CHAPTER 4

ENVIRONMENTAL IMPACTS

This chapter presents the results of the potential environmental impacts under the Proposed Action at the CEMRC, the WIPP Alternative, and the No Action Alternative at LANL.

4.1 HUMAN HEALTH

This section describes the potential human health impacts as a result of the three alternatives evaluated. Construction and operation of an actinide chemistry laboratory could potentially affect the health and safety of workers at the facility and members of the public in the surrounding area as the result of industrial activities (workers only) and exposure to radioactive and hazardous materials.

4.1.1 Proposed Action at CEMRC

The Proposed Action involves the addition of the proposed ACRSL facility to the existing CEMRC facility. Human health impacts may occur from construction and operation of this facility.

4.1.1.1 Construction

Construction of the proposed ACRSL facility could result in occupational injuries and illnesses to construction workers. Approximately six to fifteen construction workers would be employed for 10 months to add the 725-square-meter (7,800-square-foot) ACRSL facility at the CEMRC. Using the latest available occupational injury and illness statistics from the Bureau of Labor Statistics (year 2000 data from BLS 2002), the number of total recordable cases of expected injuries and illnesses would be one, while less than one (0.51) lost workday case would be expected. No other non-radiological or radiological impacts would occur to workers or members of the public during construction because no hazardous or radioactive materials would be present.

4.1.1.2 Operations

As described in Chapter 2 and Appendix A, operations at the proposed ACRSL facility would involve various chemical and radiochemical laboratory experiments and procedures. Workers could incur occupational injuries such as falls and cuts and potentially be exposed to radioactive materials or chemicals used in the experiments. Members of the public could be exposed to radioactive materials and chemicals that potentially would be released from the facility during experiments.

Workers

The total estimated number of full-time equivalent workers in the proposed ACRSL facility, including scientists, technicians, support staff, and visiting scientists, would be 25. Using Bureau of Labor Statistics for private industry (BLS 2002), the estimated annual number of total recordable cases of injury and illness would be about two (1.5), and the annual number of lost workday cases would be less than one (0.75).

The highest occupational radiation dose to a staff member at the proposed ACRSL facility would be less than 100 mrem per year, mainly from external radiation from small gamma sources. All potentially dispersible radionuclides would be handled in fume hoods or glove boxes. The probability of a latent cancer fatality from a 100-mrem dose to an individual would be about 0.00004 per year. The average dose to staff members at the proposed ACRSL facility would be less than this, estimated at about 10 mrem per year or less. Total radiation dose to the work force would be about 0.25 person-rem per year; the estimated number of occupational latent cancer fatalities in the worker population would be about 0.0001 per year. Over a 30-year facility lifetime, no latent cancer fatality (less than 0.004) would be expected. The proposed ASRCL facility would implement a radiation dosimetry program to monitor potential internal and external worker exposures to radioactive material to help keep such exposures as low as reasonably achievable and below applicable regulatory and administrative limits in all cases.

Small quantities of non-radioactive but potentially toxic or hazardous material also would be used in the proposed ACRSL facility. Appendix B contains a list of the chemicals used in the CEMRC and their quantities. All are chemicals typically found in chemical or radiochemical laboratories. The quantities shown in Appendix B for laboratory chemicals would increase by no more than a factor of two to accommodate proposed ACRSL operations. The largest single container of any chemical in stock would be about 3.8 liters (1 gallon). Like radionuclides, chemicals would typically be handled in fume hoods or glove boxes. The potential for health and safety impacts to staff members at the proposed ACRSL facility would be very low.

Public

The proposed ACRSL facility would be designed with the best available radionuclide control technology, including HEPA filters on all fume hoods and glove boxes to minimize the potential release of radionuclides to the atmosphere from the facility ventilation exhaust. No radionuclides would be released in sanitary sewage streams, as small quantities of liquid waste would be collected in carboys beneath lab sinks, dried, and disposed of as low-level waste.

The potential radiation dose to the maximally exposed member of the public (also known as the maximally exposed individual or MEI) was estimated based upon the CEMRC facility permit for up to 2 curies (the site-wide limit), which would apply to the combined ACRSL and CEMRC facilities. It was assumed that 2 curies of plutonium-239 were used in experiments and sample analyses over the course of 1 year. Experimental media and samples were assumed to be in particulate solid or solution form. Estimates of radionuclide emissions were made using guidance found in 40 CFR 61 Appendix D. Ventilation exhaust would pass through a minimum of two HEPA filters, each with 99 percent or higher efficiency for particle removal. Atmospheric dispersion was estimated using Carlsbad-specific meteorological data from SEIS-II (DOE 1997). Radiation doses were estimated using dose-screening factors from NCRP Report No. 123 (NCRP 1996). The MEI was assumed to reside 100 meters (328 feet) south of the proposed ACRSL facility and raise a large amount of their own food at this location. This individual would receive an estimated dose of less than 0.003 millirem per year, with the probability of a latent cancer fatality being less than 2×10^{-9} per year. If the entire population of Eddy County, numbering 51,658 (U.S. Bureau of the Census 2002), was assumed to be located within 1.6 kilometers (1 mile) of the ACRSL, the dose to the population would be less than 0.006 person-rem, with no (less than 0.000003) latent cancer fatality expected in the exposed population. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (about 0.00009) would be expected in the exposed population. In reality, the potential doses and health impacts to individuals and the surrounding population would be lower than these conservative estimates because actual operating conditions would result in lower releases (for example, more HEPA filters would likely be present, with higher removal efficiency). Radionuclide exposures would also likely be lower, because the population is more dispersed and relatively few individuals would be expected to raise a large amount of their own food.

Potential impacts to members of the public from non-radiological but potentially toxic or hazardous chemicals would also be very small because only small quantities of chemicals would be used in the preparation and analysis of chemicals. As noted above, Appendix B contains a list of the chemicals used in the CEMRC that are also likely to be used in the ACRSL in similar or somewhat larger quantities. The largest single container of any laboratory chemical in stock would be about 3.8 liters (1 gallon). Laboratory chemicals would be present in quantities below the Reportable Quantities provided in 40 CFR 302. Like radionuclides, no releases of chemicals would occur in building liquid effluent streams. Potential releases in ventilation exhaust would be very small, and no potential health impacts would be expected for members of the public.

4.1.2 Alternative at WIPP

This section describes the potential human health impacts under the WIPP Alternative.

4.1.2.1 Construction

Under this alternative, a new laboratory facility would be constructed at WIPP. Although the WIPP site infrastructure would be available to support the construction, more construction workers would be needed. Construction activities could result in occupational injuries and illnesses to construction workers. Approximately twenty construction workers would be employed for fifteen months to build the new actinide facility at WIPP. Using the latest available occupational injury and illness statistics from the Bureau of Labor Statistics (year 2000 data from BLS 2002), the expected total recordable cases would be 2.1, while approximately one lost workday case would be expected. DOE and DOE contractor occupational injury statistics were not used because a private contractor was assumed to construct the facility. No other non-radiological or radiological impacts would occur to workers or members of the public during construction because no hazardous or radioactive materials would be present.

4.1.2.2 Operations

Operations at an actinide chemistry laboratory under this alternative at WIPP would involve the same chemical and radiochemical laboratory experiments and procedures discussed for the Proposed Action. Workers could incur occupational injuries such as falls and cuts and potentially be exposed to radioactive materials or chemicals used in the experiments. Members of the public could be exposed to radioactive materials and chemicals that potentially would be released from the facility during experiments.

Workers

Operations in a new actinide facility at WIPP would be identical to those described under the Proposed Action. The total estimated number of full-time equivalent workers in the ACRSL, including scientists, technicians, support staff, and visiting scientists, would be about thirty (slightly more than the proposed ACRSL facility) because this laboratory would be a separate, stand-alone building. Using DOE occupational injury and illness statistics for operations of the DOE Carlsbad Area Office (2000 data from CAIRS 2002), the estimated annual number of total recordable cases would be less than one (0.3), as would the annual number of lost workday cases (0.15).

As for the Proposed Action, the highest occupational radiation dose to a staff member at the alternative laboratory at WIPP would be expected to be less than 100 mrem per year, mainly from external radiation from small gamma sources. All potentially dispersible radionuclides would be handled in fume hoods or glove boxes. The probability of a latent cancer fatality from a 100-mrem dose would be about 0.00004 per year. The average dose to staff members at the alternative laboratory at WIPP would be less than this, estimated at about 10 mrem per year. Total radiation dose to the work force would be about 0.3 person-rem per year, with the estimated number of occupational latent cancer fatalities about 0.00015 per year. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (less than 0.004) would be expected. The alternative laboratory at WIPP would be included under WIPP's existing radiation dosimetry program to monitor potential internal and external worker exposures to radioactive material to help keep such exposures as low as reasonably achievable and below applicable regulatory and administrative limits in all cases.

Small quantities of non-radioactive but potentially toxic or hazardous material would be used in the alternative WIPP actinide laboratory. Chemicals likely to be used would be similar to those shown in Appendix B for the CEMRC. Quantities used would also likely be similar. Like radionuclides, chemicals would typically be handled in fume hoods or glove boxes. The potential for health and safety impacts to staff members at the alternative laboratory at WIPP would be very low.

