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Environmental Assessment for the Center for Integrated Nanotechnologies at Sandia National Laboratories/New Mexico

Final Environmental Assessment

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Department of Energy, Sandia Site Office
Kirtland Air Force Base, Albuquerque New Mexico

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ABBREVIATIONS AND ACRONYMS

AEHD	Albuquerque Environmental Health Department
ALARA	as low as reasonably achievable
BMBL	Biosafety in Microbiology and Biomedical Laboratories
BSL	Biosafety Level
CDR	Conceptual Design Report
CFR	Code of Federal Regulations
CINT	Center for Integrated Nanontechnologies
CO	carbon monoxide
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
EA	Environmental Assessment
EPA	Environmental Protection Agency
ES&H	Environment, Safety, and Health
ft	foot
ft^2	square feet
ft/sec	feet per second
gal	gallon
HAP	hazardous air pollutant
hr	hour
IMRL	Integrated Materials Research Laboratory
IWGN	Interagency Working Group on Nanoscale Science, Energy, and Technology
KAFB	Kirtland Air Force Base
kg	kilogram
L	liter
LLW	low-level radioactive waste
LLMW	low-level mixed waste
lb	pound
m	meter
m^2	square meters
m^3	cubic meter
MTRU	mixed transuranic
$\mu g/m^3$	micrograms per cubic meter
MEI	maximally exposed individual
MGY	million gallons per year
NA	not applicable
NAAQS	National Ambient Air Quality Standards
NEPA	*National Environmental Protection Act*
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	*National Historic Preservation Act*
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NNI	National Nanotechnology Initiative
NNSA	National Nuclear Security Administration
NSRC	Nanoscale Science Research Centers
OBES	Office of Basic Energy Sciences
OEL	Occupational Exposure Limit
OSHA	Occupational Health and Safety Administration
PEL	permissible exposure limits
PPE	personal protective equipment

ppm	parts per million
RCRA	*Resource Conservation and Recovery Act*
ROI	radius of impact
SHPO	State Historic Preservation Office
SNL	Sandia National Laboratories
SNL/NM	Sandia National Laboratories/New Mexico
SWEIS	Site-Wide Environmental Impact Statement
TA	Technical Area
TEV	Threshold Emission Value
TPY	tons per year
TRU	transuranic
TSCA	*Toxic Substances Control Act*
USAF	U.S. Air Force
USC	United States Code
USFS	U.S. Forest Service
VOC	volatile organic compound
yd	yard
yd^3	cubic yard
yr	year

1.0 PURPOSE AND NEED FOR AGENCY ACTION

In 1999, the United States government announced the National Nanotechnology Initiative (NNI) that included a proposal directed at doubling the nation's investment in nanotechnology to ensure the United States' competitive position in the rapidly developing field of nanotechnology.

As part of the NNI, the National Science and Technology Council Interagency Working Group on Nanoscale Science, Engineering, and Technology (IWGN) concluded that research centers would permit activities that cannot be accomplished in the traditional mode of small groups or single investigators or with the current research infrastructure. The IWGN recognized the importance of establishing research centers with major Department of Energy (DOE) specialized and user facilities. Consequently, the DOE Office of Basic Energy Sciences (OBES) plans to support the NNI, in part, through the establishment of an integrated national program of Nanoscale Science Research Centers (NSRC) affiliated with major facilities at DOE's national laboratories.

Specific objectives of the NSRCs are to accomplish the following:

- Advance the fundamental understanding and control of materials at the nanoscale regime
- Provide an environment to support research of a scope, complexity, and disciplinary breadth not possible under traditional investigator or small group efforts
- Provide the foundation for the development of nanotechnologies important to the DOE
- Provide state-of-the-art equipment to in-house laboratory, university, and industry researchers and optimize the use of national user facilities for materials characterization employing electrons, photons, and neutrons
- Provide a formal mechanism for both short- and long-term collaborations and partnerships among DOE laboratory, academic, and industrial researchers
- Provide training for graduate students and postdoctoral associates in interdisciplinary nanoscale science, engineering, and technology research

To date, five centers have been initiated. Four of the centers would each be located at an individual laboratory; Lawrence Berkley National Laboratory, Oak Ridge National Laboratory, Argonne National Laboratory, and Brookhaven National Laboratory. The fifth center, the Center for Integrated Nanotechnologies (CINT), would be located at both Sandia National Laboratories/New Mexico (SNL/NM) and Los Alamos National Laboratories (LANL).

This joint operations approach would be used to leverage laboratory expertise and facilities to create a unified scientific community. This community would be built with significant participation from university, industrial, and laboratory researchers and would provide them with the proper tools and scientific focus to address the challenges on nanoscale science and technology. Consistently with the NSRC objectives, CINT would focus on (1) developing the scientific principles that govern the performance and integration of nanoscale materials, and (2) providing a research center for educating a new generation of scientists, thereby building the foundations for future scientists with expertise in nanotechnologies. The CINT program would work closely with other DOE nanoscience centers, universities, and industrial partners.

The purpose for DOE action is to ensure that the objectives of CINT can be met. While the capabilities and success of CINT will draw heavily upon facilities and expertise at SNL/NM and LANL, new facilities are needed that would encourage interactions across CINT's multiple areas of research emphasis, provide for easy and continuous access to state-of-the-art equipment, and support participation by students and collaborators, including foreign nationals.

2.0 NO ACTION AND PROPOSED ACTION ALTERNATIVES

This chapter describes the No Action Alternative, the Proposed Action, and alternatives considered but not analyzed in detail. The No Action Alternative involves continuing operations at SNL/NM as described in the Sandia National Laboratories/New Mexico (SNL/NM) Site-Wide Environmental Impact Statement (SWEIS).

The Proposed Action would consist of the construction and operation of a CINT Core Facility and the establishment of a Gateway to Sandia Facility. The CINT Core Facility would be constructed on DOE-owned property north of the entrance to Kirtland Air Force Base (KAFB) on Eubank Boulevard in Albuquerque, New Mexico, and the Gateway to Sandia Facility would be established in existing space within the existing Integrated Materials Research Laboratory (IMRL) SNL/NM's Technical Area I (TA-I).

Alternatives considered but not analyzed in detail include the following:

- *Construct the facility in another location at SNL/NM* – Part of the purpose of the CINT would be to allow greater access for non-DOE/SNL personnel and academic researchers, which is problematic in the secure areas. The DOE-owned land on which the CINT is proposed to be built is the only location at SNL/NM where there is sufficient acreage to build the CINT outside the secure areas.

- *Construct the facility at another DOE facility* – Proximity to facilities and personnel currently conducting nanotechnology-related research at SNL/NM is part of the need for this facility. Constructing the facility at another DOE location would remove the CINT to a location distant from many of the researchers who would likely be employed in its operation. Therefore, this alternative was not analyzed further.

