building 86 at TA-33). The tritium capture subsystems in place at the WETF reduce the quantity of tritium that could be released to the environment in all of the abnormal events.

The methodology used in calculating the doses is described in the FSAR (LANL 1989b).

5.2 Consequences from Abnormal Events

Because of the conservative assumptions made, the consequences presented bound those that would realistically be expected if one of the abnormal events should occur. In all cases, exposure is assumed to occur during the entire time it takes for the release plume to pass, about 2 hours. If an accident were to occur, however, the nearest on-site individuals would be evacuated from the direct downwind area within minutes of the release; hence, the calculations presented here overestimate doses that these individuals might actually receive by a factor of 20–30 because it is extremely unlikely that any individual would be exposed for longer than 5 minutes. The estimated doses for on-site individuals exposed as a result of abnormal events are compared in Table 5-2 for the proposed action and the no-action alternative. The same information is presented in Table 5-3 for a member of the public located on the highway at the site boundary when the abnormal event occurs. The doses and risk to potentially exposed populations are shown in Table 5-4.

When comparing the consequences of the same abnormal event taking place at the WETF and at TA-33, the analyses showed that doses are less for the WETF location in all cases except for the maximally exposed individual who is on site when the low-pressure release tank ruptures at the WETF. This exception is due to a shorter downwind distance at the WETF (150 m) than at TA-33 (175 m) before the release plume intersects the ground because of differences in stack heights at the

TABLE 5-1. Tritium Releases Caused by Abnormal Events at the WETF and TA-33

Abnormal Event	Probability of Release (events/year)	Source Term (Ci)	Release to Environment[a] (Ci)	
			WETF	TA-33
Earthquake	2×10^{-4}	9.6×10^{5} [b]	1.9×10^{0}	9.6×10^{5}
Unpackaging release	1×10^{-1}	1.1×10^{5}	2.3×10^{-1}	1.1×10^{5}
Low-pressure boundary failure	1×10^{0}	3.0×10^{5}	8.8×10^{-2}	3.0×10^{5}
Ruptured tank because of failed gas chromatograph mass-flow controller	1×10^{-5}	9.6×10^{5} [b]	7.2×10^{5}	9.6×10^{5}

[a]Release is 99% tritium gas, 1% oxidized to tritiated water.
[b]Release quantity is 100 g of tritium, the maximum at risk.

TABLE 5-2. Dose to On-Site Individual from Abnormal Events at WETF and TA-33

Abnormal Event	Probability of Release (events/year)	WETF Distance (m)	WETF Dose (rem)	TA-33 Distance (m)	TA-33 Dose (rem)
Earthquake	2×10^{-4}	150	3.3×10^{-7}	175	8.3×10^{-2}
Unpackaging release	1×10^{-1}	150	4.0×10^{-8}	175	9.5×10^{-3}
Low-pressure boundary failure	1×10^{0}	150	1.5×10^{-8}	175	2.7×10^{-2}
Ruptured tank because of failed gas chromatograph mass-flow controller	1×10^{-5}	150	1.3×10^{-1}	175	8.3×10^{-2}

TABLE 5-3. Dose to Individual at the Site Boundary from Abnormal Events at WETF and TA-33

Abnormal Event	Probability of Release (events/year)	WETF Distance (m)	WETF Dose (rem)	TA-33 Distance (m)	TA-33 Dose (rem)
Earthquake	2×10^{-4}	427	1.0×10^{-7}	200	8.1×10^{-2}
Unpackaging release	1×10^{-1}	427	1.2×10^{-8}	200	9.3×10^{-3}
Low-pressure boundary failure	1×10^{0}	427	4.5×10^{-9}	200	2.6×10^{-2}
Ruptured tank because of failed gas chromatograph mass-flow controller	1×10^{-5}	427	3.8×10^{-2}	200	8.1×10^{-2}
Background[a]			3.3×10^{2}		3.3×10^{2}

[a]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).