Public

The alternative WIPP actinide laboratory would be designed with the best available radionuclide control technology, including HEPA filters on all fume hoods and glove boxes to minimize the potential release of radionuclides to the atmosphere from the facility ventilation exhaust. Liquid wastes containing radionuclides would be controlled so there would be no radionuclide releases in liquid effluent streams such as sanitary sewage. The potential radiation dose to the maximally exposed member of the public was estimated based upon a building inventory of 2 curies (the site-wide limit), the same as the Proposed Action. It was assumed that 2 curies of plutonium-239 were used in experiments and sample analyses over the course of one year. Experimental media and samples were assumed to be in particulate solid or solution form. Estimates of radionuclide emissions were made using guidance found in 40 CFR 61, Appendix D. Ventilation exhaust would pass through a minimum of two HEPA filters, each with 99 percent or higher efficiency for particle removal. Atmospheric dispersion was estimated using meteorological data from SEIS-II (DOE 1997). Radiation doses were estimated using dose-screening factors from NCRP Report No. 123 (NCRP 1996). The MEI was assumed to reside continuously 3,000 meters (1.9 miles) north of the laboratory, the same location as described in SEIS-II (DOE 1997), and raise a large amount of their own food at this location. This individual would receive an estimated dose of about 0.00001 millirem per year, with the probability of a latent cancer fatality being less than 1×10^{-11} per year. The dose to the population within 80 kilometers (50 miles) of WIPP would be less than 0.00001 person-rem, with no (4×10^{-9}) latent cancer fatality expected. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (about 0.0000001) would be expected. These are also conservative estimates, and actual doses and health impacts to individuals and the surrounding population would likely be lower because actual operating conditions would result in lower releases (for example, more HEPA filters would likely be present, with higher removal efficiency). Radionuclide exposures would also likely be lower, because of the assumptions made about potentially exposed individuals raising a large amount of their own food. Most individuals in the potentially exposed population would purchase a large portion of their food.

Potential impacts to members of the public from non-radiological but potentially toxic or hazardous chemicals would also be very small because only small quantities of chemicals would be used in the preparation and analysis of chemicals. Laboratory chemicals in a WIPP laboratory would be present and used in amounts similar to those described for the ACRSL (Section 4.1.2.2). Laboratory chemical quantities would be below the Reportable Quantities provided in 40 CFR 302. No releases of chemicals would occur in building liquid-effluent streams. Potential releases in ventilation exhaust would be very small, and no potential health impacts would be expected for members of the public.

4.1.3 No Action Alternative at LANL

Under the No Action Alternative, actinide laboratory experiments would continue to take place in the existing TA-48-1 Radiochemistry Laboratory at LANL. There would be no new construction and therefore no potential for impacts to workers from construction-related industrial accidents or injuries.

Workers

Operations involving actinide radiochemistry experiments to support WIPP are a small part of the total operations in the LANL Radiochemistry Laboratory. WIPP-related activities would be essentially identical to those proposed for the new ACRSL facility and at the alternative laboratory at WIPP, so potential impacts to workers would be very similar to those described for the other alternatives. Potential impacts to members of the public would also be very low. The MEI would be located about 890 meters (2,900 feet) north-northeast of TA-48. Using the same assumptions affecting the potential release of radionuclides as were used for the Proposed Action, the estimated annual dose to the MEI would be about 0.00009 millirem per year, with the probability of a latent cancer fatality being about 5×10^{-11} per year.

Public

There is a larger population within 80 kilometers (50 miles) of LANL than around either Carlsbad or WIPP, although most of it is more than 32 kilometers (20 miles) distant. The dose to the population within 80 kilometers (50 miles) of LANL would be about 0.0001 person-rem, with no (7×10^{-8}) latent cancer fatality expected. Over a hypothetical 30-year facility lifetime, no latent cancer fatality (about 0.000002) would be expected. Similar to operations at the proposed ACRSL facility or at the alternative laboratory at WIPP, potential exposure of the public from toxic or hazardous chemicals would be very low, and no health impacts would be expected.

4.2 ACCIDENTS

This section describes potential accidents as a result of the three alternatives evaluated. DOE analyzed the same accident scenarios at the three alternative locations for the proposed ACRSL, taking into account different atmospheric conditions at the sites. However, because the CEMRC site and the WIPP site are in close proximity, the same atmospheric conditions were assumed for these two sites.

4.2.1 Proposed Action at CEMRC

This section investigates the potential hazards that could result from operations at the proposed ACRSL expansion of the CEMRC facility and conducts a bounding analysis to illustrate the quantitative effects of potential accidents. A preliminary hazards analysis was conducted to identify potential hazards at the facility. A standard accident analysis was used to identify potential hazards and accidents that could result if the hazards were uncontrolled. Next, the physical and administrative barriers that would be designed to control the frequencies of the identified hazards or minimize releases of radioactive or hazardous materials are identified for each potential accident. The information is intended to assess the impacts from a potential accident.

General information about the proposed ACRSL facility and the existing CEMRC facility (CEMRC 2000, Webb 2002a) that was used to identify hazards, accidents, and associated controls is summarized below.

- The State of New Mexico is a Nuclear Regulatory Commission-designated Agreement State. New Mexico regulations do not require an accident analysis to support emergency preparedness planning for facilities possessing less than 2 curies of radioactive material (20 NMAC 3.1, Section 309, New Mexico Environment Department, Radiation Licensing and Registration). The State has approved, and the CEMRC is now permitted to possess, up to 2 curies of radioactive material (the site-wide limit).

- Currently, the CEMRC possesses less than 100 microcuries, and the inventory is dominated by gamma emitters such as cesium.

- With the addition of the proposed ACRSL facility, the maximum limit allowed on the site would be 2 curies of plutonium-239. However, a more realistic isotopic breakdown of the 2-curie limit would be 1 curie of plutonium, 0.5 curie of uranium, and 0.5 curie of all other radioactive materials (for example, plutonium-241).

- If experimental operations were initiated at the proposed ACRSL facility, the radiological hazard would be dominated by the plutonium inventory in a glove box where samples would be prepared. There would also be a fume hood where experiments would occur over a long timeframe (several years) that may contain many millicurie-size samples. The general plan would be to bring in, for example, 1 curie of plutonium into the glove box, separate it into millicurie-size samples, and transfer the millicurie-size samples to other locations for the experiments when needed. The plutonium would be a nitrate solution, but there also may be a need for certain solid-state experiments. Some plutonium metal may be brought in. Other solid-state plutonium may be in the form of precipitates that form in solutions in certain experiments.

- The proposed ACRSL facility would be constructed to be consistent with, or greater than, Uniform Building Code seismic criteria. It would be a single-story, all-steel structure with a concrete floor.

- There would be no radioactive releases to the sanitary sewer. All potentially radioactive liquids would be collected in carboys beneath lab sinks, dried, and disposed of as low-level waste. The proposed ACRSL facility would be provided with evaporation, precipitation, and filtration capabilities for the purpose of drying the potentially contaminated solutions collected from sink drains.

- No airborne emissions above regulatory limits would be expected from the proposed ACRSL facility due to physical and administrative barriers. All exhaust airflows would have double-HEPA filters at a minimum. The glove box would also be provided with a local HEPA filter in its exhaust so this would receive a triple-HEPA-filter treatment before discharge to the environment. The high-activity fume hood would also be provided with a local HEPA filter.

- The CEMRC is currently a conditionally exempt hazardous material facility. For this to continue with the addition of the proposed ACRSL facility, the CEMRC could possess quantities of hazardous materials up to EPA threshold quantities as listed in 40 CFR 355. The current hazardous chemical inventory at the CEMRC is shown in Table B-1 of Appendix B. The future combined inventory for both the proposed ACRSL facility and the existing CEMRC facility would be no more than twice the current CEMRC inventory. The largest single container of any chemical in stock would be 3.8 liters (1 gallon).

- Standard industrial hygiene practices would be implemented in the proposed ACRSL facility, including flammable chemical storage in special cabinets and separation of acids and bases. The CEMRC would be audited by the State to ensure these practices were adequate to protect workers and control chemical hazards.

- The proposed ACRSL facility would be provided with fire protection systems that comply with National Fire Protection Association requirements. These systems would include fire suppression systems (for example, local fire extinguishers and a wet pipe sprinkler system) and detection systems (for example, smoke and flame detectors in lab rooms, hallways, and ventilation ductwork). There would also be fire barriers between rooms. The proposed ACRSL building would be constructed with noncombustible materials (that is, all metal walls and a concrete floor).

- Criticality would not be credible because of the 2-curie limit.

- Occupational doses for the CEMRC staff are estimated to be less than 100 mrem per year to the maximally exposed worker. To date, none of the CEMRC personnel has recorded a dose. Each quarter, the CEMRC performs a survey of dose rates and lab smears to identify potential problems. Currently, CEMRC personnel do not wear personnel dosimeters because the dose rates are so low and the quarterly checks confirm the low dose rates. However, they would restart the dosimetry program if the additional radioactive material were received for the proposed ACRSL facility. This would include personnel dosimeters, urine bioassay, and lung/whole-body counting. There also would be continuous air monitors in rooms with high activity in the proposed ACRSL facility such as the glove box room and the high-activity fume hood.