2.1 NO ACTION ALTERNATIVE

As stated, under the No Action Alternative the CINT Core Facility would not be constructed and operated at SNL/NM, and current operations would continue as described in the Expanded Operations Alternative and, as presented in the Record of Decision for the SWEIS (DOE 1999). SNL/NM CINT Gateway activities would likewise not be conducted under the No Action Alternative. Following is a description of environmental and human health and safety resources as they exist under the No Action Alternative.

2.1.1 Air Quality

The No Action Alternative would result in no change in or relocation of air emissions sources. Air emissions would continue as described in the SWEIS Expanded Operation Alternative (DOE 1999).

2.1.2 Waste Management

Under the No Action Alternative, there would be no change in the types or quantities of solid, liquid, radioactive, mixed, or hazardous wastes associated with nanotechnology-related research at SNL/NM.

2.1.3 Water Use and Wastewater

The No Action Alternative would result in no change in water use or wastewater generation at SNL/NM, which would continue as described in the Expanded Operations Alternative of the SWEIS (DOE 1999).

2.1.4 Human Health and Safety

Worker health and safety precautions and controls for current operations are implemented according to the SNL Environment, Safety, and Health (ES&H) Manual (SNL 2003) and supplemental job-specific procedures. Each major piece of process equipment has an operating procedure.

Operations that employ laser and x-ray hazards are performed using appropriate administrative controls and engineered barriers. These controls include, but are not limited to, operator training and shielding of personnel according to current requirements, including equipment housing that shields the operator from laser beam or x-ray exposure.

2.2 PROPOSED ACTION CONSTRUCTION ACTIVITIES

Under the Proposed Action, the CINT Core Facility would be constructed on a 20-acre DOE-owned parcel of land on the west side of Eubank Boulevard, north of the entrance to KAFB. This one-story facility would be approximately 90,000 square feet (ft^2) (8,360 square meters [m^2]) in size. It would include clean rooms for nanofabrication, characterization, and lithography, as well as laboratories for general purpose chemistry, biology, electronic, and physical measurement activities. Figure 2.2-1 provides a general location map for SNL/NM, and Figure 2.2-2 presents the location of the DOE-owned parcel on which the CINT Core Facility would be built. No construction or renovation would be required to establish CINT Gateway to Sandia Facility activities within the IMRL.

2.2.1 Construction

For the purpose of this assessment, it as assumed that the entire 20-acre parcel would be disturbed. With the exception of the 183,000 ft^2 (17,000 m^2) that would be needed to accommodate the building, parking lot, utilities, drainage, and other permanent features, the site would be restored using native or adapted plant species.

2.2.2 Construction Air Conformity

Bernalillo County has been designated as a maintenance area under the *Clean Air Act* for carbon monoxide (CO) emissions and is in attainment for other federally regulated pollutants. Trucks and construction equipment would generate CO emissions. Estimated hours of operation for diesel and gasoline engines and subsequent CO emissions that would result from project construction are included in Table 2.2.-1.