TABLE 5-4. Dose to the Nearest Population[a] from Abnormal Events at WETF and TA-33

Abnormal Event	Probability of Release (events/year)	WETF (Los Alamos) Distance (m)	WETF (Los Alamos) Dose (person-rem)	TA-33 (White Rock) Distance (m)	TA-33 (White Rock) Dose (person-rem)
Earthquake	2×10^{-4}	5 500	7.4×10^{-4}	4 000	1.2×10^{2}
Unpackaging release	1×10^{-1}	5 500	2.1×10^{-5}	4 000	1.4×10^{1}
Low-pressure boundary failure	1×10^{0}	5 500	8.2×10^{-6}	4 000	3.8×10^{1}
Ruptured tank because of failed gas chromatograph mass-flow controller	1×10^{-5}	5 500	6.7×10^{1}	4 000	1.2×10^{2}
Background[b]			4.1×10^{3}		3.0×10^{3}

[a]Population of White Rock is assumed to be 9 200; Los Alamos, 10 200.
[b]Data are from the Laboratory 1988 environmental surveillance report (LANL 1989a).

two facilities. The expected on-site individual dose is less than the DOE accident-related, whole-body guideline dose of 25 rem (DOE 1987). Doses from the WETF caused by abnormal releases are smaller than those from TA-33 because of the WETF's Emergency Tritium Capture Subsystem, which decreases releases to the environment. The effectiveness of this capture system in case of an accidental release is apparent from the dose comparisons. For all abnormal events, doses are well below background and no adverse effects would be apparent.

5.2.1 Earthquake

As discussed in Sec. 3.1.2 above, the maximum earthquake in the Los Alamos area has a force of 0.38 g and an annual probability of occurrence of 2×10^{-4} per year. This earthquake is assumed to cause the glove box and exhaust-containment system to fail at one or more connection points. The glove box inventory is assumed to be at the system maximum, 100 g of tritium or 9.6×10^5 Ci, as specified in Scenario 4 of the FSAR (LANL 1989b). The entire inventory is assumed to be released into the facility because of failure of the primary and secondary confinement systems. At the WETF, the release would be exhausted through the Emergency Tritium Cleanup Subsystem to the stack. Only 1.9 Ci are assumed to be emitted. At TA-33, because there is no tritium cleanup system, the entire 9.6×10^5 Ci release would be exhausted through the stack. The releases are assumed to be blown toward the nearest site boundary, White Rock, and Los Alamos under conditions that minimize plume dispersion, although these directions are recognized to be mutually exclusive (see Fig. 1-2).

5.2.2 Release During Unpackaging

As a package of tritium received from the Savannah River Plant is being unpacked, the entire quantity of 12 g of tritium, or 1.1×10^5 Ci, is released into the facility, as described in Scenario 1 of the FSAR for the WETF (LANL 1989b). Operator error or coupling failure is assumed to cause the release, with a probability assigned of 0.1 per year. At the WETF, the release would be exhausted through the Emergency Tritium Cleanup Subsystem to the stack. Only 2.3×10^{-1} Ci would be released. At TA-33, because there is no room tritium-cleanup system, the entire 1.1×10^5 Ci would be released.

5.2.3 Low-Pressure Boundary Failure in Glove Boxes

Any of several failures could cause overpressure in the glove box and a consequent tritium leak from the glove box into the facility. Scenario 3 of the FSAR for the WETF (LANL 1989b) considers a low-pressure boundary-failure leak as the most probable accident, occurring about once per year. The glove boxes have a pressure-relief seal that allows excess air or gas to bubble through an oil trap into a contained area in case the atmospheric pressure in the glove box rises more rapidly than the exhaust system can accommodate. This capture system is assumed to fail, allowing the tritium to escape into the laboratory. The maximum quantity for a single stage in the packaging operation, 36 g of tritium, or 3×10^5 Ci, is assumed to escape. At the WETF, the laboratory atmosphere is passed through the Emergency Tritium Cleanup Subsystem before being exhausted to the stack, so only 8.8×10^{-2} Ci would be exhausted to the environment. At TA-33, because there is no tritium-capture capability, the entire release of 3×10^5 Ci would be exhausted through the stack.

5.2.4 Ruptured Tank in the Tritium Waste Treatment Subsystem

The maximum inventory at risk in the glove box line, 100 g of tritium, or 9.6×10^5 Ci, is assumed to be vented from primary containment into the glove box atmosphere because of a failure in the gas

chromatograph mass-flow controller, as described in Scenario 10 in the FSAR (LANL 1989b). At the WETF, the monitor and control on the glove box atmosphere exhaust causes the tritium to be redirected through the Emergency Tritium Cleanup Subsystem, where excess gas flow is stored in the low-pressure receiver tank pending processing through the recovery system. For this abnormal-event analysis, the WETF tank is assumed to be overpressurized and a ruptured disk fails, allowing most of the tritium to escape through the stack. Some tritium is retained in the recovery system, reducing the release to 7.2×10^5 Ci. At TA-33, the entire 9.6×10^5 Ci quantity released by the failure of the gas chromatograph mass-flow controller is vented to the environment through the stack because there is no capture system.