Based on the above information and the proposed ACRSL facility description provided in Chapter 2, the hazard analysis in Table 4-1 was developed. As shown, for all of the key hazards associated with the radiological and chemical materials in the facility, at least one mitigation measure is available to either control the frequency of occurrence or the consequences of potential accidents that could result from the presence of the hazard.

Table 4-1. Preliminary Hazard and Accident Identification

Hazard	Potential Accident	Mitigation
Kinetic/potential energy	Lab container dropped, struck by other object, container breaks and spill occurs	-Only small quantities (millicuries) of radioactive material would be handled outside containment (glove box, fume hood) -All lab areas would have minimum double-HEPA filtration
	Shipping container dropped, breaks open, releases contents (inside or outside the facility)	-Container integrity – radionuclides would be received in certified transportation containers -All lab areas would have minimum double-HEPA filtration -Operating procedures
Leakage	Loss of air balance in glove box or fume hood expels radioactive material into room	-Consequences would be small because experiments involve small quantities (millicuries) of radioactive material -Continuous air monitors would be used in rooms with high activities -Air balance (negative air pressure maintained) -Use of personnel dosimetry, bioassay, whole body counting -Use of personnel protective equipment (e.g., eye protection)
Thermal energy	Fire in glove box	-Fire detectors in glove box, ductwork -Non-combustible construction -Local fire extinguishers, trained operators
	Fire in Lab Room	-Fire detectors -Fire barriers between rooms -Non-combustible construction -Wet-pipe sprinkler system -Flammable chemical storage
	Hot exposed surface burns personnel	-Operator procedures and training -Thermal sources insulated or access restricted
	Site-wide fire	-Non-combustible construction -Fire Department response

Table 4-1. Preliminary Hazard and Accident Identification (continued)

Hazard	Potential Accident	Mitigation
Chemical reactions	Explosion	-Separate storage cabinets for acids and bases would be used -Use of a chemical information system to identify chemical incompatibilities when ordering -Operator training/accreditation -Use of personnel protective equipment (e.g., eye protection)
	Mixing error leads to inadvertent chemical reaction	-Use of a chemical information system to identify chemical incompatibilities when ordering -Operator procedures and training -Use of small quantities at any one time would limit energy release
Toxic chemical	Toxic chemical spill into sanitary sewer	All potentially contaminated lab sinks would drain into carboys; no direct connection to sanitary sewer
	Chemical spill contaminates personnel	-Use of a chemical information system to identify incompatibilities, toxicity, container requirements, etc. -Use of personnel protective equipment -Availability of lab showers -Operator procedures and training
	Chemical spill leads to offsite release	-Use of hazardous chemical quantities less than EPA threshold quantities, limits offsite exposures -Use of a chemical information system to identify incompatibilities, toxicity, container requirements, etc.
Nuclear reaction	Inadvertent criticality	Not possible - less than minimum critical mass allowed in facility
External penetrating radiation	Personnel overexposure	-Low radiation dose rates limit the potential for overexposure -Personnel dosimeters, bioassay program, whole-body counters -Quarterly dose rate measurements
Radioactive contamination	Personnel receives external contamination	-Quarterly lab smears -Personnel dosimeters, bioassay program, whole body counters
Electrical energy	Personnel receives electrical shock	-Installation of standard electrical protection, such as insulated high-voltage sources, grounded outlets, etc. -Operator training
Seismic event	Seismic event causes spill	-Building structures and heating, ventilation, and air conditioning systems designed to Uniform Building Code seismic event -Glove box supported in accordance with Uniform Building Code criteria -Minimum double-HEPA filtration; local HEPA filter at glove box and high-activity fume hoods
	Seismic event causes building collapse	-Building structures and heating, ventilation, and air conditioning systems designed to Uniform Building Code seismic event -Glove box supported in accordance with Uniform Building Code criteria -Inventory limits control offsite radiation doses and chemical exposures -Chemicals stored in cabinets that limit upsets, releases

4.2.1.1 Radiological Impacts

A bounding analysis was conducted to illustrate the potential consequences that could result from a release of radioactive material from the proposed ACRSL facility. This bounding analysis was based on atmospheric dispersion data from both SEIS-II (DOE 1997) and the LANL SWEIS (DOE 1999). The following equation was used to calculate the radiological consequences:

Dose (TEDE) = Release * E/Q * Breathing Rate * DCF

where:

TEDE	=	Total effective dose equivalent (rem)
Release	=	Release quantity (curies)
E/Q	=	Time-integrated atmospheric dispersion where the receptor is located (seconds per cubic meter)
Breathing rate	=	0.00033 cubic meter per second
DCF	=	Dose conversion factor (rem per curie)

The input values for each of these parameters are discussed below.

Release. For this bounding assessment, it was conservatively assumed that the entire 2-curie inventory (the site-wide limit) of radioactive material would be available for release from the proposed ACRSL facility. It was further assumed that the entire release would be plutonium-239, although release of this quantity of material from the building would not be possible given the administrative controls and physical barriers in place designed to prevent such an occurrence. Furthermore, it was assumed that the entire amount of material available for release would be in powder form.

The bounding accident selected for this analysis is a severe seismic event that could potentially affect the entire inventory of plutonium-239. The release quantity from the bounding seismic event was calculated as the product of the initial inventory (2 curies of plutonium-239) and the release and respirable fractions taken from the *DOE Handbook* (DOE 1994b). The release was modeled as a free-fall spill of a cohesionless powder. For seismic events, the release mechanism was assumed to occur via suspension of bulk powders caused by vibration of substrate due to seismic vibration. For this mechanism, the release and respirable fractions are 0.001 and 0.1, respectively. These are the “bounding” values from DOE (1994b) for this release mechanism. Therefore, the overall respirable release quantity is 2 curies x 0.001 x 0.1 = 0.0002 curies of plutonium-239. It was assumed that the seismic event fails the building ventilation system such that the HEPA filters are ineffective or bypassed. No plate-out or deposition of the released material on the building structures or ventilation system ductwork was assumed.

RELEASE BY TORNADO

It is recognized that tornados have occurred in Eddy County (TPO 2000). Although the probability of a direct hit by a tornado on the proposed ACRSL building is very remote, such an event could release the entire inventory of plutonium-239. However, the dispersal of plutonium would be over an extremely large area due to the high winds (100 to 200 miles per hour) associated with tornados. This would result in a much smaller exposure to any person than the bounding analysis conducted in this EA for a seismic incident. With the seismic release, it was assumed that the weather is nearly stagnant and the material stays in somewhat of a cloud. Thus, the dose received by the maximally exposed member of the public due to the release by a tornado would be far less than for the seismic accident modeled as the bounding analysis and determined not to cause any significant impacts.

An earthquake that would cause the collapse of the ACRSL, resulting in a release of radioactive material, would be highly unlikely because the laboratory will be constructed to be consistent with, or greater than, the Uniform Building Code seismic criteria. Furthermore, the Carlsbad area is classified in the Uniform

Building Code (ICBO 1990) as Seismic Risk Zone 1, which means there is little seismic activity in the region. The strongest earthshaking experienced in the vicinity of Carlsbad in the past has only been sufficient to crack plaster and overturn unstable objects (DOE 1997).

E/Q. Atmospheric dispersion factors for the CEMRC and WIPP sites were taken from SEIS-II (DOE 1997) and amount to 0.00065 second per cubic meter for both the offsite public and noninvolved workers. These values were used for both the Proposed Action and the WIPP Alternative because no E/Q values for the existing CEMRC site were available. For LANL, the E/Q values are 0.00065 second per cubic meter for the public MEI and 0.0014 second per cubic meter for the noninvolved worker (DOE 1997).

Breathing Rate. The breathing rate used in the analysis was 0.00033 cubic meter per second. This rate is representative of a typical acute breathing rate (light activity) and was taken from the International Commission on Radiological Protection Publication 23 (1975).

Dose Conversion Factor. The dose conversion factor for plutonium-239 (0.000116 Sievert per becquerel) was taken from *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion* (EPA 1988).

Dose to Public and Noninvolved Worker

Table 4-2 presents the results of this bounding analysis for all three alternatives as bounding approximations of the potential exposure for the proposed ACRSL facility. As shown, the total dose to the maximally exposed member of the public and noninvolved worker at the CEMRC or WIPP sites from a release of the entire inventory of plutonium at the facility would be about 18 mrem. Using a standard dose-to-health-effects conversion factor of 0.0005 latent cancer facility per rem, the probability of this MEI contracting a fatal cancer is about 0.00001 or one chance in 100,000. Based on the air dispersion factors used for CEMRC and WIPP, there would be no public health impact from this conservative release scenario at the proposed ACRSL facility.