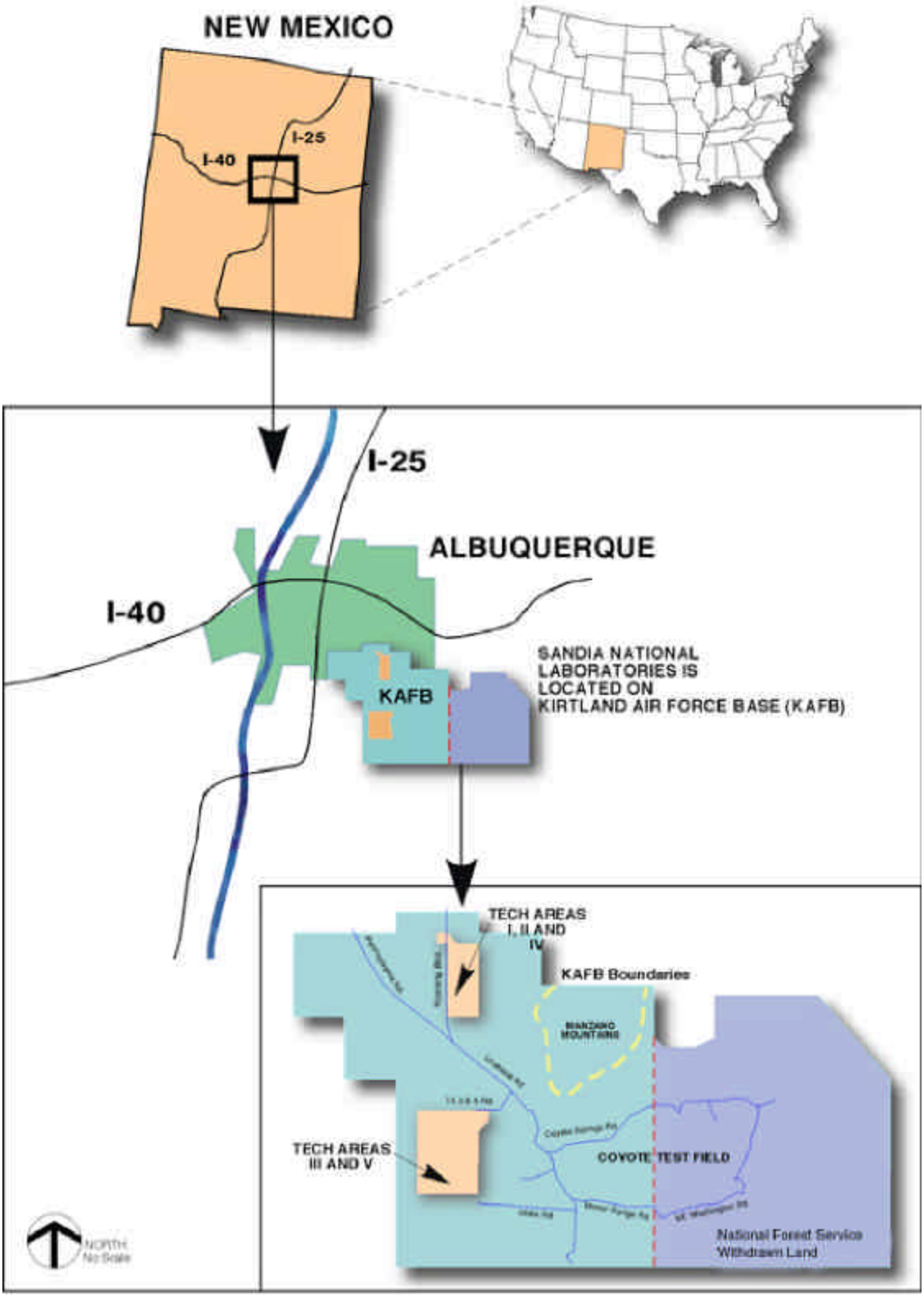

Figure 2.2-1. Location Map of the SNL/NM Technical Areas

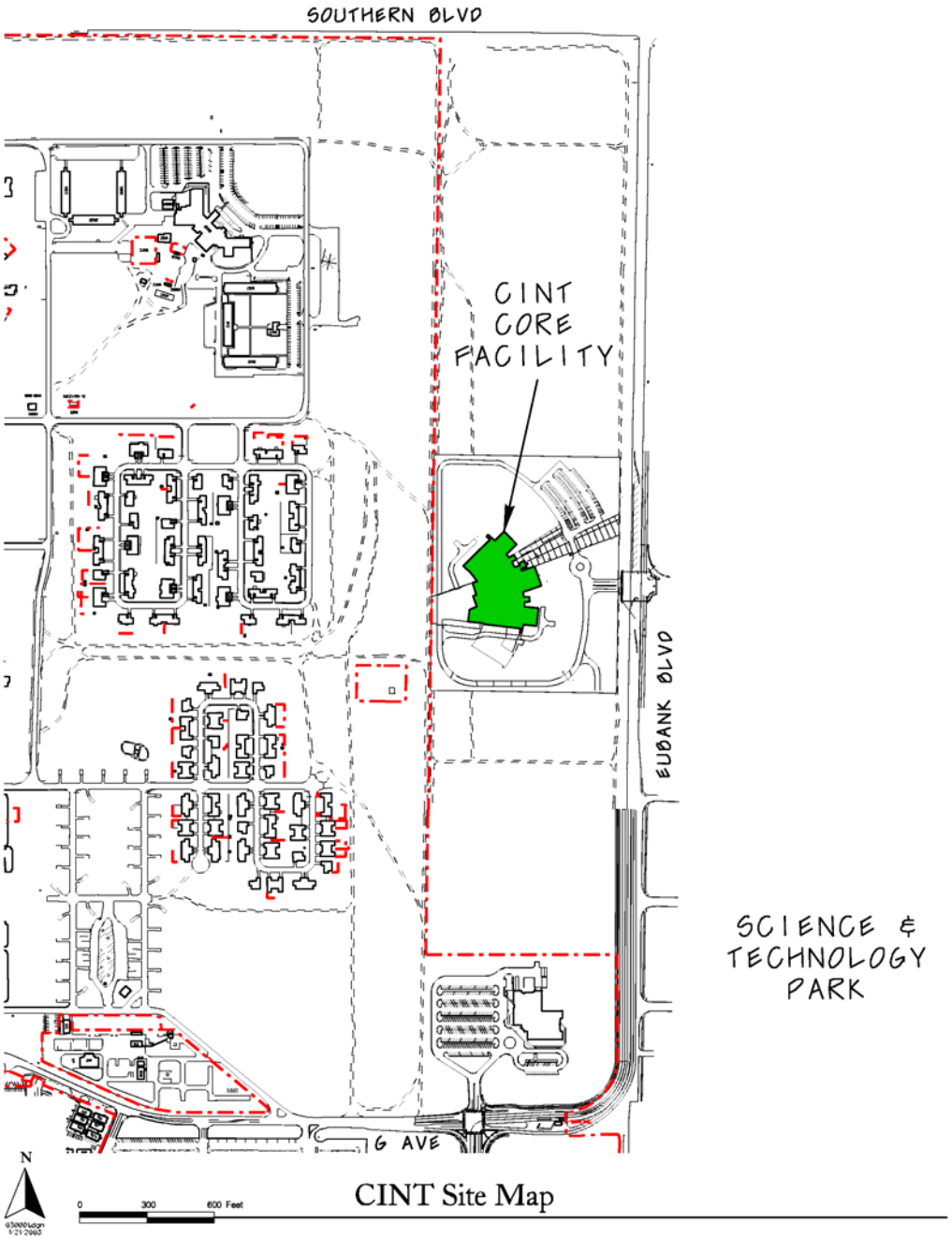

Figure 2.2-2. CINT Core Facility Site Map

The New Mexico Administrative Code (NMAC), Title 20, Part 11.04, (20 NMAC 11.04), entitled *General Conformity*, implements Section 176(c) of the *Clean Air Act*, as amended (42 U.S.C 7401 et seq), and regulations under 40 CFR 51, Subpart W, with respect to conformity of general Federal action in Bernalillo County. Regulation 20 NMAC Part 11.04.II.1.2, paragraph B, establishes the emission threshold of 100 tons per year (TPY) of CO at SNL/NM that would trigger the requirement to conduct a conformity analysis. As shown in Table 2.2-1, the total CO releases for this project are anticipated to be approximately 6.63 tons throughout the life of the construction project, which is substantially below the 100 TPY threshold; therefore, a conformity analysis is not required.

Table 2.2-1. Estimated CO Emissions Associated with CINT Core Facility Construction Activities

1-Year Construction Activity (assumes 21 work day months or 252 days)	Total Annual Hrs. of Operation	Equipment Emission factors*	Est. Total Annual CO Emissions (total lbs. per year)	Est. Total Annual CO Emissions (total TPY)
Assumptions for Diesel Vehicles Emissions				
7-Diesel units – (trucks for transportation of materials to site throughout life of construction phase)	3528 (or ≈ 2 hrs/day each for 252 days)	.11	388	0.194
8-Diesel units – (dozers, backhoes, graders, dump trucks to grade and lay foundation)	800 (or ≈ 5 hrs/day each for 20 days)	.11	88	0.044
6-Diesel units – (dozers, backhoes, graders, dump trucks for construction of buildings)	10,584 (or ≈ 7 hrs/day each for 252 days)	.11	1164	0.582
Total Diesel units (21)	14,912	N/A	1640	0.82
Assumptions for Gasoline Vehicles Emissions				
60-Light Gasoline vehicles - (worker personal vehicles)	18,000 (or ≈ 1 hr each/day for 300 days)	.48	8,640	4.320
24-Light Gasoline units - (vehicles, snack wagons, light commercial vans)	6048 (or ≈ 1 hr/day each for 252 days)	.48	2903	1.451
2-Hand tampers	160 (or ≈ 4 hrs/day each for 20 days)	.48	77	.038
Total Gas units (86)	24,208	N/A	11,620	5.81
Total Estimated CO Emissions During Construction Phase				**6.63 tons**

*CO emission factors are based on the Environmental Protection Agency (EPA) National Vehicle and Fuel Emission Laboratory (Ann Arbor, Michigan) average emission rates for idling vehicles (EPA's AP-42, 5th Edition, January 1995). CO emissions for light-duty trucks are estimated at 219 grams/hr, for heavy-duty gas vehicles at 245 grams/hour, and for heavy-duty diesel vehicles at 50 grams/hr.
Calculations are based on a conversion factor of 0.035 ounce per gram (grams x 0.035) divided by 16 (ounces/lbs.) times hours of operation divided by 2,000 (lbs./ton) to obtain tons/yr. for the project.