5.3 Risks from Abnormal Events

Comparing the safety of a proposed action with that for an alternative can be complex. It is difficult to compare an abnormal event having a high probability and low consequence of occurrence with another event having a lower probability and greater consequence and to arrive at some overall conclusion on the relative safety of alternatives. Consequently, the concept of risk is used as a standardized basis on which to compare alternatives.

Risk is defined as the product of the consequence of an event and the probability of the event's occurrence (in events per year). The consequences used for events that involve radiological releases are increased population doses that could be caused by the abnormal events evaluated. For these analyses, the probabilities of release are taken from the FSAR for the WETF (LANL 1989b), as shown in Table 5-1.

The risk to the nearest potentially exposed populations from each abnormal event and the summed risks for the two alternatives are shown in Table 5-5.

The risk estimate, shown in Table 5-5, indicates that the proposed action, the WETF, has the smaller risk by nearly four orders of magnitude. This is because smaller releases produce smaller consequences. At the WETF, the quantity of tritium released is much less than the amount that would be released at TA-33 for the same abnormal event because of the WETF's emergency tritium capture

TABLE 5-5. Risk to Nearest Population[a] from Abnormal Events at WETF and TA-33

Abnormal Event	Probability of Release (events/year)	WETF (Los Alamos) Dose (person-rem)	WETF (Los Alamos) Risk (person-rem/yr)	TA-33 (White Rock) Dose (person-rem)	TA-33 (White Rock) Risk (person-rem/yr)
Earthquake	2×10^{-4}	7.4×10^{-4}	1.5×10^{-7}	1.2×10^{2}	2.4×10^{-2}
Unpackaging release	1×10^{-1}	2.1×10^{-5}	2.1×10^{-6}	1.4×10^{1}	1.4×10^{0}
Low-pressure boundary failure	1×10^{0}	8.2×10^{-6}	8.2×10^{-6}	3.8×10^{1}	3.8×10^{1}
Ruptured tank because of failed gas chromatograph mass-flow controller	1×10^{-5}	6.7×10^{1}	6.7×10^{-4}	1.2×10^{2}	1.2×10^{-3}

[a]Population of White Rock is assumed to be 9 200; Los Alamos, 10 200.

capability. In addition, the WETF is more distant than TA-33 from the nearest population concentration, 5 500 m compared with 4 000 m. The proposed action, therefore, has a lower potential for adverse impact on the environment.

6.0 RELATIONSHIP OF THE PROPOSED ACTION TO APPLICABLE FEDERAL, STATE, REGIONAL, AND LOCAL LAND USE PLANS AND POLICIES

An Action Description Memorandum (ADM) for the WETF was reviewed by the Laboratory Environmental Review Committee. No known conflict exists with any federal, state, regional, or local land use plans. The location at TA-16 selected for the proposed action is a part of the Laboratory long-range site-development plan.

7.0 AGENCIES AND PERSONS CONTACTED

This Environmental Assessment was reviewed by Los Alamos National Laboratory personnel in the following organizations:

- Health, Safety, and Environment (HSE) Division;
- Facilities Engineering (ENG) Division;
- Design Engineering (WX) Division (operating group); and
- Laboratory Environmental Review Committee (LERC).

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GLOSSARY OF UNITS USED IN THIS REPORT

Ci	curie — a unit of radioactivity, the amount of any nuclide that undergoes exactly 3.7×10^{10} radioactive disintegrations per second
g	gram — unit of mass and weight in the metric system, equal to the mass of one cubic centimeter of water
g	symbol denoting acceleration of gravity, used in measuring effective peak horizontal acceleration of an earthquake, usually at the earth's surface
m^3	cubic meter
mCi	millicurie — one-thousandth of a curie
μCi	microcurie — one-millionth of a curie
mrem	millirem — one-thousandth of a rem
person-rem	unit of dose equivalent for a population, used in the field of radiation dosimetry
rem	the amount of ionizing radiation required to produce the same biological effect as one roentgen of high-penetration x rays; unit of dose equivalent for a single individual, used in the field of radiation dosimetry

EXPONENTIAL NOTATION

Many values in the text and tables of this Environmental Assessment are expressed in exponential notation. An exponent is the power to which the expression, or number, is raised. This form of notation is used to conserve space and to focus attention on comparisons of the order of magnitude of the numbers (see following examples).

$$1 \times 10^4 = 10\,000$$

$$1 \times 10^2 = 100$$

$$1 \times 10^0 = 1$$

$$1 \times 10^{-2} = 0.01$$

$$1 \times 10^{-4} = 0.0001$$