As shown in Table 4-2, the impacts to the public MEI under the No Action Alternative would be the same as those under the Proposed Action and WIPP Alternative because the E/Q values are the same. The noninvolved worker impacts would be slightly higher under the No Action Alternative than under the WIPP Alternative because the noninvolved worker at LANL would be located closer to the facility than would the noninvolved worker at WIPP. The noninvolved worker at the proposed ACRSL facility at the CEMRC would be located at the same distance from the facility as the noninvolved worker at WIPP; therefore, there would be no difference in impacts. However, no incremental latent cancer fatalities are anticipated for the LANL noninvolved workers and thus are not anticipated for noninvolved workers at the proposed ACRSL facility at the CEMRC.

Table 4-2. Results of Radiological Accident Impact Analysis

	Release (Ci Pu-239)	E/Q (sec/m^3)	Breathing Rate (m^3/sec)	Dose Conversion Factor (Sv/Bq)	Unit Conversion (Bq/Ci)	Unit Conversion (rem/Sv)	Total Effective Dose Equivalent (rem)	Total Effective Dose Equivalent (mrem)
Proposed Action (CEMRC) and WIPP Alternative								
MEI and noninvolved worker	0.0002	0.000650	0.000330	0.000116	37 billion	100	0.0184	18
No Action Alternative (LANL)								
MEI	0.0002	0.000650	0.000330	0.000116	37 billion	100	0.0184	18
Noninvolved worker	0.0002	0.00140	0.000330	0.000116	37 billion	100	0.0397	40

Dose to Involved Worker

A preliminary estimate of the radiation dose to a maximum involved worker was calculated for the seismic scenario. In order for the seismic event to affect the entire inventory of plutonium-239 in the ACRSL, it would have to be severe and would most likely cause major safety systems to fail, including the building ventilation system and associated filtration capabilities, as well as major building structures. Involved workers would be exposed to falling debris and would likely receive fatal injuries that are not related to the radioactive material in the building. Nevertheless, preliminary calculations were performed to develop a bounding estimate of the radiation dose to an involved worker. It was assumed that a worker would be in a room in which the entire inventory of plutonium-239 is present. It was assumed that the seismic event causes all of the material to be spilled. A fraction would become airborne, similar to the scenario that was used to calculate the noninvolved worker and public dose estimates. It is assumed the worker would survive the building collapse produced by the seismic event and remain conscious for 8 hours after the event. Thus, the involved worker would be exposed to an airborne release of plutonium-239 and would remain in place and conscious for 8 hours after the event.

The dose to an involved worker from a severe seismic event is highly uncertain due to large potential variations in the parameters required to estimate the dose. Examples of widely variable parameters include the effectiveness of personnel protective equipment, alarm response time, evacuation time, concentration of released material in an indoor environment, and concentration of released material outdoors at distances less than about 100 meters (328 feet). Consequently, a number of assumptions are described in the following paragraphs that were made to develop the involved worker dose estimate.

The general equation used to calculate the dose to the maximum involved worker is essentially the same as that used to calculate the noninvolved worker and public dose estimates. However, the main difference is in the calculation of the airborne concentration of plutonium-239 to which the worker would be exposed. That concentration of plutonium-239 was calculated assuming the released material would be dispersed into a room with a volume of 500 cubic meters (654 cubic yards). Thus, the initial concentration was calculated by dividing the total plutonium-239 respirable release quantity by the room volume. The air concentration was assumed to decrease by a factor of 10 every hour. This decrease would be due to diffusion of the released material caused by wind blowing through openings in the structure that were caused by the seismic event. In reality, a large fraction of the released material would have been dispersed during the building collapse; however, to be conservative, this was not included in the calculation. In this manner, the air concentrations of plutonium-239 initially and 1 to 8 hours after the event were estimated.

The worker's intake of plutonium was estimated by multiplying the air concentration values by the breathing rate discussed previously (3.3×10^{-4} cubic meters per second). It was assumed that the initial concentration would last for the 0- to 1-hour period, the concentration at 1 hour would last for the 1- to 2-hour period, and so on. The total quantity of plutonium-239 inhaled by the involved worker is then the sum of the quantities inhaled in the eight 1-hour periods. This quantity was then multiplied by the dose conversion factor for plutonium-239 to calculate the dose to the involved worker.

The involved worker dose was estimated to be about 230 rem. This dose is not likely to result in a prompt radiological fatality, but it has an approximate 1 in 10 chance of resulting in a latent fatal cancer over the involved worker's lifetime. Note that this was calculated assuming the worker survives the building collapse, does not or cannot evacuate the collapsed building, is conscious for 8 hours after the event, and is wearing personal protective equipment that is ineffective.

4.2.1.2 Hazardous Chemical Impacts

Estimates of the noncarcinogenic consequences of exposure to potentially hazardous chemicals are made by comparing air concentrations found in the Emergency Response Planning Guidelines. For many chemicals, such guidelines have not yet been developed. Instead, DOE has supported the development of Temporary Emergency Exposure Levels (TEELs) that provide interim, temporary, or equivalent exposure limits until Emergency Response Planning Guidelines' limits are developed (Craig 2000). Descriptions of the various TEEL levels are provided below.

- *TEEL-0:* The threshold concentration below which most people will experience no appreciable risk of health effects.
- *TEEL-1:* The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.
- *TEEL-2:* The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.
- *TEEL-3:* The maximum concentration in air below which it is believed nearly all individuals could be exposed without experiencing or developing life-threatening health effects.

For hazardous chemical impacts, the concentrations of the chemicals at the MEI receptor locations were calculated and compared to the appropriate TEEL level (that is, 0, 1, 2 or 3) using the following equation:

$$\mathbf{TEEL_f} = \frac{\mathbf{E/Q \times Rate}}{\mathbf{TEEL\text{-}X}}$$

where:

$TEEL_f$	=	Fraction of the TEEL-X level, an indicator of the potential noncarcinogenic impact from exposure to polychlorinated biphenyls
E/Q	=	Time-integrated atmospheric dispersion factor where the receptor is located (seconds per cubic meter)
Rate	=	Source term release rate (milligrams per second [assumed to be released over 2-hour period or 7,200 seconds])
TEEL – X	=	Appropriate TEEL level (milligrams per cubic meter)

The hazardous chemicals of interest to this assessment were taken from a recent inventory of chemicals at the CEMRC facility (see Table B-1 in Appendix B). As stated previously, the estimated hazardous chemical inventory for the ACRSL facility would be no more than double the current inventory at the CEMRC facility. Thus, the existing CEMRC facility inventory represents the incremental chemical inventory required to support the ACRSL facility at the CEMRC. This would also represent the incremental inventory required to support the WIPP and LANL alternatives. The chemicals evaluated here were those that have threshold-planning quantities as defined in 40 CFR 355, *Emergency Planning and Notification*. The other chemicals listed in Table B-1 were not evaluated further. However, researchers at the proposed ACRSL facility would be trained in the proper storage, handling, and use of all of these chemicals.

The results of the hazardous chemical impact calculations for the proposed ACRSL facility are shown in Table 4-3 for a hypothetical, conservative release scenario that affects the entire inventory of each chemical. As shown, none of the chemical concentrations exceeded TEEL-3, which indicates that no life-threatening health effects are anticipated. The concentration of one chemical, nitric acid, approaches the TEEL-2 concentration (that is, it is near the concentration at which the exposure could impair a person's ability to take protective action). The other chemicals are all less than one-half of the TEEL-2 value and would not be expected to affect a person's ability to take protective action.

The concentrations calculated in Table 4-3 were based on a hypothetical, bounding scenario that affects the entire inventory of each chemical. Such a scenario would require a large event such as a fire or severe earthquake, which would involve multiple rooms. Although the total quantities of some of the chemical inventories may be relatively large (for example, 93 liters [25 gallons] of nitric acid), they would be received and moved around the facility in much smaller quantities. The largest container of any chemical would be 3.8 liters (1 gallon). Consequently, an accidental release of such a chemical would most likely not involve the entire inventory but rather a small fraction of the inventory that represents, at most, a few containers. Therefore, the results presented in Table 4-3 are extremely conservative.

Table 4-3. Results of Hazardous Chemical Impact Analysis for All Three Alternatives

Chemical Name	Concentration (mg/m^3)	Fraction of TEEL Levels			
		TEEL-0	TEEL-1	TEEL-2	TEEL-3
Acetic acid, glacial	0.51	0.021	0.014	0.0060	0.0042
Acetone	3.7	0.0021	0.0016	0.00018	0.00018
Hydrochloric acid (concentrated)	10	14	2.3	0.34	0.046
Hydrofluoric acid	0.57	0.35	0.35	0.035	0.014
Hydroquinone	0.045	0.023	0.0075	0.0045	0.00090
Lactic acid	0.056	0.0038	0.0014	0.00019	0.00011
Mercurous chloride	0.0090	0.36	0.12	0.090	0.00090
Nitric acid (concentrated, reagent)	13	4.9	4.9	0.98	0.24
Nitric acid (fuming)	0.34	0.13	0.13	0.026	0.0066
Sulfuric acid	3.3	3.3	1.7	0.33	0.11

In addition, an accident scenario that involves the entire inventory of a chemical in the facility would not be credible. This judgment was made based on the provided fire protection systems (including fire detection and suppression systems and fire barriers between rooms), chemical storage requirements, non-combustible facility construction, and seismic design requirements. These and other accident mitigation measures would prevent a facility-wide accident from releasing hazardous chemicals from multiple locations. Therefore, it was determined that a facility-wide accident scenario was not credible. Nonetheless, the impacts of such an event were calculated to illustrate the effects of such an event.