2.2.3 Construction Waste Management

It is anticipated that construction activities would result in the generation of non-hazardous wastes (primarily construction debris and sanitary wastewater). The Proposed Action would result in the generation of approximately 810 tons (734,830 kg) of construction debris, which would consist of packaging material including wood crates, cardboard, and plastic; scrap material such as electrical wire, insulation, gypsum drywall, floor tile, carpet, scrap metal, and empty adhesive and paint containers; and concrete debris resulting from the construction equipment wash-down process following pours. Recyclable material would be separated, and the remaining waste transported to the KAFB landfill or other appropriate construction waste landfills for disposal.

2.2.4 Construction Water Use and Liquid Effluents

Water use would increase slightly during Proposed Action construction activities due to additional construction personnel onsite and water requirements related to installation and adjustments in the mechanical and plumbing systems of the proposed CINT Core Facility. Water would also be used for dust control as appropriate. No long-term increase in water use would result from construction activities.

2.2.5 Construction Worker Health and Safety

Construction activities would incorporate all applicable health and safety standards common to each of the construction disciplines employed in the project and would follow all Occupational Safety and Health Administration (OSHA) standards for health and safety practices. The potential for worker exposure to hazardous materials is anticipated to be minimal.

2.3 PROPOSED ACTION OPERATIONS

Under the Proposed Action, nanotechnology research would be conducted at the CINT Core Facility and at the CINT Gateway to Sandia located in the IMRL in TA-1 at SNL/NM.

Nanotechnology refers to a branch of research that examines processes and creates a variety of products at the nanometer (nm) scale. One nm (1×10^{-9} m) is approximately 1/100,000 the width of a human hair. At this scale, materials exhibit improved properties. This allows for the development of a wide variety of new materials and processes that would otherwise be impossible.

Research at the CINT facilities at SNL/NM would focus on five primary areas:

- Nano-Bio-Micro Interfaces
- Complex Functional Nanomaterials
- Nanomechanics
- Nanophotonics and Nanoelectronics
- Theory and Simulation

Each area is described briefly below.

Nano-Bio-Micro Interfaces. This area of research examines the physical interface between biomolecular systems and nanoscale synthetic materials; the length-scale interface that bridges nanoscale materials to

the micro (and larger) world of devices and applications; and the conceptual interface of how biological systems can inspire the creation of new materials and new functions. The focus of this research area is to develop materials based on attributes of biological systems by control of the interfaces.

Complex Functional Nanomaterials. This research area focuses on the integration of multiple materials and structures across nano- to macro-length scales to promote complex and collective interactions and develop improved properties. Efforts would include research in synthetic chemistry and self- and directed-assembly. Research at the SNL/NM CINT facilities would include exploration of self-assembled porous and composite nanostructures; films; quantum dots and arrays; magnetic field structured solids; micromachining; advanced lithography; and simulations of a variety of substances.

Nanomechanics. Nanomechanics research examines the production of mechanical work at the nanoscale and the transfer of energy from nano- to microscale systems. Researchers seek to learn from nature how to better fabricate and utilize nanoscale mechanical systems by examining the unique mechanical properties of nanostructured materials and designing tools to perform work and probe material properties.

Nanophotonics and Nanoelectronics. This area of research focuses on understanding electronic, magnetic, and optical phenomena and materials properties at the nanoscale. Activities would include research in electrical characterization and laser spectroscopy.

Theory and Simulation. This research area will be closely coupled to the experimental activities within the four research areas described above. It will use experiments to verify models, use modeling and simulation to understand experiments, analyze data in terms of unifying models, and serve as a center-wide resource supporting the CINT user program.

Operations related to these focus areas at the CINT Core Facility would be based on the following activities:

- Research into applications for computing, communications, remote sensing, advanced solid-state lighting, and novel photovoltaics
- Research involving organic materials for their unique molecular scale properties, thereby creating opportunities for the development of novel composite and structured materials for electronic and photonic applications
- Projects that create cross-disciplinary teams composed of leading researchers from academic and government labs throughout the country and providing a wide variety of experience with nanomaterial synthesis, processing, and characterization rarely available at a single institution or location
- Research into new approaches to combine materials, in structures ranging in size from nanometer to micron length (10^{-6}) length scales, to discover improved material properties and functions
- Research into the integration of materials to discover interactions that lead to the development of new devices and concepts
- Research providing the tools for nanotechnology through measurement and characterization, computation and simulation, and fabrication of nanomaterials
- Research into how materials respond at the nanoscale compared to larger scale properties

- Research using a variety of techniques for observing nanomechanical response such as electron, x-ray, photon, neutron, and ion analysis techniques, and advanced diagnostics and microscale test devices to understand how materials interact at this level

- Research into controlling the properties of materials at the nanometer scale to allow greater integration of different materials, while developing stronger, tougher, and more wear-resistant systems

- Research designed to use concepts learned from biological systems in nanoscience and microengineering

- Multidisciplinary research collaborations that would use biological systems as models for complex and collective phenomena used in nanotechnology research

- Research to understand the properties and behavior of nanometer scale structures on time scales that are ideally matched to computer simulation and modeling methods

- Research into methods to connect nanometer scale modeling and simulation to larger length scale materials properties

- Development of methods to predict the properties of systems that contain dissimilar materials

- Understanding the reasons for changes in material properties or structures as they interact with the environment

The use of microbiological materials to provide models of natural design systems as well as the potential of these materials to provide opportunities to learn from the mechanics of nature are two examples of the importance of using microbiological materials in nanotechnology research. Microbiological materials expected to be available to support research at the CINT Core Facility, however, would be limited to materials typically found in undergraduate and secondary educational training and teaching laboratories (BSL-1). Operation of such a laboratory in the CINT Core Facility would follow a strict adherence to the practices and techniques established by the Centers for Disease Control and Prevention (CDC, 1999). Although the risks are small, research staff working with these materials would be trained and proficient in safely handling the materials. All waste generated in the use of these materials would also follow strict disinfectant procedures.

The operation of such laboratories as would be installed in the CINT Core Facility has been accomplished over decades of experience with little risk to either the workers or the public. SNL/NM would ensure that operations involving these materials will meet all local, state, and federal regulatory requirements for the transport, use, storage, and disposal of these materials.