A conservative bounding analysis was conducted to illustrate the potential consequences that could result from an offsite release of hazardous chemicals from the proposed ACRSL facility. This bounding analysis was based on atmospheric dispersion data from both SEIS-II (DOE 1997) and the LANL SWEIS (DOE 1999). If the existing laboratory at LANL were used, the public MEI consequences would be identical to those for a new laboratory located at WIPP because the chemical inventories would be the same, and the E/Q for the public MEI at LANL is the same as the E/Q at WIPP. For the noninvolved worker, the E/Q is slightly higher than at WIPP, as discussed earlier. The noninvolved worker consequences at LANL would be equivalent to the consequences shown in Table 4-3 multiplied by the ratio of E/Q values, or about 2.1 (0.0014/0.00065). Even under these conditions, no life-threatening health effects would be anticipated (all concentrations would be less than TEEL-3), and only nitric acid concentrations would exceed the TEEL-2 concentration. Thus, no health effects would be anticipated from a release of hazardous chemicals at the proposed ACRSL facility using the extremely conservative bounding analysis results for the LANL and WIPP sites.

4.2.2 Alternative at WIPP

Based on the conservative bounding analysis results using atmospheric dispersion data from SEIS-II (DOE 1997) for both radiological materials and hazardous chemicals described in Section 4.2.1 for the Proposed Action, no health effects would be anticipated from operation of a new actinide chemistry laboratory at WIPP. The results of the bounding analysis for WIPP are presented for radiological materials in Table 4-2 and for hazardous chemicals in Table 4-3. This assumes a new actinide chemistry laboratory at WIPP would have inventories of radiological materials and hazardous chemicals equivalent to those described above for the Proposed Action.

4.2.3 No Action Alternative at LANL

Based on the conservative bounding analysis results using atmospheric dispersion data from the LANL SWEIS (DOE 1999) for both radiological materials and hazardous chemicals described for the Proposed Action, no health effects would be anticipated for continuation of actinide chemistry experiments at the Radiochemistry Building (TA-48-1) at LANL. The results of the bounding analysis for LANL are presented for radiological materials in Table 4-2 and for hazardous chemicals in Table 4-3. This evaluation only includes the types of actinide chemistry experiments at the Radiochemistry Building (TA-48-1) that are described for the Proposed Action; it does not include other experimental programs that may be conducted in the same building. Thus, it assumes inventories of radiological materials and hazardous chemicals would be equivalent to those described above for the Proposed Action.

4.3 LAND USE

This section describes the potential land use impacts as a result of the three alternatives evaluated.

4.3.1 Proposed Action at CEMRC

Under the Proposed Action for a new laboratory at the CEMRC, impacts on land use would be minimal. The new laboratory would be constructed adjacent to the existing CEMRC building on land that was previously disturbed during the original construction of the CEMRC. The proposed ACRSL facility would make use of existing CEMRC support facilities (for example, meeting rooms, administrative offices, reception area, and parking), so no additional land would be required for these support facilities.

4.3.2 Alternative at WIPP

Under the alternative for a new actinide chemistry laboratory at WIPP, the impacts on land use would be minimal. The most likely location for this new laboratory would be in the northeast corner of the WIPP site inside the fence (see Figure 2-1), which is not currently in use and has been dedicated for use by facilities supporting WIPP. The surface area that would be required for laboratory construction under this alternative would be larger than that required under the Proposed Action because the new laboratory would need to include facilities for meeting rooms, administrative offices, and a reception area.

4.3.3 No Action Alternative at LANL

No land use impacts would occur under the No Action Alternative, which would involve continued use of the existing Radiochemistry building (TA-48-1) at LANL for actinide chemistry experiments. Use of the

Radiochemistry building for actinide chemistry experiments would be consistent with the land use for other laboratories in the LANL area.

4.4 GEOLOGY AND HYDROLOGY

This section describes the potential impacts to surface geology and hydrology as a result of the three alternatives evaluated.

4.4.1 Proposed Action at CEMRC

Under the Proposed Action for a new laboratory at the CEMRC, impacts on the surface geology or hydrology due to construction would be minimal. There would be a very minor impact to the surface geology due to construction of the proposed laboratory on an area of about 725 square meters (7,800 square feet). Because the proposed laboratory would make use of existing CEMRC support facilities (for example, meeting rooms, administrative offices, reception area, and parking), no additional impacts would occur to the surface area.

4.4.2 Alternative at WIPP

Under the alternative for a new actinide chemistry laboratory at WIPP, impacts on the surface geology or hydrology due to construction would be minimal. There would be a minor impact to the surface geology due to construction of the proposed laboratory. The surface area required for the laboratory construction under this alternative would be greater than that for the Proposed Action because the new laboratory would need to include facilities for meeting rooms, administrative offices, and a reception area.

4.4.3 No Action Alternative at LANL

No impacts on the surface geology or hydrology would occur under the No Action Alternative. No disturbance to the surface geology would be required because this alternative would involve continued use of the existing Radiochemistry building (TA-48-1) at LANL for actinide chemistry experiments.

4.5 BIOLOGICAL RESOURCES

This section describes the potential impacts to biological resources as a result of the three alternatives evaluated.

4.5.1 Proposed Action at CEMRC

Construction and maintenance of the ACRSL at the CEMRC would have little biological impact. The facility would be constructed on previously disturbed land. Previous surveys of the CEMRC site have found no threatened or endangered species at the site. The arroyos bordering the site are well vegetated, and great care would be taken during construction to ensure the plants were not disturbed.

4.5.2 Alternative at WIPP

Construction and maintenance of a new actinide chemistry laboratory within the fenced area of the WIPP site would have little impact on the biological resources. There have been no endangered or threatened species observed within the WIPP boundaries during DOE-conducted surveys over the past several years (DOE 1997).

4.5.3 No Action Alternative at LANL

Under the No Action Alternative, no construction would take place and the biological environment would remain unchanged. Therefore, no new impacts to biological resources would occur.

4.6 CULTURAL RESOURCES

This section describes the potential impacts to cultural resources as a result of the three alternatives evaluated.

4.6.1 Proposed Action at CEMRC

As discussed in Section 3.4.1, a cultural resources survey conducted at the CEMRC (DOE 1995c) did not locate any prehistoric or historic properties. Based on the documented absence of cultural resource sites at the CEMRC property, construction of the ACRSL would have no impact to cultural resources.

4.6.2 Alternative at WIPP

The northeast corner of the fenced area has been previously disturbed by construction activities and was found to not have any cultural resources present prior to that disturbance. Therefore, construction of the new ACRSL at this area of the WIPP site would have no impact to cultural resources.

4.6.3 No Action Alternative at LANL

Under the No Action Alternative, conducting experimental activities in actinide chemistry would continue at the LANL Radiochemistry Building (TA-48-1). Although this particular building has not yet been formally recorded and evaluated for eligibility in the National Register of Historic Places by the LANL Cultural Resources Management Team, continued laboratory use without structural modifications would have no adverse effect on its pending evaluation as a historic property.

4.7 SOCIOECONOMIC RESOURCES

This section describes the potential socioeconomic impacts as a result of the three alternatives evaluated.

4.7.1 Proposed Action at CEMRC

Under the Proposed Action, the ACRSL facility would be administered as an integrated program of the CEMRC. Consolidated operations at the CEMRC site would potentially increase the efficacy of the WIPP experimental program at a reduced cost to DOE. Long- and short-term research projects could be performed by research entities identified by CBFO, with the CEMRC facilitating these projects under its operations and maintenance contract with DOE.

Carlsbad, New Mexico, located in Eddy County, is considered the affected region when analyzing the socioeconomic impacts from the construction and operation of the ACRSL facility. Potential socioeconomic impacts were projected for the design, construction, and operations phases of the capital project. During the design and construction phases of the project, local economic impacts are considered relative to employment and earnings in specific industries (for example, construction, lodging, and restaurants) and in use of additional public goods and services (for example, roads and highways, hospitals, schools, and universities). Managerial economic impacts are considered relative to the potential cost-savings to DOE during the operations phase of the project, which would include consolidation of research activities and reduction in outsourcing and administrative costs. Project cost information was provided by CEMRC (2000).

4.7.1.1 Local Economic Impacts

Construction of the ACRSL facility would represent a modest capital investment towards expanding CEMRC research activities to meet current and future needs involving experiments by various DOE contractors. Project engineers have provided scheduling and budget information relating to the facility design, construction, and operations at the CEMRC site (all cost figures are measured in 2000 dollars).

ACRSL Facility Construction

The total budget for construction activities is estimated to be $3,634,937, as summarized in Table 4-4. The projected total cost includes site work, construction, construction contingency, major fixed and movable building equipment, minor movable equipment and furnishings, fees, salary, fringe benefits, domestic travel, and facility and administrative costs.

Table 4-4. Budget for Construction

Category	Cost (in dollars)
CEMRC Project Support	
Professional salary	85,631
Fringe benefits @ 27%	23,120
Domestic travel	4,000
Facility & administrative costs @ 26%	29,316
Subtotal	*142,067*
Construction Costs	
Building cost at $250/gross square feet (7,800 square feet)	1,950,000
Major fixed and movable building equipment @ 35% building cost (e.g., fume hoods, glove boxes etc.)	682,500
Land cost	0
Site costs (e.g. parking lots, utilities, landscaping)	200,000
Construction contingency @ 10% building costs	195,000
State of New Mexico gross receipt tax (6.8%)	205,870
Subtotal	*3,233,370*
Other Costs	
Minor movable equipment and furnishing costs @ 10% building costs	195,000
Miscellaneous allowances @ 3% building/site costs (e.g., relocation cost, legal fees, etc.)	64,500
Subtotal	*259,500*
Total	**3,634,937**

Construction could be completed within about 18 months of the completion of design activities, award of funding by DOE, and acceptance by New Mexico State University.

Based on scheduling and budget information provided by project engineers, the total estimated costs for the design and construction phases would be $4.2 million spread over a 32-month period. This level of capital spending would have negligible effects on the demand for goods and services within the local

Carlsbad economy, when compared to numerous larger construction projects by DOE in the Carlsbad area such as WIPP. At the same time, construction of the ACRSL facility at the CEMRC site would require few additional workers and would have only a very minor, positive, short-term impact on employment and earnings in the local economy. Similarly, design and construction of the facility would not be expected to have any significant impacts on public goods or services in Carlsbad or the surrounding community.

ACRSL Facility Operation

The estimated budget for operating and maintaining the ACRSL facility at the CERMC site is $2,870,194, as summarized in Table 4-5. The CEMRC would operate the facility as a multi-user research laboratory to support the WIPP experimental program under a contract from DOE, providing basic usage coordination, physical plant operation, and environmental, safety, and health management. The analysis assumes a 5-year period of performance. Proposed funding levels for operations of the ACRSL facility at the CEMRC site are under $600,000 per year. Operating costs and staff salaries are assumed to increase by 1 percent and 2 percent, respectively, in each year. Annual budgets are based on actual operating costs for the CEMRC during FY1998 through FY2000. These costs were conservatively determined and based on historical costs of CEMRC operations, making adjustments for building size (in square feet) and accounting for the fact that the proposed ACRSL facility would be more costly to operate on a square-foot basis. The amount of laboratory space in the proposed ACRSL would be very similar to that currently in operation at the CEMRC. One assumption in estimating the operating costs for the ACRSL was that the non-laboratory space at the current CEMRC contributes minimally to historical operating costs.

Table 4-5. Annual Operating Cost for the ACRSL

	Cost (in dollars)					
Category	**FY2004**	**FY2005**	**FY2006**	**FY2007**	**FY2008**	**Total**
Minor building equipment replacement	6,000	6,060	6,121	6,182	6,244	30,606
Environmental health and safety management	20,000	20,200	20,402	20,606	20,812	102,020
Building-related maintenance and service contracts	50,000	50,500	51,005	51,515	52,030	255,050
Insurance	100,000	101,000	102,010	103,030	104,060	510,101
Building-related office and non-office supplies	25,000	25,250	25,503	25,758	26,015	127,525
Chemical reagents	25,000	25,250	25,503	25,758	26,015	127,525
Communications	15,000	15,150	15,302	15,455	15,609	76,515
Utilities	64,000	64,640	65,286	65,939	66,599	326,464
Custodial and pest control services	12,000	12,120	12,241	12,364	12,487	61,212
Professional and technical staff salary	100,000	102,000	104,040	106,121	108,243	520,404
Fringe benefits @ 27%	27,000	27,540	28,091	28,653	29,226	140,509
Subtotal	*444,000*	*449,710*	*455,503*	*461,379*	*467,340*	*2,277,932*
Facility and administrative cost @ 26%	115,440	116,925	118,431	119,958	121,508	592,262
Total	**559,440**	**566,635**	**573,933**	**581,337**	**588,849**	**2,870,194**

Based on the budget information provided by project engineers in December 2000, the annual operating costs for the proposed ACRSL facility would have negligible impacts on the demand for goods and services in the local economy. Operations of the facility would have only a very minor, positive impact on local employment opportunities, as most administrative staff are employed at the CEMRC and some of the proposed fifteen permanent research staff are already situated in the Carlsbad area. Most of the research staff would consist of personnel on long-term assignments from LANL, Sandia National Laboratories, and the Westinghouse TRU Solutions, LLC, who would probably reside permanently in Carlsbad. Some staff would consist of personnel on short-term assignments from other DOE laboratories, other federal agencies, American university or companies, or foreign governments, universities, or companies. These personnel would probably not reside permanently in Carlsbad. The total long- and short-term staff would comprise between fifteen and twenty-five people. Thus, the operations phase of the project would only have very minor, positive impacts on the income levels in the local economy. Facility operations would not be expected to have any significant impacts on public goods or services.

4.7.1.2 Potential Managerial Economies to DOE

In the past, research activities involving actinide chemistry have been performed at LANL, Argonne National Laboratory, Florida State University, and Pacific Northwest National Laboratory. Now, with the exception of the LANL location, WIPP has ended experiments at other sites. DOE has determined that it will be much more efficient and cost-effective to consolidate these activities in a local Carlsbad facility that does not present the difficulties inherent with the distances currently involved or the security requirements at laboratories that primarily perform weapons-related work. Operating the ACRSL facility at the CERMC would consolidate the WIPP experimental program in Carlsbad, New Mexico, and offer DOE a potential cost-savings as compared to current mechanisms for funding the WIPP experimental programs (that is, consolidation of research activities and reduction of outsourcing and administrative costs). These and other potential benefits are examined below.

Consolidation of Research Activity

The proposed ACRSL would be built contiguous to the existing CEMRC facility and make use of existing facility infrastructure and staff support (for example, land, access road, parking, fiber optic line, utilities, meeting rooms, administrative offices, low-level laboratories, and reception area). Operating costs for the ACRSL would also be minimized through the support of the CEMRC administrative infrastructure (for example, director, fiscal specialist, buyer, computer technicians, etc.) as a continuing direct cost under an existing grant. By leveraging these resources, project engineers estimate the size requirements of the ACRSL would decrease by approximately 50 percent and reduce project costs by approximately $2 million over construction elsewhere where these existing resources were not available (that is, the WIPP Alternative).

Reduction of Outsourcing and Administrative Costs

Ignoring construction cost, the annual operating and research costs of the ACRSL would be approximately $5.6 million, which compares favorably to annual outsourcing costs over the past 5 years ($8 million per year on actinide chemistry support for the WIPP experimental program). Based on the current and projected needs of the WIPP experimental program, these potential cost savings would continue throughout the operations phase of the project and in the “out years” beyond FY2008. Thus, during the operational phase, the CEMRC estimates a cost savings of some $12 million over the 5-year period as compared to operational costs at national laboratories. Although such comparisons are difficult because of ever-changing scope (when compared to the past), this cost comparison was conducted using the projected staffing data provided by local offices at Sandia National Laboratories and LANL. The annual operating cost was primarily based on the staffing plan (for example, number of full-time equivalents) for the proposed ACRSL using loaded rates for the Sandia National Laboratories and LANL staff.

4.7.2 Alternative at WIPP

This section describes the potential socioeconomic impacts under the WIPP Alternative, as the result of construction and operation of a new actinide chemistry laboratory at the WIPP site in Carlsbad. Construction costs under this alternative would be relatively higher than the construction cost estimates described under the Proposed Action. Operations costs under the WIPP Alternative would also differ from the Proposed Action because the new actinide chemistry laboratory would require employment of a new set of laboratory administrators. Although there would be insignificant local economic impacts under this alternative, DOE could potentially experience relatively higher managerial and programmatic costs over the various phases of the project. These impacts are described below.

4.7.2.1 Local Economic Impacts

Compared to the Proposed Action, the design and construction of a new actinide chemistry laboratory at the WIPP site represent a larger capital project. Laboratory construction under this alternative would require infrastructure that would not be required under the Proposed Action. The additional infrastructure required at the WIPP site would include fiber optic line, utilities, meeting rooms, administrative offices, and a reception area. Nonetheless, the level of capital spending represents a minor capital investment in the local economy and would not have a significant impact on the demand for goods and services in the Carlsbad community.

Design and construction of a new actinide chemistry laboratory at the WIPP site would require few additional workers and would have insignificant impacts on employment and earnings in the local economy. Similarly, the design and construction of the facility would not be expected to have any significant impacts on public goods or services in Carlsbad or the surrounding community. Operations of a new actinide chemistry laboratory at the WIPP site would also have insignificant impacts on local employment opportunities, as most administrative and research staff are already situated in the Carlsbad area. Thus, the operations phase of the project would have insignificant impacts on the employment base or income levels.