The CINT Gateway to Sandia Facility would consist of an existing office space in the IMRL. This facility would enable CINT researchers (including visitors, post-doctoral associates, and students engaged in collaborative projects) to benefit from the specialized microfabrication and nanomaterials capabilities and expertise located within SNL/NM. The IMRL currently houses many existing nanomaterials assets, including chemical and physical materials synthesis, scanning probe diagnostics, and laser-based and surface spectroscopies.

2.3.1 Air Quality

For the purpose of this assessment, air emissions were evaluated according to the same methodology used for the SNL/NM SWEIS (Section 2.1.1). Potential hazardous air pollutant (HAP) emissions are provided in Table 2.3.1-1.

Table 2.3.1-1. CINT HAP Dispersion Modeling Results

Compound	OEL/100 (mg/m^3)	Maximum Impact* (mg/m^3)	Percent of OEL/100
Ammonia	350	1.2	0.34
Chlorine	30	1.2	3.97
Silane	70	0.6	0.83
Nitrous Oxide	450	1.3	0.29
Boron Trichloride	70	1.2	1.70
Halocarbon 23	100	2.4	2.45
Halocarbon 14	100	2.6	2.61
Sulfur Hexafluoride	60000	5.6	0.01
Isopropyl Alcohol	9800	3.9	0.04
Methanol	2000	3.9	0.20
Methylisobutylketone	1000	0.04	0.004
n-methylpyrrolidinone	1000	0.4	0.04
Hexamethyldisilazane	450	0.1	0.02
Trichloroethylene	1000	0.4	0.04
Acetone	24000	7.9	0.03
Potassium Hydroxide	20	0.3	1.49
Hydrochloric Acid	70	0.3	0.43
Sulfuric Acid	10	2.0	20.15
Hydrogen Peroxide	14	0.9	6.19
Nitric Acid	50	0.3	0.60
Ethanol	19000	10.2	0.05
Chlorobenzene	3500	0.1	0.002
Toluene	2000	1.1	0.05
Dimethylformamide (DMF)	2000	0.05	0.002
Hexanes	18000	2.0	0.01
Hydrofluoric Acid	25	0.6	2.36
Tetraethoxysilane	8500	2.3	0.03

* Maximum eight-hour concentration

2.3.2 Waste Management

Under the Proposed Action, CINT Core Facility operations would generate 24,600 lbs (11,182 kg) of solid waste annually. This estimate represents a conservative assumption that the facility would be occupied to capacity throughout the year; however, waste is expected to be less because many of the personnel using the facility would be visitors and would be present only part of the time. Hazardous waste would be generated at approximately 2,640 lbs (1,200 kg) per year and would be conveyed to SNL/NM waste management facilities for disposal.

2.3.3 Water Use and Liquid Effluents

Operations under the Proposed Action would use up to 470,400 gal (1.78 million L) of potable water per year (assuming continuous maximum occupancy) and 2.24 MGY (8.47 million L/yr) of process water. Of this total, water use and wastewater generation by current activities that would be transferred to the CINT are estimated at 393,600 gal (1.5 million L). For the purposes of this assessment, it is assumed that all water utilized at the facility will be discharged as wastewater; however, current water management goals at SNL/NM include a 30 percent reduction in wastewater generation through wastewater recycling and other methodologies.

2.3.4 Human Health and Safety

Worker health and safety precautions and controls for current operations are implemented according to the SNL ES&H Manual (SNL 2000b) and supplemental job-specific procedures. Each major piece of process equipment has an operating procedure.

Operations that employ laser and x-ray equipment are performed using appropriate administrative hazard controls and engineered barriers. BSL-1 safety precautions would be in effect for all biological work at the CINT Core Facility. Worker health and safety procedures would be revised if new processes or equipment are introduced.

3.0 AFFECTED ENVIRONMENT

The following sections include discussions of the local environment currently and potentially affected by the construction and operation of the CINT. The resource areas described are specific to SNL/NM site-wide conditions and, where applicable, specific to the proposed CINT project area located near TA-I (but outside the eastern boundary of KAFB).

A number of other resources, summarized below, were considered but are not discussed in detail because they would not be substantially impacted by the Proposed Action or No Action Alternative. The proposed buildings and facilities that would be constructed under the Proposed Action are located in a previously disturbed area just outside the eastern boundary of KAFB and west of Eubank Boulevard. Surrounding areas have been disturbed as a result of development of each area.

- *Geology and Soils Resources* – Previous surveys discussed in the Environmental Information Document and the SNL/NM SWEIS identified no impacts to the geology and soils in the areas of the proposed CINT Project. No prime farmlands exist at SNL/NM.

- *Surface Water* – Natural water flow has already been interrupted by the previous site disturbances. Construction of the CINT will include grading and drainage for storm water management. Storm water would be handled in accordance with best management practices. A National Pollutant Discharge Elimination System Construction Permit (NPDES) and an associated Storm Water Pollution Prevention Plan (SWPP) would be required. If a Multi-sector Storm Water General (NPDES) Permit is required, then the existing general SWPP Plan would be modified.

- *Groundwater* – Neither construction nor operation of the CINT Project would involve discharges to or withdrawals from groundwater. No substantial sources of potential groundwater contamination would be created or altered.

- *Biological Resources* – A scoping survey was conducted for the proposed CINT Facility in August 2002 without detecting any protected or sensitive species in the project area. A comprehensive biological survey will be conducted prior to construction if the Proposed Action is selected to ensure biological conditions have not changed (Salinas 2002).

- *Cultural Resources* – The proposed site of the CINT Facility has been surveyed for surface cultural resources as part of large survey conducted in 1990 (Gerow 1990). No cultural resources were recorded, and subsurface resources are possible but not anticipated.

- *Socioeconomics* – Construction of the facility would require the services of architectural, engineering, and construction firms; however, such support would be temporary. New and upgraded facilities would be staffed primarily with existing personnel. No substantial long-term increases in employment or substantial increases in funding would result from the Proposed Action and the No Action Alternative.

3.1 GENERAL SITE DESCRIPTION

The CINT Core Facility would be located adjacent to SNL/NM, but offsite just outside the eastern boundary of KAFB. The CINT Core Facility would be constructed on a 20-acre plot of land west of Eubank Boulevard and north of the Air Force Safety Center near the KAFB Eubank Gate (see Figures 2.1 and 2.2).