4.7.2.2 Potential Managerial Economies to DOE

As described earlier, research activities involving actinide chemistry have recently been performed at several separate laboratories around the country. Thus, operating a new actinide chemistry laboratory facility at the WIPP site would help centralize the WIPP experimental program in Carlsbad, New Mexico, and offer DOE a potential cost-savings as compared to the existing WIPP experimental program. However, the administrative costs of managing the facility would tend to increase, relative to the Proposed Action, because DOE would not be leveraging existing infrastructure and human resources to the same degree. Also, DOE would potentially lose the benefits of having a simplified licensing mechanism for the facility and the programmatic cost advantages offered by the CEMRC.

4.7.3 No Action Alternative at LANL

Currently, the actinide chemistry experiments are conducted in the Radiochemistry Laboratory (TA-48-1). The existing laboratory facility was designed as an actinide chemistry and metallurgy building, with full capabilities for performing special nuclear material analytical chemistry and materials science. Consequently, this alternative does not require additional construction or operations costs and would not pose additional socioeconomic impacts for the Los Alamos community. Nonetheless, the No Action Alternative could potentially result in higher managerial and programmatic costs as compared to the Proposed Action, as described below.

Research activities involving actinide chemistry have recently been performed at several separate laboratories around the country, including LANL. Through continuation of these experiments at the LANL site, the WIPP experimental program would remain decentralized. As compared to the Proposed Action, the WIPP experimental program would continue to experience the burden of coordinating research activities and the attendant outsourcing costs.

4.8 AIR QUALITY

This section describes the potential air quality impacts as a result of the three alternatives evaluated.

4.8.1 Proposed Action at CEMRC

If a new laboratory were constructed at the CEMRC, there would be: (1) local, temporary degradation of air quality during construction of the new ACRSL; (2) small amounts of air emissions associated with the operation of heating and cooling equipment (for example, emissions of carbon monoxide, nitrogen oxides, hydrocarbons, sulfur oxides, and particulates); and (3) emissions of low levels of hazardous air pollutants. Temporary construction-related air quality degradation would be the primary air quality impact. However, it would be of short duration, limited to daytime construction hours, and confined to the general area of construction, although on windy days dust and PM_{10} emissions could be mobilized and transported beyond the immediate construction area. Construction-related emissions would vary from day to day, depending on the level of construction activity, specific operation, and weather. Air emissions from heating and cooling equipment during operation of the facility would be minor, similar to those from a small cluster of houses. Emissions of hazardous air pollutants would be within the limits established by existing regulations.

Appendix A of the CEMRC EA (DOE 1995c) discusses the air quality investigations, including the methodology, calculations, and estimates of emission rates, that were conducted and submitted to the New Mexico Environment Department Air Quality Bureau for informal review prior to construction of the CEMRC. These investigations included the primary effects from construction and other effects from heating and cooling equipment and from hazardous air pollutant emissions. The New Mexico Environment Department accepted the results based on “worst case assumptions” and concluded that there would be no need for the CEMRC to seek an air quality permit. In addition, because anticipated emission levels were low, the New Mexico Environment Department concluded that computer modeling, as further substantiation of emission levels, was not warranted.

If the Proposed Action were implemented, there would be an increase in the inventory and estimated total annual use of some volatile solvents and reagents whose use would result in toxic air emissions (Appendix B provides the current chemical inventory). A conservative projection would double the estimated total annual use and, therefore, potentially double the emission rates or concentrations cited in the CEMRC EA (DOE 1995c, Appendix A, Table 2). For most of the chemicals, the projected increase in the inventory and use rates of volatile solvents and reagents would not result in aggregate emission rates or concentrations that would require permitting under air quality regulations. However, a permit would be needed for nitric and sulfuric acids because doubling the existing rates for these two chemicals could exceed New Mexico Environment Department air quality standard 20.2.72.502. The CEMRC would apply for, and obtain, the necessary air permit before proceeding with construction of the proposed ACRSL.

Although the CEMRC is permitted to emit very low levels of radionuclides, it has never reported any release of radionuclides to the atmosphere, and the Proposed Action would not result in any planned releases of radionuclides. Redundant HEPA filters would prevent releases of airborne radionuclides during normal operations. At a minimum, all exhaust airflows in the proposed laboratory would be treated by double-HEPA filtration. Each glove box would also be provided with a local HEPA filter in its exhaust, which would afford triple-HEPA filtration before discharge to the environment.

4.8.2 Alternative at WIPP

The WIPP Alternative would construct and operate a new laboratory that would essentially be identical to the one proposed under the Proposed Action, but it would be located about 42 kilometers (26 miles) to the southeast on the WIPP site. Because of the relative proximity of the CEMRC and WIPP, weather and ambient air quality conditions would be very similar or identical. Consequently, air quality impacts from the construction and operation of a new laboratory at WIPP would be identical to those described for construction and operation of a new laboratory at the CEMRC.

The post-construction air quality impacts from the WIPP Alternative would not represent a significant degradation in current air quality at the WIPP site. SEIS-II (DOE 1997) assessed the potential impacts, including air quality impacts, of continuing the phased development of WIPP as a geologic repository for the safe disposal of TRU waste.

4.8.3 No Action Alternative at LANL

Under the No Action Alternative, actinide chemistry experiments would continue to be conducted in the Radiochemistry Building (TA-48-1). This alternative would maintain the *status quo*; consequently, there would be no radiological or non-radiological air quality impacts above those currently occurring at LANL. The LANL SWEIS (DOE 1999) provides an analysis of the environmental impacts, including air quality impacts, resulting from ongoing and reasonably foreseeable new operations and facilities at LANL.

4.9 WASTE GENERATION AND DISPOSAL

This section describes the potential impacts on waste generation and disposal as a result of the three alternatives evaluated.

4.9.1 Proposed Action at CEMRC

The City of Carlsbad municipal waste treatment and disposal systems process 54,100 metric tons (59,600 tons) annually (NMED 2000). The projected additional 2 metric tons (2.2 tons) of solid sanitary waste that would be produced by the ACRSL would have little impact on the city's waste management system.

The quantities of hazardous and radioactive wastes at the expanded CEMRC would not pose an environmental impact. Current levels of hazardous and radioactive wastes generated at the CEMRC would double with the addition of the ACRSL. However, the new quantity and types of wastes would be well within the capabilities of commercial disposal companies already used at the CEMRC.

4.9.2 Alternative at WIPP

The additional waste that would result from the construction and operation of a new actinide chemistry laboratory at WIPP would have little environmental impact. The sanitary liquid waste treatment system at WIPP would be capable of handling the output from the actinide chemistry laboratory, and the commercial companies handling and disposing of hazardous waste from WIPP would be capable of managing the additional wastes.

4.9.3 No Action Alternative at LANL

No additional wastes would be produced should the existing laboratory at LANL continue normal operations. There would therefore be no new environmental impacts due to waste generation and disposal.

4.10 ENVIRONMENTAL JUSTICE

This section considers the potential environmental justice impacts that would result from the three alternatives evaluated. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

In February 1994, the President issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 Fed. Reg. 7629 (1994)). This Order directs federal agencies to incorporate environmental justice as part of their missions. As such, federal agencies are specifically directed to identify and address as appropriate disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations.

The Council on Environmental Quality has issued guidance to federal agencies to assist them with their NEPA procedures so that environmental justice concerns are effectively identified and addressed (CEQ 1997). In this guidance, the Council encouraged federal agencies to supplement the guidance with their own specific procedures tailored to particular programs or activities of an agency. DOE (2000) has prepared a draft guidance document based on Executive Order 12898 and the Council on Environmental Quality environmental justice guidance.

Among other things, the DOE draft guidance states that even for actions that are at the low end of the sliding scale with respect to the significance of environmental impacts, some consideration (which could be qualitative) is needed to show that DOE considered environmental justice concerns. DOE needs to demonstrate that it considered apparent pathways or uses of resources that are unique to a minority or low-income community before determining that, even in light of these special pathways or practices, there are no disproportionately high and adverse impacts on the minority or low-income populations. The DOE draft guidance also defines “minority population” as a demographic composition of the populace where either the minority population of the affected area exceeds 50 percent or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population.

For this EA, DOE applied the draft environmental justice guidance to determine whether there could be any disproportionately high and adverse human health or environmental impacts on minority or low-income populations in the ROIs (see Section 3.8) as a result of the implementation of any of the alternatives analyzed. Analysis of environmental justice concerns was based on an assessment of the impacts reported in Sections 4.1 through 4.9. Although no high and adverse impacts were identified, DOE considered whether minority or low-income populations would be disproportionately affected by the alternatives.

The proportions of minority or low-income persons in the ROIs for the Proposed Action, WIPP Alternative, and No Action Alternative are greater than in the United States and the region as a whole.

Thus, to the extent that some offsite impacts could occur (particularly in the unlikely event of an accident involving offsite radiological or hazardous chemical releases), the minority or low-income communities living near the proposed or existing laboratory for each alternative would be adversely affected. However, based on the analysis in Section 4.2, releases of radioactive or hazardous chemical materials from the proposed laboratory during an accident would not be expected to be sufficient to result in any public health impacts because of the very low volume of materials present.