Albuquerque

Albuquerque is located in Bernalillo County, in north-central New Mexico, and is the state's largest city, with a population of approximately 448,607. The Sandia Mountains rise steeply immediately north and east of the city, with the Manzano Mountains extending to the southeast. The Rio Grande runs southward through Albuquerque and is the primary river traversing central New Mexico. Nearby communities include Rio Rancho and Corrales to the northwest, the Pueblo of Sandia and town of Bernalillo to the north, and the Pueblo of Isleta and towns of Los Lunas and Belen to the south (DOE 1999).

SNL/NM

SNL/NM is located within KAFB, approximately 7 miles (mi) southeast of downtown Albuquerque. KAFB, including SNL/NM, is situated on a high, arid alluvial fan in the foothills of the Manzano Mountains. The alluvial fan slopes gently to the west to the Rio Grande. There are five SNL/NM TAs that cover approximately 2,560 acres of DOE-owned land. TAs-I, - II, and -IV encompass approximately 645 acres. TA-III encompasses approximately 1,890 acres, and TA-V encompasses approximately 25 acres. Of these TAs, the CINT Project is closest to, but north of, TA-I and outside the eastern boundary of KAFB.

3.2 AIR QUALITY

Meteorological Conditions

SNL/NM is located along the eastern margin of the regional area known as the Albuquerque Basin. The geography of this area, which consists of mountains, canyons, and the Rio Grande Valley, greatly influences the meteorological conditions. Temperature inversions occur during the winter months, restricting dispersion and dilution of air pollutants in the basin area by trapping the pollution near the surface. The most important implication of meteorological variation across SNL/NM, however, is the effect of wind variability on transport and dispersion of pollutants. Wind characteristics vary across SNL/NM based on proximity to topographical and urban features. The mountains and canyons to the east create the predominant wind directions at SNL/NM. Dispersion occurs as a result of wind patterns developing from the complex interactions of the numerous geographic features. When constituents are emitted to the atmosphere, they are carried away from the source by wind transport and diluted by mixing with the ambient air.

Meteorological Monitoring

Meteorological monitoring commenced at SNL/NM in January 1994. The 8-tower meteorological monitoring network consists of six 10-meter towers, one 50-meter tower, and one 60-meter tower. All towers are instrumented at the 3- and 10-meter levels. Instrumentation is also installed at the top of the tall towers. Meteorological variables measured at all tower levels include wind speed, wind direction, and temperature. Relative humidity, precipitation, and atmospheric pressure are also measured.

Air Quality Standards

SNL/NM is located in the Albuquerque Middle Rio Grande Intrastate Air Quality Control Region. Under the National Ambient Air Quality Standards (NAAQS), Bernalillo County is currently in maintenance status for the CO NAAQS. Depending on emission levels, modification to existing sources or construction of new sources emitting CO may require a general or transportation conformity analysis as

well as additional levels of controls to comply with the NAAQS. In addition, modification to existing sources or construction of new sources emitting the other criteria pollutants (sulfur dioxide, nitrogen dioxide, ozone, particulate matter, and lead) for which a pre-construction permit must be obtained are required to comply with the NAAQS.

3.3 LAND USE

Land ownership on KAFB is divided primarily among the U.S. Air Force (USAF), DOE, the Bureau of Land Management, and the U.S. Forest Service (USFS). The USAF and DOE are the principal land users within KAFB. Land use is established through coordination and planning agreements between these agencies. The CINT Core Facility would be outside of the boundaries of KAFB on DOE-owned land. Land use in the general vicinity includes commercial, light industrial, and research operations as well as single-unit and multiple-unit residential development.

3.4 WASTE MANAGEMENT

SNL/NM waste management activities consist of managing, storing, and preparing for offsite disposal of all wastes in accordance with applicable Federal and state regulations, permits obtained under these regulations, and DOE Orders.

Typical waste categories generated onsite include:

- Radioactive waste includes low-level radioactive waste (LLW), low-level mixed waste (LLMW), transuranic (TRU) waste, and mixed transuranic (MTRU) waste
- Hazardous waste includes *Resource Conservation Recovery Act* (RCRA) listed waste (chemical), *Toxic Substances Control Act* (TSCA)-listed waste, and biohazardous waste (medical)
- Non-hazardous waste includes solid waste deposited in local landfills (trash and debris) and sewage waste
- Recyclable material includes lead, ignitable liquids, solvents, oils, scrap metal, paper, and plastics
- Spent nuclear fuel

3.5 SITE SERVICES

Security

Security for CINT Core Facility operations would be provided by SNL/NM's security force, which would be available 24 hours, 7 days a week. Fire protection would be provided either through an agreement with the USAF or through arrangements through the City of Albuquerque. Qualified researchers provided access to the CINT Core Facility and the CINT Gateway to Sandia Facility would have to meet DOE and SNL security procedures and requirements.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes and compares the environmental consequences of the No Action Alternative and the Proposed Action for the CINT. Descriptions of the Proposed Action and No Action Alternative are provided in Chapter 2 of this EA, and affected aspects of the environment are discussed in Chapter 3. The following sections compare potential environmental consequences of the two alternatives. Other aspects of the environment were considered in the scoping of the analysis; however, only those potentially affected by the proposed project are discussed in this chapter.

The Proposed Action and No Action Alternatives would both result in air emissions, waste generation, process and facility water use, and discharge of liquid effluents into the Albuquerque sanitary sewer system. Table 4-1 comparatively summarizes air emissions and other waste volumes related to operations under the No Action Alternative and the Proposed Action. The issues summarized in the table are addressed in the following sections.

Table 4-1. Comparison of Estimated Annual Emissions and Wastes for the No Action and Proposed Action Alternatives

Emissions and Wastes	No Action Alternative	Proposed Action
Construction and Demolition		
Air Emissions/Conformity	NA	6.63 tons CO
Construction Debris	NA	810 tons (73,636 kg)
Operations		
Air Quality	NA	See Section 4.3.1
Solid Waste	NA	24,600 lbs (11,182 kg)
Hazardous Waste	NA	2,640 lbs (1,200 kg)
Water Use		
Potable	393,600 gal/yr (1.5 million L/yr)	470,400 gal (1.78 million L/yr)
Process	NA	2.24 mgy (8.47 million L/yr)
Wastewater Generation		
Potable	393,600 gal/yr (1.5 million L/yr)	470,400 gal (1.78 million L/yr)
Process	NA	2.24 mgy (8.47 million L/yr)

4.1 NO ACTION ALTERNATIVE OPERATIONS

Description of the projected environmental effects of the No Action Alternative is based on information available from the SNL/NM SWEIS (DOE 1999) and the *Conceptual Design Report for the CINT* (SNL 2001). The following sections are organized according to environmental issues.