4.10.1 Proposed Action at CEMRC

As discussed above and in Sections 4.1 through 4.9, the Proposed Action to construct and operate the ACRSL facility at the CEMRC site would not pose significant environmental justice impacts on either minority or low-income populations in the ROI.

4.10.2 Alternative at WIPP

As discussed above and in Sections 4.1 through 4.9, the alternative to locate a new actinide chemistry laboratory at WIPP would not pose significant environmental justice impacts on either minority or low-income populations in the ROI.

4.10.3 No Action Alternative at LANL

As discussed above and in Sections 4.1 through 4.9, the alternative to continue to use LANL laboratory facilities as part of the WIPP experimental program would not pose significant environmental justice impacts on either minority or low-income populations in the ROI. Also, no impacts to the general public from the existing actinide chemistry research in the Radiochemistry Building (TA-48-1) at LANL were identified in the LANL SWEIS (DOE 1999).

4.11 CUMULATIVE IMPACTS

NEPA implementing regulations require an analysis of the cumulative impacts of the proposed action. Cumulative impacts are defined as the impact on the environment that could result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. In accordance with guidance issued by the Council on Environmental Quality, a cumulative impact analysis requires the identification, through research and consultations, of federal, non-federal, and private actions that, when combined with the proposed action, could have an adverse effect on resources, ecosystems, and human communities. This section addresses the cumulative impacts under the Proposed Action for this EA (construction and operation of an ACRSL facility in Carlsbad to support actinide chemistry experiments for WIPP).

The proposed ACRSL facility would be located adjacent to the existing CEMRC laboratory and managed by the CEMRC administration for DOE. As indicated in Chapter 1, the CEMRC is equipped for the low-level measurement of actinides, fission products, activated corrosion products, and naturally occurring radionuclides, although the primary focus of the CERMC environmental chemistry program is the measurement of non-radioactive inorganic substances in various environmental media. Thus, some of the radiological research currently conducted at the CEMRC is very similar to the actinide chemistry research described in Chapter 2 for the Proposed Action, but it uses materials with much lower levels of radioactivity. As indicated in this chapter, the inventory of hazardous chemicals and radiological materials used at the CEMRC would essentially be the same as that for the Proposed Action, but the combined quantities would be increased to accommodate the research for the Proposed Action. The radiological materials inventory for both laboratories combined would be less than 2 curies (the site-wide limit). The combined hazardous chemical inventory for both laboratories would be no more than double the current inventory for the CEMRC alone.

The human health analysis in Section 4.1.1 considered the impact of the hazardous chemical and radiological material inventories for the proposed new ACRSL laboratory and concluded that there would be no impacts on worker health or the general public. Under normal operations, there would be no cumulative impacts on worker health or the general public due to the combined CEMRC and proposed ACRSL because chemical emissions from fume hoods would be extremely small and both facilities would be designed with the best available radionuclide-control technology, including HEPA filters on all fume hoods and glove boxes. No radionuclides would be released in sanitary sewage streams.

A radiation dosimetry program to monitor potential internal and external worker exposures to radioactive materials would be in place for the combined CEMRC and proposed ACRSL to help keep such exposures as low as reasonably achievable and below applicable regulatory and administrative limits in all cases. The analysis in Section 4.1.1 indicated that the highest occupational radiation dose to a staff member at the proposed ACRSL facility would be less than 100 mrem per year. This applies to both the CEMRC and proposed ACRSL combined, because it was based on the maximum permitted inventory of 2 curies. The probability of a latent cancer fatality from a 100-mrem dose to staff member would be about 0.00004 per year. The potential radiation dose to the public was also estimated based upon a maximum permitted inventory of 2 curies for both laboratories combined. Given the combined inventory of 2 curies, the dose to the population within 1.6 kilometers (1 mile) of the CEMRC/ACRSL under normal operating conditions would be less than 0.006 person-rem. There would be no latent cancer fatality expected in the exposed population on either an annual basis (less than 0.000003) or hypothetical 30-year facility lifetime (about 0.00009). In reality, the potential doses and health impacts to individuals and the surrounding population would be lower than these conservative estimates because actual operating conditions would result in lower releases.

The accident analysis in Section 4.2.1 considered the impacts of the hazardous chemical and radiological material inventories for the proposed new ACRSL laboratory, and it concluded that there would be no impacts on worker health or the general public. The concentrations calculated in Table 4-3 were based on a hypothetical, bounding scenario that would affect the entire inventory of each chemical. Such a scenario would require a large event such as a fire or severe earthquake, which would involve multiple rooms. However, doubling the inventory (to consider both laboratories combined) doubles each of the TEEL fractions in Table 4-3. Even with the increase from doubling the inventories, only one chemical (nitric acid) would exceed TEEL-2 and no chemicals would exceed TEEL-3. However, it is not considered credible that the combined inventory of nitric acid at both laboratories would be released in the same accident. As indicated in Section 4.2.1, the chemical inventories would be received and moved around the facility in small quantities, and the largest container of any chemical would be 3.8 liters (1 gallon). Given the administrative and physical barriers that would be in place to prevent accidents and uncontrolled releases of hazardous chemicals, an accidental release of such a chemical would most likely not involve the entire inventory but rather a small fraction of the inventory that represents, at most, a few containers. Therefore, the results presented in Table 4-3 are conservative and represent more than the maximum credible amount that would be released from an accident.

The accident analysis in Section 4.2.1 also considered the impacts of the combined radiological material inventories for both the CEMRC and the proposed new ACRSL laboratory, and it concluded that there would be no impacts to worker health or the general public. For this hypothetical, bounding assessment, it was conservatively assumed that a severe seismic event could potentially affect the entire 2-curie inventory (the site-wide limit) of radioactive material, which is the maximum quantity permitted at the combined CEMRC and proposed ACRSL. It was further assumed the entire release would be plutonium-239, although release of this quantity of material from the building would not be possible given the administrative controls and physical barriers in place designed to prevent such an occurrence. The overall respirable release quantity was calculated to be 2 x 10^{-4} curies of plutonium-239. As shown in Table 4-2, the total dose to the MEI and noninvolved worker from a release of this quantity of plutonium at the combined facilities would be about 18 mrem. Thus, the probability of this MEI contracting a fatal cancer is about 0.00001 or one chance in 100,000. Based on the air dispersion factors used for CEMRC, there would be no public health impacts from this conservative release scenario at the combined CEMRC and proposed ACRSL facilities.

The impacts of the Proposed Action on land use (Section 4.3.1), geology and hydrology (Section 4.4.1), biological resources (Section 4.5.1), and cultural resources (Section 4.6.1) would be expected to be very minor or nonexistent. The cumulative impacts of the CEMRC and proposed ACRSL would not be expected to be any greater, because no additional land use is planned for the CEMRC.

The cumulative impacts of the combined CEMRC and the proposed ACRSL would be expected to have a very minor, positive impact on socioeconomics in the Carlsbad area. The research grant for the CEMRC was increased from $27 to $33 million and extended from 1999 to 2008 (CEMRC 2000). When this is combined with the operating budget for the proposed ACRSL, there would be a very minor, positive impact to the Carlsbad community. As indicted in Section 4.7.1, the estimated budget for operating and maintaining the proposed ACRSL facility at the CERMC site is $2,870,194 over 5 years.

As indicated in Section 4.8.1 on air quality, a conservative projection would double the estimated total annual use of hazardous chemicals and, therefore, potentially double the emission rates or concentrations cited in the CEMRC EA (DOE 1995c, Appendix A, Table 2). For most of the chemicals, the projected increase in the inventory and use rates of volatile solvents and reagents would not result in aggregate emission rates or concentrations that would require permitting under air quality regulations. However, a permit would be needed for nitric and sulfuric acids because doubling the existing rates for these two chemicals could exceed New Mexico Environment Department air quality standard 20.2.72.502. The CEMRC would apply for, and obtain, the necessary air permit before proceeding with construction of the proposed ACRSL.

As indicated in Section 4.9.1 on waste generation and disposal, the quantities of hazardous and radioactive wastes at the combined CEMRC and proposed ACRSL would not pose an environmental impact. Current levels of hazardous and radioactive wastes generated at the CEMRC would double with the addition of the ACRSL. However, the combined quantity and types of wastes would be well within the capabilities of commercial disposal companies already used at the CEMRC.

The proposed ACRSL, combined with the existing CEMRC, would be located in the vicinity of New Mexico State University, the Guadalupe Medical Center, and the Radiation Oncology Center (DOE 1995c). None of these last three facilities releases any radioactive materials. There are some chemical emissions from the chemical laboratory at New Mexico State University, but these emissions are very small as compared to the combined emissions expected from the proposed ACRSL and the CEMRC. The cumulative impacts of chemical emissions from the proposed ACRSL/CEMRC and the chemical laboratory at New Mexico State University would be essentially the same as those for the proposed ACRSL/CEMRC alone.

4.12 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The short-term uses of the proposed ACRSL facility would not result in any significant impact on long-term productivity. Except for a very minimal impact on land use from construction of the proposed ACRSL facility adjacent to the existing CEMRC laboratory, there would be no long-term impact on geology, hydrology, or biological resources.