4.1.1 Air Emissions

The SWEIS examined approximately 465 chemicals used at SNL/NM as potential components of routine emissions (Section 5.3.8 of the SWEIS). Occupational Exposure Limits (OELs; a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect) were identified for each of these chemicals, and a "screening" value of the OEL divided by 100 (for conservatism) was established for determining whether emissions factors for each chemical should be developed. This

"screening" value is called the Threshold Emission Value (TEV). The initial screening was based on total inventory (in essence, this screening assumed that the entire quantity of a given chemical would be emitted). A chemical passed the screen if a theoretical release of the entire inventory did not cause the TEV to be exceeded. Facility-specific emissions factors were developed for those chemicals that did not pass the initial screening. After applying facility-specific emissions factors, chemicals were screened again to determine whether the TEV was exceeded. Chemicals also passed this screen if the TEV was not exceeded. The SWEIS concluded that normal operations at SNL/NM, including the No Action Alternative for this EA, would not likely result in degradation of air quality.

4.1.2 Waste Management

The No Action Alternative would not result in changes to existing waste storage, transportation, or other related processes anticipated under the No Action Alternative. Waste volumes that would be generated under the No Action Alternative, including non-hazardous and hazardous waste are described in Section 2.1.2 and summarized in Table 4-1. All wastes would continue to be managed by SNL/NM's waste management program.

4.1.3 Water Use and Liquid Effluents

Potable water use and wastewater generation associated with existing nanotechnology research would continue at 393,600 gal (1.5 million L) , assuming that all potable water is eventually discharged as waste, under the No Action Alternative. The No Action Alternative would not result in a change in water use or wastewater generation.

4.1.4 Human Health and Safety

Current operations utilize hazardous chemicals and other substances that may affect human health and safety.

Air is the primary pathway for possible worker or public exposure; however, no adverse human health effects would be expected to occur from HAP exposure resulting from the No Action Alternative. The chemicals and solvents used in the current processes are common industrial materials.

Engineering and administrative controls are enforced at the facilities associated with the current nanotechnology research to ensure that workers are not exposed to chemicals beyond the permissible exposure limits (PELs) established by the OSHA. Hazards from chemicals in SNL/NM facilities are controlled through engineered barriers, such as fume hoods, local exhaust ventilation, closed containers, closed loop systems, and volume limits. Potential scenarios for accidental exposure to chemicals would continue to be handled in accordance with provisions outlined in the SNL/NM ES&H Manual, Chapter 6, Industrial Hygiene (SNL, 2003).

According to the SNL/NM SWEIS (DOE, 1999), impacts for the entire SNL/NM workforce are projected to be zero fatalities per year and 1 or 2 confirmed chemical exposures annually. No measurable effects on worker health and safety are anticipated to result from chemical exposure under the No Action Alternative.

4.2 PROPOSED ACTION CONSTRUCTION ACTIVITIES

Construction of the CINT Core Facility under the Proposed Action would result in short-term environmental effects, including noise generated by construction, fugitive dust, and safety issues

associated with construction personnel on the site. However, these effects would be minimal and confined to relatively small areas for short periods of time.

4.2.1 Construction Air Conformity

No discernible changes in air quality are anticipated as a result of Proposed Action construction activities. CO emissions from equipment used for construction would affect air emissions under the Proposed Action. However, construction-related CO emissions are projected to be approximately 6.63 tons over the life of the project. This amount is less than the 100 TPY threshold requiring a conformity analysis; therefore, a conformity analysis is not required.

4.2.2 Construction Water Use and Liquid Effluents

Water use for installation of equipment and dust suppression would occur during the construction process. The short-term increase in water use due to construction activities is anticipated to be negligible in comparison to SNL/NM's site-wide water use.

4.2.3 Construction Waste Management

Generation and proper management of construction wastes related to the Proposed Action would not exceed the capacity or greatly reduce the life of existing waste management systems. Typical construction debris, as identified in Section 2.4.5, would be generated from demolition and building renovations and modifications under the Proposed Action. Construction, renovation, and demolition activities would result in the generation of approximately 810 tons (73,636 kg) of solid waste.

Construction projects are common at SNL/NM; wastes associated with construction are considered routine and are managed according to prescribed procedure. Waste generated during construction of the Proposed Action would be stored in dumpsters prior to disposition. Current plans call for disposal of standard construction waste in a permitted construction waste landfill.

4.2.4 Construction Health and Safety

Little effect on worker health and safety is anticipated as a result of construction activities associated with the Proposed Action. Workers would likely have limited, if any, exposure to chemical hazards during construction of the CINT Core Facility. Hazards would be limited to those commonly associated with construction activities and would be analyzed prior to performing the work. Worker protection measures, including hazard training, work procedures, and the use of PPE, would be enforced.

4.3 PROPOSED ACTION OPERATIONS

Implementation of the Proposed Action would result in minor expansion of current operations and primarily involves relocation of activities currently performed at various locations at SNL/NM to the CINT Core Facility and the CINT Gateway Facility, with the added benefit of new research capabilities and the ability to more effectively integrate research at SNL/NM with that conducted by other institutions. The following sections describe the environmental consequences of increased production that could result from implementation of the Proposed Action.

4.3.1 Air Emissions

The air quality assessment found that the CINT would not adversely affect the ambient air quality in the region. Additionally, the HAP analysis completed for the proposed CINT showed compliance with the Albuquerque Environmental Health Department (AEHD) HAP policy for all potential HAP impacts.

The HAP emissions associated with the proposed action were initially compared to the OEL divided by 15 to determine if modeling was required, as outlined by the AEHD Hazardous Air Pollutant Policy (dated April 16, 1998). Based on this evaluation, emissions of HAPs from CINT operations do not require modeling. However, HAP modeling was conducted to ensure that emissions of HAPs from CINT operations would not adversely affect the surrounding air quality. Modeled HAP impacts were compared to the ambient threshold of the OEL divided by 100. Dispersion modeling results for HAPs are summarized in Table 4.3.1-1. The maximum 8-hour impacts do not exceed 1/100 of the OEL; therefore compliance with the AEHD HAP policy is demonstrated.

Table 4.3.1-1. CINT HAP Dispersion Modeling Results

Compound	OEL/100 ($\mu g/m^3$)	Maximum Impact* ($\mu g/m^3$)	Percent of OEL/100
Ammonia	350	1.2	0.34
Chlorine	30	1.2	3.97
Silane	70	0.6	0.83
Nitrous Oxide	450	1.3	0.29
Boron Trichloride	70	1.2	1.70
Halocarbon 23	100	2.4	2.45
Halocarbon 14	100	2.6	2.61
Sulfur Hexafluoride	60000	5.6	0.01
Isopropyl Alcohol	9800	3.9	0.04
Methanol	2000	3.9	0.20
Methylisobutylketone	1000	0.04	0.004
n-methylpyrrolidinone	1000	0.4	0.04
Hexamethyldisilazane	450	0.1	0.02
Trichloroethylene	1000	0.4	0.04
Acetone	24000	7.9	0.03
Potassium Hydroxide	20	0.3	1.49
Hydrochloric Acid	70	0.3	0.43
Sulfuric Acid	10	2.0	20.15
Hydrogen Peroxide	14	0.9	6.19
Nitric Acid	50	0.3	0.60
Ethanol	19000	10.2	0.05
Chlorobenzene	3500	0.1	0.002
Toluene	2000	1.1	0.05
Dimethylformamide (DMF)	2000	0.05	0.002
Hexanes	18000	2.0	0.01
Hydrofluoric Acid	25	0.6	2.36
Tetraethoxysilane	8500	2.3	0.03

* Maximum eight-hour concentration

Potential maximum criteria pollutant impacts would occur along the fence line or just beyond the fence line to the west of the proposed emission source. Potential impacts of NO_2, SO_x, and PM_{10} exceeded the EPA Significance Levels, which requires further cumulative modeling. The results of further cumulative modeling are presented in Table 4.3.1-2. The purpose of 20 NMAC 11.41 is to show that a source will not cause or significantly contribute to air pollution in violation of any NAAQS.

Cumulative modeling was completed to determine if the proposed CINT contributed to an exceedance of the NAAQS for NO_2, SO_2, and PM_{10}.

Table 4.3.1-2. CINT Secondary Modeling Results

Pollutant	Averaging Period	NAAQS (mg/m^3)	Maximum Impacts (mg/m^3)*	Percent of NAAQS
NO_2	24 Hours	156	95.2	61%
	Annual	78.0	35.4	45%
SO_x	3 Hours	1,300	85.1	7%
	24 Hours	218	12.1	6%
	Annual	43.5	2.86	7%
PM_{10}	24 Hours	150	81.1	54%
	Annual	50	21.3	43%

* = Includes background concentrations

The criteria pollutant impacts from the proposed CINT combined with background concentrations are below the NAAQS, as shown in Table 4.3.1-2. Thus, compliance with the NAAQS, and therefore 20 NMAC 11.41, has been demonstrated. The maximum total potential impacts would occur to the west of the proposed CINT, along the KAFB fence line.

4.3.2 Waste Management

Under the Proposed Action, CINT operations would generate 24,600 lbs (11,182 kg) of solid waste annually. Collection and disposal of these wastes would remain within the capacity of existing facilities and operations.

Hazardous waste would be generated at approximately 2,640 lbs (1,200 kg) per year. Management of this quantity of waste remains within the capacity of existing hazardous waste management systems at SNL/NM.

4.3.3 Water Use and Liquid Effluents

Under the Proposed Action, the CINT Core Facility would use up to 470,400 gal (1.78 million L) of potable water per year (assuming continuous maximum occupancy) and 2.24 mgy (8.47 million L/yr) of process water. Of this total, water use and wastewater generation by current activities that would be transferred to the CINT are estimated at 393,600 gal (1.5 million L). Water use under the Proposed Action would represent an increase of approximately 0.01 percent in SNL/NM's total water use in FY 2000 (SNL 2001 SWEIS AR) from approximately 416 MGY (1.57 billion L/yr). Liquid effluent generated by the Proposed Action is assumed to be roughly equivalent to water use for the purpose of this assessment; however, current water management goals at SNL/NM include a 30 percent reduction in wastewater generation through wastewater recycling and other methodologies.

The increase in water use would not substantially affect current or projected water supply to SNL/NM, and increase in liquid effluent generation would not affect SNL/NM's ability to discharge wastewater.

No modifications to either system, other than routine connections between the systems and the facilities, would be required. Both the increase in water use and the decrease in effluent discharge would be minor.

4.3.4 Human Health and Safety

The Proposed Action would not result in substantially increased risks to workers and the public. Analysis of human health impacts in the SNL/NM SWEIS supports the conclusion that any increase in human health risk would be a result of a larger employee population, rather than introduction of new or unique hazards. Operations and processes with the potential to affect health and safety would be performed using appropriate administrative controls and engineered barriers. Workers and visiting researchers would be instructed in applicable health and safety procedures. Administrative controls would include adherence to worker health and safety precautions and controls according to the current ES&H Manual, supplements, and additional job-specific procedures. Worker health and safety procedures will be revised, if new processes or equipment are introduced.

4.4 ENVIRONMENTAL JUSTICE

The 2000 census for New Mexico reported that the average minority population within the state was 55.3 percent of the state's total population. Low-income populations, those households at or below an annual income level of $17,029, accounted for an average of 18.4 percent of the state's population.

Minority and low-income populations, as compared to those populations not classified as minority or low-income, within a 1-mile, 5-mile, and 10-mile radius of CINT Core Facility are shown in Table 4.4-1.

Table 4.4-1. Average Minority and Low-Income Populations in the CINT Core Facility Vicinity Compared to the State Averages

	1-Mile Radius	5-Mile Radius	10-Mile Radius	State Average
Average Minority Population	49.6%	41.3%	47.3%	55.3%
Average Low-Income Population	12.4%	13.6%	13.4%	18.4%

As shown by the information in Table 4.4, the average minority and low-income populations within the 1-, 5-, and 10-mile radii do not exceed the state's average population. Further, as indicated in Section 4.3.4, no increased health risks to the public are anticipated; therefore, there would be no disproportionately high negative impacts to minority or low-income populations.

4.5 CUMULATIVE EFFECTS

The consequences of the proposed action on air quality, water use, and liquid effluents, waste management, and human health and safety were not substantial. These incremental effects, when taken in the context of other DOE, U.S. Department of Defense (DoD), Federal, state, and local activities, would not add substantially to the cumulative impacts of these activities. Therefore, the effects of the Proposed Action, when combined with the effects resulting from common issues of actions taken by DOE, DoD, Federal, state, and local entities, do not result in cumulatively significant effects.

4.6 ABNORMAL OCCURRENCES

Abnormal events associated with operations such as CINT may include laboratory accidents such as small (liter-scale) indoor chemical spills as well as other accidents associated with research activities. Such accidents are anticipated to be uncommon and unlikely to result in the release of substantial quantities of hazardous or toxic substances to the environment outside the facility. Any small-scale indoor spills would be handled according to existing SNL/NM procedures for such occurrences. All operations would be conducted according to the SNL/NM ES&H Manual (SNL 2003), which includes policies and procedures for preventing such accidents and responding to them in the unlikely event that they should occur. Because the chemicals on-hand at the CINT Core Facility are generally present only in small quantities, it appears unlikely that abnormal occurrences associated with the CINT Core Facility would affect public health or safety.

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